Preferences for Micro-credentials Offered by Canadian Colleges and Universities

by

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Abstract

Micro-credentials are certifications earned for acquiring specific skills or knowledge. They may be useful to earners for their relevance and immediacy in addressing learning needs. When offered by post-secondary institutions, micro-credentials can provide learners with flexible and focused learning pathways to employment or further education. . Noticeably absent from scholarly and public discourse on micro-credentials offered by traditional post-secondary institutions is empirical evidence about the factors potential learners of these new credentials find appealing and important. This dissertation in practice investigates the attributes that potential learners find appealing in micro-credential programs offered by accredited post-secondary institutions in Canada. Using a discrete choice experiment (DCE), the study surveyed 1,005 Canadian respondents aged 24 to 64 to understand their preferences and willingness to pay for various program attributes. These attributes included the format of instruction, total hours to complete, time commitment, provider reputation, connections to employers and other programs, availability of reimbursement, and program cost.

The analysis used conjoint, latent class, and market simulation methods to explore aggregate, individual, and subgroup preferences. Subgroups were formed based on similar decision profiles and stated preferences rather than socio-demographic data. Results indicated that enrollment preferences are influenced by program cost, provider reputation, employer connections, and instructional format. Reimbursement availability, total completion hours, and time commitment were also factors, but to a lesser extent.

Four latent class segments were identified, showing significant variations in preferences, particularly regarding employer connections and in-person versus online learning. Practical implications of potential learners' preferences were demonstrated through market simulations, predicting different enrollment rates and willingness to pay among the four subgroups.

This study is the first to apply DCE methodology to investigate micro-credential program preferences, providing insights into adult learner preferences and discussing their implications for program design. By quantifying preferences for various program attributes, this research establishes a national empirical baseline that informs post-secondary institutions on how to tailor micro-credential offerings to meet the diverse preferences of adult learners and serves as a foundation for future empirical research in this field.

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Chapter 1
Introduction

Regardless of context or industry, individuals need to convey their expertise and skills to others. Traditional credentials such as associate, bachelor, and graduate degrees from accredited post-secondary institutions are one long-established means of doing so. They represent one end of the spectrum. On the other end are qualifications outside of the traditional academic credentialing systems for colleges and universities, such as professional certifications, industry-specific endorsements, and artistic and creative recognition (Fong et al., 2016; Matkin, 2018).

Micro-credentials, which fall between these extremes, are a flexible form of certification that verifies specific skills and competencies (Brown et al., 2021; Cirlan & Loukkola, 2020; Kato, et al., 2020; Oliver, 2019). Although there is no common definition, there is consensus that micro-credentials are a means of certifying learning accomplishments smaller than that of a full degree (Selvartnam & Sankey, 2021) and symbolize proof of learning (Kato et al., 2021) where learning outcomes have been assessed against transparent standards (Brown et al., 2021; Oliver, 2022). They can be delivered by accredited post-secondary institutions, professional organizations, or industry associations and often focus on practical, job-relevant skills (Oliver, 2019; Pichette et al., 2021). They may also complement or form part of formal qualifications (CICan, 2021). However, the ideal formats for these new credentials to appeal to adult learners are largely unknown and are the focus of this dissertation in practice.

Approximately 30 to 50% of Canadian adults annually participate in some form of learning that does not directly lead to a traditional credential, such as a diploma or a degree (OECD, 2022; 2023a). Educational program options for these lifelong learners include workshops, seminars, massive open online courses (MOOCs), peer-to-peer learning through professional organizations and industry associations, and, most recently, micro-credentials (HolonIQ, 2021). Fueling interest in micro-credentials, and other adult learning opportunities, outside of traditional long-form degree and diploma programs, are several different but interconnected drivers.

Lifelong learning is crucial to thriving in today's rapidly evolving digital society. Impacts from automation and artificial intelligence have led to technological advancements that are transforming industries and changing the skills employers require (Tschang & Almirall, 2021; Webster & Ivanov, 2020). In particular, these advancements further amplify job loss, skill obsolescence, and precariousness for workers with lower levels of education and skills (Advisory Council on Economic Growth, 2017), and include workers in industries which had not previously employed such technology (Muro et al., 2020). Despite Canada having the highest share of a tertiary-educated workforce across Organization for Economic Co-operation and Development (OECD) countries (60% in Canada, compared with 40% across the OECD) (OECD, 2023a), 38% of Canadian employers struggle to find the talent they require (Canadian Federation of Independent Business, 2021) and 21.7% of Canadian workers are considered underqualified for their job, which is above the OECD average of 18.9% (OECD, 2020). The World Economic Forum predicts that by 2027, six in ten workers will need to reskill to remain in their roles (World Economic Forum, 2023). Additionally, a Statistics Canada report notes that 10% of the Canadian workforce will face a high risk of job loss and struggle to find new positions by 2030 unless they acquire new qualifications (Frenette & Frank, 2020). Thus, the need for upskilling and reskilling is not limited to those of a particular demographic or industry. Rather, job-relevant education and skills development are imperatives for workers who hope to remain employed and advance in their careers.

Fewer employers are investing in on-the-job training and are instead calling on educational institutions to be more responsive to their needs (Cappelli, 2015). Governments are also demanding more labour market responsiveness from post-secondary institutions and are using their funding and policy levers to advance this agenda. Since 2020, the Ontario government has announced investments of over $60 million in *Ontario's Micro-credentials Strategy* with the aim of "bridging the gap between postsecondary education and the labour market to equip learners with the specific skills employers are looking for" (Ministry of Colleges and Universities (MCU), 2023), British Columbia's Ministry of Post-Secondary Education and Future Skills has funded more than 130 micro-credentials (Ministry of Post-Secondary Education and Future Skills (MPSFS), 2024), and in 2021 the Alberta government established a $5.6 million micro-credential initiative for post-secondary institutions to help individuals reskill, upskill, and find new career opportunities (Ministry of Advanced Education (MAE), 2021). Learners too are increasingly prioritizing their job and career outcomes when choosing educational programs (McKinsey & Company, 2015) and do not find educational programs fit for purpose when they are padded with content they do not find of value (Boud & Jorre de St Jorre, 2021). Rightly or wrongly, the picture that is emerging suggests that it is colleges and universities which should enhance graduate employability and that students and workers must play a role in the development of skills employers want (Atkins, 1999; Clarke, 2018; Knight & Yorke, 2003; Sin et al., 2019; Rees, 2019; Romgens & Beausaert, 2020).

Against this backdrop, micro-credentials have become a priority for policymakers, post-secondary institutions, and employers. Viewed as "a sort of all-purpose solution for the problems confronting education, training, and labour market systems" (OECD, 2023b p. 3) micro-credentials are being developed worldwide by post-secondary institutions in a variety of modalities to respond to the changing nature of work and to provide alternative learning pathways for adult learners (McGreal & Olcott, 2022) that can complement, substitute, or constitute a combination of traditional qualifications (Brown & Nic-Giolla-Mhichil, 2022) without necessarily replacing traditional credentials (Shapiro Futures et al., 2021). Micro-credentials have become a global trend (Brown et al., 2021).

Micro-credentials' appeal and usefulness to learners has been assumed and theorized, but lacks empirical evidence (Liyanagunawardena et al., 2017). Amid the "craze" (Ralson, 2021), the volume of empirical studies on micro-credentials is extremely limited (Resi et al., 2019; Selvaratnam & Sankey, 2021). Although scholarly literature has increased in recent years (Tamoliune et al., 2023; Thi Ngoc Ha et al., 2023; Varadarajan et al., 2023), there remains uncertainty about potential learner demand for micro-credentials (Brown & Nic-Giolla-Mhichil, 2022; Oliver, 2022) that can be used to inform and shape micro-credential programs that cater to the needs and demands of adult learners in an ever-changing global landscape. Research on the appeal of micro-credential programs to potential learners is needed and overdue.

1.1 The Current Study

Governments and post-secondary institutions are investing heavily in micro-credential programs (MAE, 2021; MCU, 2023; MPSFS, 2024; McGreal & Olcott, 2022). The policy and financial context of post-secondary education make it important for post-secondary institutions to understand the preferences of potential learners for micro-credential program characteristics or attributes.

While micro-credentials are thought to meet learner needs, this remains a largely uninvestigated assumption. What attributes of micro-credential programs matter most to potential learners? What program attributes must be present and in what combination for adult learners to consider enrolling in micro-credentials?

This dissertation in practice examines Canadians' preferences for micro-credentials using a stated preference (SP) method (Louviere et al., 2010), specifically a discrete choice experiment (DCE) also known as a choice-based conjoint analysis (CBCA) method (Louviere et al., 2010; Rao, 2014). It addresses a research and practice gap in higher and continuing education as potential learner preferences for micro-credential programs have been largely absent from scholarly research and micro-credential program designs (Reynoldson, 2022). The research herein focuses on attributes of micro-credential programs delivered by accredited post-secondary institutions that may increase or decrease the attractiveness of a micro-credential program to a potential learner. To explore aggregate, individual, and subgroup-level preferences for micro-credential program characteristics, conjoint analysis, latent class analysis, and market simulation methods were employed. Conjoint analysis determines how people value different attributes of a product or service by presenting them with a set of choices and analyzing their decisions. Latent class analysis identifies distinct segments within a population that share similar preferences or characteristics. Market simulation predicts how changes in program attributes will influence overall market preferences by simulating real-world market scenarios. These three forms of analyses at different levels of granularity establish an empirical baseline of adult Canadians' preferences for micro-credential programs offered by post-secondary institutions at a national scale. The results and discussion will be relevant for post-secondary administrators seeking to understand adult learner preferences and attract lifelong learners to their micro-credential programs, as well as for education researchers. This dissertation will also reflect on the implications for practice and offer recommendations for post-secondary institutions as they consider, design, and implement micro-credentials within local contexts. It also offers suggestions for future research to extend and complement the findings reported here.

Chapter 2
Literature Review

Micro-credentials are increasingly the subject of academic journal articles (Tamoliune et al., 2023; Thi Ngoc Ha et al., 2023; Varadarajan et al., 2023), websites, blogs, and other media (Fitzgerald & Huijser, 2021) and increasingly considered as new program options by administrators within post-secondary institutions (Olcott, 2022; McGreal & Olcott, 2022). Moreover, the percentage of Canadian institutions which offered or had plans to offer micro-credentials increased from 41% (n = 90) in 2019 (Duklas, 2020) to 83% (n = 105) in 2020 (Pichette et al, 2021). But despite this attention, the volume of empirical studies on micro-credentials is small (Liyanagunawardena et al., 2017; Resi et al., 2019; Varadarajan et al., 2023).

Notwithstanding their increased presence in practice and scholarly literature, there is no universally accepted definition of micro-credential and less agreement on the emerging taxonomies and qualification frameworks used to differentiate and characterize them (Resei, et al., 2019; Kato et al., 2020; Maxwell & Gallagher, 2020; OECD, 2021a; Presant, 2020). Kazin and Clerkin (2018) attribute the multitude of definitions to the nature of a rapidly evolving field. Brown et al. (2021) believe this situation has hampered productive and effective communication between and within academic, learner, employer, and policymaker communities, while Zhang and West (2020) deem it the key challenge impeding the implementation of micro-credentials.

In Canada, the micro-credential definition adopted by Colleges and Institutes Canada (CICan), the national association representing publicly supported colleges, institutes, and polytechnics, has gained some prominence in the higher education sector. It is, “a certification of assessed competencies that is additional, alternate, complementary to, or a component of a formal qualification” (CICan, 2021). In this study, micro-credentials are defined as small, focused certifications on a specific skill or particular topic that are earned from post-secondary institutions in a relatively short amount of time. Once earned, micro-credentials are a way for the learner to prove their expertise, knowledge, and skills to others.

This literature review first situates micro-credentials as a response to changes in the workplace and an outcome of an earlier adult education option, Massive Open Online Courses (MOOCs). It next reviews how micro-credentials have been theorized to benefit learners and other stakeholders, and then examines several of the defining features of micro-credentials or micro-credential program attributes in theory and practice. Finally, it introduces the research method used in this study, a discrete choice experiment (DCE) (Louviere et al., 2010; Rao, 2014).

2.1 Changing Labour Market Needs

Most of the existing academic literature situates micro-credentials emerging from the changing world of work, employer demands for new and changing skills, and the need for higher educational institutions and workers to adapt to these changing realities (Nic Giolla Mhichil et al., 2023). These realities include major global companies, such as Google, IBM, Apple, Hilton Hotels, and Penguin Random House, no longer requiring a degree as a pre-requisite for employment (Connelly, 2018). Instead, these companies focus on the skills portfolio and experience a potential employee brings to their workplace. For example, Google recognizes its short courses as the equivalent of a bachelor's degree for recruitment and selection purposes (Bariso, 2020), IBM offers more than 1,400 badges and 100 certificates focused on its technologies, project management, and artificial intelligence (IBM, 2024), and Canadian company Shopify offers a customized computer science degree program to employees called Dev Degree (Shopify, 2024) which is co-designed with Carleton University and York University in Ontario.

Ralston (2020) suggests that micro-credentialing has emerged as the preferred training option for employers as the value traditionally attached to university degrees diminishes. Authors such as Fitzgerald and Huijser (2021) highlight that degrees are increasingly viewed as unreliable indicators of specific skills, instead representing more generalizable competencies. This discrepancy arises from the mismatch between how post-secondary institutions assess achievement and what employers prioritize during the hiring process (Hills et al., 2003; Tomlinson, 2008; Ajjawi et al., 2020). Gallagher (2016) and Jorre de St Jorre et al. (2021) posit that perhaps it is not that degrees are not seen as valuable, but rather it is more that some perceive there to be no relationship between the holder of a degree qualification and the skill sets that employers need.

The currency of a degree, the length of time the skills and knowledge learned during its acquisition remain current, is estimated to be between five and seven years (Allen & van der Venden, 2002). Giving rise to “one of the most common complaints about university degrees is that they are blunt instruments lacking in detail about the skill or learning of the holder and existing as static paper documents” (Gallagher, 2016, p. 112). While summarizing the problem of traditional degrees and diplomas, Gallagher (2016) was also one of the first to describe a solution. “There appears to be consensus among key parties that the future higher education landscape will include a proliferation of new options and university credentials beyond the monolithic degree” (p. 18).

Societies and economies in the twentieth century valued formal qualifications; however, those in the twenty-first century now demand skills (Oliver, 2019). Thereby necessitating novel higher education systems and ways in which knowledge, skills, and competencies are recognized and communicated rather than what is captured on a degree parchment or traditional post-secondary course transcript (Gauthier, 2020). As a result, post-secondary institutions are exploring new ways to explore this new need for lifelong learning, which includes methods that allow learners to learn, document, and validate their skills to employers. In this exploration, more than one method has been tried to offer what are collectively called alternative credentials (Brown & Kurweil, 2017).

2.2 An Attempt with Massive Open Online Courses (MOOCs)

In the 1990s, a parallel post-secondary universe of technological certifications emerged to fulfill the needs of employers for information technology workers during the dot-com boom (Adelman, 2000). Early courses centred around proprietary technologies (Gallagher & Zanville, 2021). These were followed by MOOCs in the late 2000s that would permit large numbers of learners to access structured and focused learning at low or no cost (Pickard et al., 2018). MOOCs are typically audio, video, and textual instructional modules delivered via the internet, occasionally coupled with moderated or unmoderated discussion boards. Yet after reaching over 220 million learners through more than 19,400 MOOCs (excluding Chinese MOOCs) (Patra & Cortes Mendez, 2023; Shah, 2021), MOOC's brief history is one of "hope, hype, and disappointment" (Gouseti, 2010).

Initially, MOOC providers relied heavily on universities to create courses and credentials offered on their platforms. However, this dependence has decreased as more content is now created by employers rather than post-secondary institutions. For example, in 2021, the majority of new courses on Coursera, an online learning platform, were developed by employers, commercial entities, or industry-related organizations rather than universities (Shah, 2021). As employer-created content becomes more prevalent on MOOC platforms, its focus has also shifted. Unlike the 1990s, when such content centred around proprietary technologies, employer and industry-related content now emphasizes specialized skills such as IT support, cloud computing, and digital marketing, which are more similar to traditional educational certificates and degrees (Gallagher & Zanville, 2021).

MOOCs were promised to create opportunities for accessing higher education (Barber et al., 2013), to build global learning communities (Mahraj, 2012; Donitsa-Schmidt & Topaz, 2018), to offer innovative instructional design (Bartolome-Pina & Steffens, 2015; Hew & Cheung, 2014), and to reduce the cost of learning (Ruth, 2012). Despite the hope of introducing large numbers of learners to higher education through online learning, observers have been disappointed by low completion rates (Clow, 2013) and that most MOOC learners are already well-educated and employed (Macleod et al., 2015). Daniel et al. (2015) further note that MOOC completers are rarely offered formal pathways to recognized academic qualifications or guaranteed professional gains. This led to MOOCs being characterized as clever marketing ploys by elite universities (Krause & Lowe, 2014), merely offering a taste of post-secondary education and unlikely to satisfy the goals of learners (Howarth et al., 2016).

Today, post-secondary institutions, independent training organizations, certifying agencies, and employers create MOOC content in what is now a more crowded and competitive marketplace (ICDE, 2019). Not all post-secondary institutions remain willing to engage within the MOOC ecosystem as was once hoped. But in the wider alternative credential ecosystem, traditional post-secondary institutions may hold an advantage over newer entrants among the host of organizations with different levels of experience and credibility vying for lifelong learners. A recent Canadian survey found that a track record of issuing quality credentials is important for credibility and acceptance in the evolving education marketplace (Pichette et al., 2021). Following their conceptual origin in 2013 (Brown et al., 2021), the Canadian education marketplace has expanded and grown to include micro-credentials since 2019 (Prud'homme-Généreux, 2023).

2.3 Micro-Credentials

Possibly better suited to post-secondary institutions' missions (McGreal & Olcott, 2022) and adult learners' education needs (Kato et al., 2020) are micro-credentials which emerged from the limitations of traditional degrees to meet the needs of the workplace (Gallagher, 2016) and the successes and failures of MOOCs (Resi et al, 2019). The OECD (2021b) advocates placing learners at the centre of learning that is inclusive, affordable, accessible, adaptable, and focused on skills for life; and recommends improving recognition, validation, and accreditation of credentials to enhance the visibility and transferability of the skills and competencies taught in different programs. UNESCO similarly calls for transforming colleges and universities into lifelong learning institutions, placing vulnerable groups at the core of a lifelong learning policy agenda, and establishing lifelong learning as a common good (UNESCO Institutes for Lifelong Learning, 2020). In addition, Wang (2022) advocates for fit-for-purpose rather than one-size-fits-all education, emphasizing small employment-oriented learning units that can be agile, responsive, and relevant. Micro-credentials are thought by advocates to meet these aspirational goals for adult learners, whereas critics warn that micro-credentials are a betrayal of higher education's purpose to prepare individuals to live lives they have reason to value.

2.3.1 *Micro-credential Learner Characteristics*

There are very few surveys of potential micro-credential learners in scholarly publications and only a relevant handful within grey literature (Nic Giolla Mhichil et al., 2023; Brown & Nic Giolla Mhichil, 2022). In addition to these sources, international data on learners participating in adult education provides indicative evidence of the types of learners who enroll in adult education programs and are thus the target population for micro-credential programs offered by post-secondary institutions.

Across OECD countries and economies that participated in the 2016 Adult Education Survey (AES), adults with higher levels of education are more likely to engage in further learning – 60% of adults with post-secondary education compared with 30% of adults without upper secondary education participate in formal or informal education and training (OECD, 2020). Employment status, wage, and employer size are also shown to affect the likelihood of participating in further education and training (OECD, 2023a). The AES also found near equal participation rates in formal and non-formal learning and training among 25- to 64-year-olds, 48% for women and 47% for men, although there was variation between subject areas (OECD, 2020).

Surveys of MOOC participants show similar patterns. A survey of 2.4 million individuals who participated in MOOCs developed by Harvard University and Massachusetts Institute of Technology, reported over 70% held a bachelor's degree (Chuang & Ho, 2016). In a smaller, more recent study, Hollands et al. (2023) found 85% (n = 262) of MOOC-based micro-credentials completers held undergraduate or graduate degrees and claimed to already have an advanced or intermediate level of knowledge about the course topic before enrolling. These completers were mostly male (56%) and the average age of respondents was 36. The base annual salary amount for completers was reported between $0 to $500,000, with a median of $50,000 (USD) (Hollands et al., 2023).

Qualitative interviews by Pichette and Courts (2024) reveal Ontario's post-secondary micro-credential providers believe their main consumer base is adult learners with financial resources who are pursuing micro-credentials to complement their previous education and work experiences. This is in line with observations in a white paper from the United States (Asthana et al., 2023) and an ongoing pilot study in the United Kingdom (Kernohan, 2023) that suggest micro-credential earners are mostly financially stable and well-educated. In summary, potential micro-credential learners are likely to be adults who completed high school, have some post-secondary education, and have a higher income. They are also more likely to pursue a micro-credential to increase, extend, or complement their existing knowledge and skills, rather than explore an unfamiliar topic area (Pichette & Courts, 2024).

2.3.2 *Benefits of and Problems with Micro-credentials*

Advocates state that micro-credentials increase post-secondary institutions' responsiveness to labour market needs for skilled employees, contribute to education accessibility, and align with post-secondary institutions' missions to provide educational opportunities (Desmarchelier & Cary, 2022; McGreal & Olcott, 2022). Micro-credentials are also thought to bridge the gap between the skills employers seek and degree programs offered by post-secondary institutions (Kato et al., 2020) because their advantage is their ability to focus on what is needed by employers and industries in an agile manner (Fitzgerald & Huijser, 2021). Micro-credentials are seen as potential solutions to a range of social and labour market challenges, such as growing the accessibility of higher education, certifying competencies, developing employability, providing innovative learning experiences, and meeting the needs of employers (Ghasia et al., 2019; Martinez-Marroquin & Male, 2021). While other authors are more cautious in their predictions, Cirlan and Loukkola (2020) expect micro-credentials to revolutionize higher education institutions for the better.

For learners, micro-credentials are believed to enable the targeted and flexible acquisition and recognition of knowledge, skills, and competencies (Selvaratnam & Sankey, 2021) in short, targeted programs that are more likely to appeal to adult learners (Carey & Stefaniak, 2018). They are believed by scholars to promote social inclusion, self-realization, personalization, and student-centred learning (Czerniewicz, 2018; Wills & Xie, 2016). The top two benefits to learners identified by peer-reviewed literature are developing professional competencies and strengthening knowledge and skills (Thi Ngoc Ha et al., 2023). Learners who complete micro-credentials report that they have value and believe the credential to be beneficial to their future (Ahmed & Jassim, 2021). Frequently anticipated future benefits for micro-credential earners in grey literature include employment, greater job security, professional mobility, and connections to other learning pathways (Kato et al., 2019; Oliver, 2019).

Additional benefits to learners, post-secondary institutions, employers, and governments have also been identified (Brown et al., 2021; Carey & Stefaniak, 2018; Evans, 2021; Fitzgerald & Huijser, 2021; Gauthier, 2020; Ghasia et al., 2019; Kato et al., 2020; OECD, 2021b; Oliver, 2019, 2021; Ralson, 2021; Selvaratnam & Sankey, 2021; Varadarajan et al. 2023; Thi Ngoc Ha et al., 2023) (Figure 1). Drivers for micro-credentials are well documented in the current literature (Nic Giolla Mhichil et al., 2023).

Figure 1

Micro-credentials' Benefits to Stakeholders

Learners:

- Developing knowledge, skills, and competencies
- Increased employability
- Access to purpose-built reskilling and upskilling focused on work readiness
- Less expensive/more affordable than traditional degrees
- New learning experiences
- Ability to demonstrate and validate granular competencies
- Higher flexibility, personalization, customization, and modularization to meet the needs of adults with multiple commitments
- Stackability[1], laddering[2], and a pathway or gateway to further education
- Multi-disciplinary, interactive
- Differentiation value
- Access to global content

Post-secondary institutions:

- New business model with the possibility of new revenue streams
- Diversifying the learner population by expanding offerings to wider audiences and new target groups
- Meeting the needs of the community and society
- Marketing tools
- Opportunities to explore new education formats
- Collaborating with industries and employers
- Creating flexible, open, multi-disciplinary curricula as units collaborate
- Increasing learner motivation, retention, and completion rates

Industries and employers:

- Workforce development for continuous education and skill development
- Improve employee retention
- Assist with recruitment
- No need to build own company training
- Increase collaboration with post-secondary institutions
- Employer branding
- Fit-for-purpose professional learning
- Taking action to address a skills gap between education and work
- Cost savings

Governments:

- New policy levers
- Address broad labour market needs

Micro-credentials are critiqued for having a possible adverse impact on higher education institutions and students, contributing to the neoliberal forces that privatize education and reduce the autonomy of the academy. As noted by Ralson, "the [micro-credential] craze represents a betrayal of higher education's higher purpose and a loss for students and faculty

[1] *Stackability* refers to the ability to combine individual micro-credentials to form higher-level, bundled, or macro-credentials.

[2] *Laddering* refers to the ability to use a single micro-credential or series of stacked micro-credentials to earn advanced standing in a related certificate, diploma, or degree program.

who continue to see university learning as more than vocational training" (2021, p. 92). Also scrutinized by Wheelahan and Moodie (2021; 2022), they criticize micro-credentials' emphasis on workplace preparation, terming them as "gig qualifications for the gig economy" (2022, p. 1279), cautioning that micro-credentials may deepen existing social inequities and reinforce disparities. They question whether micro-credentials are more accessible and affordable forms of education, warn against "diverting students from substantial credentials with substantial value to micro-credentials with micro-value" (Wheelahan & Moodie, 2021 p. 11), and argue that workforce development should be the responsibility of employers, not employees. Expressing the worry that through micro-credentials post-secondary education will fail in its important mission to prepare students for a career and citizenship (Wheelahan & Moodie, 2021).

To the best of the author's knowledge, only one study has queried learners' general dislikes about micro-credentials. Conducted in Europe by the Modularisation of Continuing Education and Professionalisation by Micro-credentials Project, 115 participants in Bruguera et al.'s (2023) study ranked, from most important to least important, these potential disadvantages of undertaking a micro-credential:

1. Little recognition/lack of validation by educational institutions
2. Little credibility, recognition, or value from employers
3. Eventually they increase the cost
4. Complex bureaucracy
5. Lack of accompaniment, socialization, and support (by teachers and classmates)
6. Lack of modularity

Documented concerns about possible negative impacts on learners and higher education merit attention and consideration by researchers and should temper uncritical acceptance of micro-credentials by practitioners. Acknowledging the potential advantages and drawbacks of micro-credentials, the conclusion reached by Thi Ngoc Ha et al. (2023) guides a pragmatic way forward: micro-credentials in post-secondary education are not a zero-sum game and micro-credentials' gains are not macro-credentials' loss. The two types of credentials can complement and strengthen the other.

The noted benefits and problems for micro-credential learners in this section are mostly derived from assumptions, and much less frequently from empirical studies (Ahsan et al., 2023). The lack of empirical data about benefits or problems for learners can be partially attributed to the methodological difficulty of researching educational benefits and outcomes for short learning courses. The OECD (2023b) notes that identifying the labour market value associated with earning micro-credentials is a much more difficult task than for degrees. It is also partially due to their novelty. Micro-credentials are a new educational offering that first appeared in 2013 (Brown et al., 2021) and experienced rapid expansion and growth in Canada around 2019 (Prud'homme-Généreux, 2023). Micro-credentials are not yet entrenched within institutional structures, which will be discussed in a subsequent section, nor are they familiar to potential micro-credential learners. Most participants in micro-credential research studies are unclear about what micro-credentials are until they are supplied with a definition by research teams (Nic Giolla Mhichil et al., 2021; Pichette et al., 2021; Bruguera et al., 2023). Only one-quarter of surveyed Canadians (n = 2,000) had heard of the term 'micro-credential' in 2020, and even fewer could supply a definition when asked (Pichette et al., 2021). Similar results were found in a survey of Irish employers and employees in which very few had some initial awareness of the term (Nic Giolla Mhichil et al, 2021). Only when participants were taking or had taken part in a European university's continuous education courses within the last five years were research participants' familiarity rates with the term 'micro-credential' higher, 54.3% (n = 115) (Bruguera et al., 2023). Regardless of the reasons, potential micro-credential learners' perspectives and voices are a gap in existing literature.

Although anecdotal and conceptual claims suggest potential value and problems with micro-credentials, their effectiveness in enhancing learning performance remains largely unknown (Newby & Cheng, 2020). The Center on Great Teachers and Leaders at American Institutes for Research noted that “the authors did not find any rigorous impact studies that examined educator or student outcomes” of micro-credentials (Center on Great Teachers and Leaders, 2020, p. 10). Authors of recent systematic literature reviews also observed a lack of empirical research on the impact and effectiveness of micro-credentials for learners (Ahsan et al., 2023; Thi Ngoc Ha et al., 2023; Varadarajan et al. 2023). This gap persists despite scholars’ calls for studies to investigate the effect of micro-credentials on learners, particularly regarding their perceptions and the capacity of micro-credentials to develop high-level competencies (Maina et al., 2022; McGreal & Olcott, 2022).

While this study is not focused on the effectiveness of micro-credentials, this literature review uncovered three large-scale outcome studies on learners excluded from previous systematic literature reviews (Ahsan et al., 2023; Thi Ngoc Ha et al., 2023; Varadarajan et al., 2023). For Statistics Canada, Ntwari and Fecteau (2020) examined the economic benefits of micro-credentials among Canadian bachelor’s degree holders using administrative data. Their study showed that the median income of the micro-credential holders grew faster than the cohort not pursuing a micro-credential. In addition, the percentage of individuals employed in low-value-added service industries decreased from 22% two years before completing a micro-credential program to 10% two years after (Ntwari & Fecteau, 2020). Similar economic gains for credential earners were reported in an American study of working adults in Virginia. The study, which also used an administrative dataset, found that individuals who earned two or more community college certificates or degrees between 2000 and 2019 were 4% more likely to be employed and earned more per quarter than those who only completed one credential during the same period (Meyer et al., 2022). The results of these two North American studies suggest modest positive outcomes for micro-credential earners. In contrast, an Australian study (Jackson & Dean, 2022) found earning a micro-credential within 4 to 6 months of completing a bachelor's degree to have negative impacts on full-time employment, although less than 10% of the recent bachelor degree earners (n = 84,427) had enrolled in a micro-credential so soon after graduation. Extant literature, although limited, presents mixed results.

Impact and effectiveness results are also found in small-scale case studies of micro-credential earners. Giani and Fox's (2017) descriptive results found graduates from short certificate programs in the United States had an appreciable increase in their annual earnings compared to those who did not enrol in further education. The benefits of micro-credentials over traditional study programs at four Tanzanian universities were noted by Ghasia et al. (2019) through interviews with lecturers, students, and educational technologists. Their findings suggest that micro-credentials can benefit learners and universities by encouraging lifelong learning. Woods and Woods (2021) report one student enrolled in a graduate degree program after taking a graduate certificate program enjoyed the ability to ease into graduate school by completing a certificate. However, Ositelu et al. (2021) found conflicting economic outcomes for micro-credential earners based on their specific field of study and whether earners later earn additional certificates or a degree (Ositelu et al., 2021). They conclude wide variation in the field of micro-credentials makes universal declarations about their effectiveness and impact difficult, since data do show that although many micro-credentials have a positive effect, others lack clear labour market value, and some may even be an economic detriment to earners (Ositelu et al., 2021).

The inconclusive and conflicting results concerning micro-credential effectiveness (Ositelu et al., 2021) as well as their noted absence (Ahsan et al., 2023; Thi Ngoc Ha et al., 2023; Varadarajan et al. 2023) uncover the need for a better understanding of the characteristics of micro-credential programs that influence potential learner preferences. An understanding that could in turn lead to an improved awareness of the conditions that may influence the effectiveness of micro-credentials for adult learners.

2.3.3 *Micro-credentials in Practice and Policy*

The uptake of micro-credentials within the higher education sector has reached the point where they are being included in provincial, national, and supra-national qualification frameworks and policy documents (c.f. MICROBOL, 2022; Ministry of Advanced Education and Skills Training (MAEST), 2021; Department of Education, Skills, and Employment, 2022). Qualification frameworks are the international norm for delineating the landscape of credentials and establishing benchmarks for credential quality. Yet the implementation of micro-credential programs by post-secondary institutions is outpacing the development of policy. The framework and policy landscapes lack coherence and consistency (Wheelahan & Moodie, 2021). This is true in Canada, where education is not a federal responsibility but rather a provincial and territorial responsibility. Provinces and territories vary in their adoption and use of qualification frameworks for micro-credentials, with each at a different stage of exploration, development, and implementation.

Between 2019 and 2023, several provinces supported post-secondary institutions to develop micro-credentials through funding and by releasing micro-credential frameworks to guide their development and implementation. An early leader, Ontario published *Micro-certification Principles and Framework* (eCampus Ontario, 2019) to accompany the RapidSkills pilot program which created 36 new micro-credentials at Ontario colleges and universities between 2020 and 2021 with the support of $59.9 million in funding (eCampus Ontario, n.d.). This was followed by an investment of an additional $15 million to support the creation of new micro-credentials over the next five years (MCU, 2021a) and a change to the province's student assistance program (student loans and grants) which made micro-credential learners eligible for provincial support (MCU, 2021b). As of March 2023, there were about 1,800 micro-credentials eligible for funding through the Ontario Student Assistance Program at 34 publicly assisted post-secondary institutions across Ontario (MCU, 2023), an approximate 16% increase from the 1,552 micro-credential courses available in April of 2022 (Davies & Dahir, 2024). Since 2020, British Columbia has funded more than 130 new micro-credential programs and in 2021 released *Micro-credentials Framework for B.C.'s Public Post-secondary Education System* (MAEST, 2021). Alberta has directed $5.6 million towards the development of 56 micro-credential programs (MAE, 2021), but as of the time of writing in 2024 has no provincial framework for micro-credentials. Saskatchewan and Nova Scotia have published micro-credential frameworks or guides: *Saskatchewan's Guide to Micro-Credentials* (Government of Saskatchewan, 2021) and *Nova Scotia Microcredential Framework* (Government of Nova Scotia, 2023). As of 2024, no other province or territory had published a province or territory-wide micro-credential framework or guide and calls for national coordination and a Canada-wide strategy for micro-credential development, acceptance, and transfer have thus far gone unanswered (Future Skills Centre, 2022; Mwaba et al., 2022).

2.4 Micro-credential Program Attributes

To address the general research question of this study, 'what attributes of micro-credentials programs matter most to potential learners?' micro-credential program attributes must be specified.

Previous research on students' educational program choices has primarily focused on which factors influence the decisions undergraduate applicants make about which post-secondary institution to attend immediately upon graduation from high school (Hossler & Gallagher, 1987; Briggs & Wilson, 2007; Hemsley-Brown & Oplatka, 2014; Walsh et al., 2018). Previous authors in this space characterize post-secondary choice as a one-time, high-risk, and highly complex multistage process that is subject to multiple influences (Briggs & Wilson, 2007; Hossler et al., 1989). However, these previous studies do not provide as much insight into what happens for older learners or learners with workplace experience, prior degrees, or family obligations, for example. Nor may the conclusions reached in undergraduate contexts be relevant when the choice being investigated is possible enrollment in a micro-credential program which does not share the same attributes as undergraduate programs. Attributes relevant to micro-credential programs must be identified.

There is no efficient national or global system to collect, connect, search, and compare up-to-date information about micro-credentials (UNESCO, 2020). Nor has there been a directed effort to develop comprehensive surveys to gather data based on any consistent definition of a micro-credential (McGreal & Olcott, 2022). This means there is no national database which compiles and categorizes operational micro-credential programs that could be used in this research. In the absence of such a database, an alternative is to identify hypothetical but theoretically possible post-secondary micro-credential program attributes through a literature review (Pérerz-Troncoso, 2020; Shang & Chandra, 2023).

Following the guidance of Shang and Chandra (2023), the following literature review is limited to attributes most likely to be relevant and important to a choice decision by the target population of interest. In this research, the population of interest is adult Canadians 24 to 64 years of age with a high school diploma because this group is most likely to engage in continuing education (OECD, 2020; 2023a) and is the target market for post-secondary institutions' micro-credential programs (Pichette & Courts, 2024).

2.4.1 *Format of Instruction*

Previous researchers have stated a micro-credentials can be acquired through in-person, online, or blended learning (Dobbs et al., 2023; Oliver, 2021), although they are generally expected to be offered online (Brown et al., 2021). The format a micro-credential can take is delineated by two provincial frameworks. British Columbia and Nova Scotia's frameworks state micro-credentials may be delivered in a variety of flexible formats, and give in-person, online, blended, synchronous, and asynchronous as examples of possible delivery formats (MAEST, 2021; Government of Nova Scotia, 2023). Moreover, British Columbia states it is important that the delivery format of instruction supports and is relevant to the competency being taught, reduces barriers, increases access and mobility, and meets the needs of learners (MAEST, 2021). Ontario and Saskatchewan's frameworks do not specify any required format or delivery method (eCampus Ontario, 2019; Government of Saskatchewan, 2021). Although there are no limitations in the provincial frameworks to preclude them from being offered in-person or through blended learning.

A survey of Canadians by Pichette et al. (2021) revealed that 52% (n = 2,000) considered an online format for potential micro-credentials to be "extremely important" or "very important." Similarly, Bruguera et al. (2023) found online learning received a high preference rating (4.40/5.00), while traditional in-person learning formats received a lower preference rating (2.74/5.00) in a European study of 115 recent or current continuing education learners.

2.4.2 *Total Hours of Work to Complete a Micro-credential Program*

The time required to complete a micro-credential can vary, but these programs typically have shorter durations than traditional degree or diploma programs (McGreal & Olcott, 2022; Oliver, 2021). Articulating the duration of a micro-credential is an important signal to the total value of the experience and provides transparency to learners in terms of their investment of time and money. As noted by Martin and van der Hijden, "Competencies are the end goal, but in the process the indication of the average notional learning time is useful information for both teachers and learners" (2023, p. 21).

Ontario, Saskatchewan, and Nova Scotia's frameworks do not specify a minimum or maximum duration for a micro-credential (eCampus Ontario, 2019; Government of Saskatchewan, 2021; Government of Nova Scotia, 2023). Although Davies and Dahir (2024) found the median length of Ontario's 1,552 micro-credentials in 2022 to be 20 hours, the longest 10% lasted 125 hours or more. British Columbia's framework states that the duration of a micro-credential should be sufficient for learners to acquire the targeted competencies but sets the maximum length at 288 hours, which is the length of a short certificate (MAEST, 2021). In Pichette et al.'s (2021) survey, a "short" credential was ranked 8^{th} in importance out of 15 potential characteristics of a micro-credential, though "short" was not defined by the authors in terms of hours.

2.4.3 *Time Commitment*

It may be possible to complete a micro-credential according to a fixed or self-paced learning schedule (Oliver, 2021; Pichette et al., 2021). Flexibility allows individuals to learn at their own pace and on their own schedule and makes studying more feasible, particularly for adults balancing family, work, education, and other obligations (Selvaratnam & Sankey, 2021). A survey of 115 recent continuing education learners in Europe supported this assumption, who reported that they most prioritized flexibility and convenience when selecting a micro-credential (Bruguera et al., 2023). Interestingly, flexibility ranked as the third most prioritized attribute for Canadians, behind "affordable" and "employer recognized" (Pichette et al., 2021). These findings demonstrate learning schedule or time commitment to be a salient attribute and suggest different groups may differently prioritize the time commitment to complete a micro-credential.

Nova Scotia and British Columbia specify flexibility as a core principle that should guide the development and implementation of micro-credentials in the province within their respective frameworks (MAEST, 2021; Government of Nova Scotia, 2023). Saskatchewan and Ontario's frameworks do not mention flexibility, learning schedules, or required time commitments (eCampus Ontario, 2019; Government of Saskatchewan, 2021).

2.4.4 *Issuing Institution*

Institutional public image and reputation play a role in differentiating institutions and the relative standing of qualifications (Hazelkorn, 2011). Oliver (2021) posits educational providers' reputational standing and quality, in terms of accreditation, are value considerations for micro-credential learners. Although Oliver (2021) does not conflate the two constructs of reputation and quality, Ralston disapprovingly writes that in the absence of accreditation standardizing micro-credential offerings, "quality assurance amounts to knee-jerk impressions of institutional reputation" (2021, p. 91). Thus, it may be difficult for potential learners to distinguish between a micro-credential provider's reputation and the quality of a program.

The micro-credential frameworks identify different micro-credential issuers. The narrowest is British Columbia's framework, which identifies only institutions within the public post-secondary education system as issuers of micro-credentials. In contrast, Nova Scotia's framework is broad and directed at any entity which may consider issuing a micro-credential. Similarly, Ontario and Saskatchewan's frameworks are intended to be applicable to all agencies, organizations, institutions, or employers wishing to issue a micro-credential. However, Saskatchewan's document specifies issuers should "have a history of operations in Saskatchewan or another recognized jurisdiction" (Government of Saskatchewan, 2021, p. 5), and Ontario requires issuers to "be established" (eCampus Ontario, 2019). A provider's reputation is likely to be a consideration for potential micro-credential learners when choosing a program (Oliver, 2021; Ralston, 2021; Pichette et al. 2021).

2.4.5 *Connections to Employers and Other Programs for Graduates*

Micro-credentials may or may not be stackable toward higher qualifications, and in some cases may be a laddering pathway into a larger credential or educational experience (Davis & Dahir, 2024; Dobbs et al., 2023; McGreal & Olcott, 2022; Pichette, et al*.,* 2021). Micro-credentials must be integrated into the credential ecosystem to enable further educational opportunities for graduates (Duklas, 2020). If a micro-credential is not stackable or does not provide a laddering pathway, it is expected to possess some stand-alone meaning to an employer or industry about the earner's knowledge, skills, or abilities or to develop an earner's transferable skills to multiple employment contexts (Kato et al., 2020). This type of micro-credential is usually workplace-aligned, often through formal consultation with employers to reflect industry-based content (Gallagher, 2020). In such cases, micro-credential learning outcomes and objectives are matched to eligibility for employment criteria or to qualification frameworks. All provincial frameworks state that connections between micro-credentials and workplaces are ideal. They also indicate that micro-credentials developed under their frameworks may be pathways to additional educational opportunities (eCampus Ontario, 2019; Government of Nova Scotia, 2023; Government of Saskatchewan, 2021; MAEST, 2021). Participants in Pichette et al.'s (2021) study ranked "employer recognized" as the second most important feature and Bruguera et al. (2023) found the two most highly ranked potential dislikes were little recognition by educational institutions and little credibility, recognition, or value from employers.

2.4.6 *Cost*

Micro-credentials should generally be less costly than traditional diplomas and degrees (Oliver, 2019; 2021). With their costs aligned with the duration, skill level, learners targeted, and expected outcomes of a micro-credential (MAEST, 2021). The cost of a micro-credential program is framed as an accessibility issue in the micro-credential frameworks for British Columbia and Nova Scotia (MAEST, 2021; Government of Nova Scotia, 2023) but is not included in Saskatchewan and Ontario's frameworks (eCampus Ontario, 2019; Government of Saskatchewan, 2021). However, Ontario made some micro-credentials eligible for its student assistance program in 2021 (MCU, 2021b), indicating that the province recognizes micro-credentials' cost as a potential barrier to access.

In 2024, the cost of post-secondary offered micro-credentials varies widely. For example, micro-credentials offered by University of Toronto (Ontario) range from $500 to $600 and are a maximum of six weeks (University of Toronto, 2024), an 80-hour micro-credential on artificial intelligence ethics offered by Athabasca University (Alberta) costs $2,000 (Athabasca University, 2024), and a 39-hour chemistry micro-credential on metabolomics at University of British Columbia costs $4,500 (University of British Columbia, 2024a) whereas the 70-hour Health Assessment for Primary Care Nursing micro-credential costs $600 (University of British Columbia, 2024b). An inexhaustive search of micro-credential programs across post-secondary institutions in Canada found most micro-credentials to be between $400 to $2,200 excluding additional fees.

Cost is a salient attribute to potential micro-credential learners. The hypothetical cost of a micro-credential was noted as the biggest concern by 2,000 Canadian respondents to a survey about micro-credentials (Pichette et al., 2021). The survey reported only about 25% of respondents would be willing to pay more than $250 of their own money for a hypothetical micro-credential. In Europe, 0€ – 50€ (approximately $0 - $74 CDN) was the maximum price per credit 58.9% (*n* = 115) respondents were willing to pay for a short course that does not offer an official credential, and only 8.5% were willing to pay more than 201€ (approximately $296 CDN) for the same unofficial credential. However, when researchers stated the short course would lead to an official credential, the percentage of respondents willing to pay 0€ – 50€ decreased to 31.8% and the percentage willing to pay more than 201€ increased to 26% (Bruguera et al., 2023). These are suggestive clues from Bruguera et al.'s (2023) findings that suggest learners are willing to pay differing amounts for different micro-credential attributes, namely a higher price for an official credential versus an unofficial credential.

2.4.7 *Reimbursement*

Financial support in the form of direct reimbursement to learners may increase their accessibility to learners who have financial pressures. Reimbursement may come from tax credits, grants, scholarships, employers, or other sources. To date, only Ontario has made micro-credentials eligible for its student assistance program (MCU, 2021b). Since 2019, the Government of Canada has provided a universally available tax credit, the Canadian Training Credit, for tuition fees paid to an eligible educational institution, including micro-credential tuition fees paid to post-secondary institutions. Up to $250 per year is available and can be accumulated to a lifetime maximum of $5,000 (Canada Revenue Agency, 2022). Grants have also made some micro-credentials free to learners, such as several offered by Nova Scotia Community College (Nova Scotia Community College, 2024) and Saskatchewan Polytechnic where over 25 free-to-learner micro-credential programs are available (Slaght, 2024).

The amount of employer reimbursement for further education, including micro-credentials, appears to be partially dependent upon the type of education. OECD (2020) reports 44% of respondents participated in a job-related and employer-paid training activity of any type in the last 12 months. However, most MOOC completers in an international study (Hollands & Kazi, 2019) were self-funded and few benefited from employer support. In 2018 and 2019, employers paid the fees for 4% of MOOC learners and contributed towards the fees of another 1% (Hollands et al., 2023). Pichette et al.'s (2021) survey indicated approximately 33% of respondents had access to financial support for professional learning activities through their employer.

Reimbursement is not an attribute included in provincial frameworks but is available to all tax-paying Canadians through a tax credit of $250 to $5,000. Additional forms of reimbursement could also be available to some micro-credential learners based on individual circumstances, such as financial support from an employer.

2.4.8 *Award Format*

Earned micro-credentials may be issued as either a paper certificate, digital marker of attainment, or both (Pichette, et al*.,* 2021). A small but notable number of scholars have advocated for the use of blockchain to validate the information on earners' micro-credentials, see Alsobhi et al. (2023) for a recent systematic literature review. Ontario and British Columbia's frameworks require micro-credentials to be "transcribable," meaning that they will be compatible with traditional transcripts (eCampus Ontario, 2019, MAEST, 2021). Saskatchewan's framework requires earned micro-credentials to be shareable and recommends using digital platforms to do so (Government of Saskatchewan, 2021). Participants in Pichette et al.'s (2021) study ranked "Digitally integrated" as the least important characteristic among 15 other characteristics. Although the format of the award is a relevant characteristic, it does not appear to be an important characteristic to potential micro-credential learners.

2.4.9 *Credential Stewardship*

In Ontario, micro-credentials are owned by the earner once awarded (eCampus Ontario, 2019). In contrast, ownership of Saskatchewan-earned micro-credentials are retained by the issuing institution, "for micro-credentials, issuing institutions maintain stewardship of the credential (e.g. expiration dates of credentials), and retain the ability to revoke credentials in situations where it is warranted (e.g. academic dishonesty)" (Government of Saskatchewan, 2021, p. 5). Nova Scotia and British Columbia do not address ownership of earned micro-credentials in their provincial frameworks. To the author's knowledge, no previous study has investigated learners' opinions of credential ownership or stewardship after their award. Given the contrasting approaches taken by Ontario and Saskatchewan for micro-credentials issued under their frameworks, this may become an area of future research.

2.4.10 *Content*

Micro-credentials are created around specific competencies knowledge, skills, or abilities, of a focused set of learning outcomes as opposed to a broad body of knowledge (Kato et al., 2020). The number of competencies and mastery levels that could be acquired in a micro-credential is possibly infinite, although advocates recommend program content be focused on skills that are or are likely to be relevant to the labour market (Brown et al., 2021; Oliver, 2019). All provincial frameworks state content relevant to the labour market and workplace are ideal (eCampus Ontario, 2019; Government of Nova Scotia, 2023; Government of Saskatchewan, 2021; MAEST, 2021).

2.4.11 *Assessment*

Micro-credentials can recognize participation in a program, although most frequently in higher education a demonstration of competence or mastery should be the basis on which the qualification is awarded (Kato et al., 2020; Pichette et al., 2021). Evidence for valid and reliable assessment of micro-credential competencies adds credibility to the value of a micro-credential (Oliver, 2022). It is a salient attribute to issuers and employers (Gallagher, 2020; Oliver, 2019; 2022) and is included in all provincial frameworks (eCampus Ontario, 2019; Government of Nova Scotia, 2023; Government of Saskatchewan, 2021; MAEST, 2021). However, the absence or presence of assessment was only noted as a tangential benefit to learners by Bruguera et al. (2023). The authors found other attributes, such as cost and flexibility, to be more important.

This literature review has, to this point, demonstrated there is a limited body of academic research about learners' preferences and attributes of micro-credential programs. Much of the literature is theoretical, based on qualitative studies, small, single-location studies, or descriptive quantitative research. Previous studies provide insights into the different attributes of micro-credentials (Pichette et al., 2021; Bruguera et al., 2023), but do not provide evidence on how potential learners make trade-offs between the different attributes of a micro-credential. The next chapter, Empirical Approach, presents this study's research question and objectives and broadly outlines the research methodology.

Chapter 3
Empirical Approach

The current study aims to advance our understanding of micro-credential program preferences by estimating the relative importance of micro-credential program attributes. It answers the research question: What are Canadians' preferences and willingness to pay for attributes related to micro-credential programs delivered by post-secondary institutions? Four specific research objectives are related to this research question:

1. To determine the extent to which the attributes of a micro-credential program influence the choice of a preferred program.
2. To quantify the trade-offs individuals make in selecting a preferred micro-credential program and to determine the extent to which they are willing to pay for preferred attributes.
3. To describe differences, if any, regarding subgroup preferences for micro-credential programs with the same program attributes.
4. To predict the uptake probabilities of different post-secondary delivered micro-credential programs, described by attributes, to subgroups of potential learners.

This research question and associated objectives are answered by the results of a discrete choice experiment (DCE).

3.1 Introduction to Discrete Choice Experiments (DCEs)

Discrete choice experiments (DCEs) are based on the principles that, firstly, any product, service, or program can be described by its attributes and, secondly, the extent to which an individual values a product, service, or program depends upon the nature and level of these attributes (Louviere et al., 2010). A stated preference (SP) method, DCEs quantify the relative importance of the attributes of a program and determine the potential uptake rates of the attributes (Hensher et al., 2005; Louviere et al., 2003). They have the advantage of focusing participants only on the factors of experimental interest as compared to other methods (Ben-Akiva et al., 2019).

Discrete choice experiments (DCEs) are theoretically grounded in random utility theory (RUT) (McFadden, 1974). Utility is an economic concept that is broadly understood to describe the value or usefulness that something has for a person. Building on the work of Thurstone (1927) and the Lancaster Characteristic Theory of Value (Lancaster, 1966), McFadden (1974) developed a framework to study choice behaviour. RUT hypothesizes that given choices between different goods and services, people generally choose the one they prefer, and when they do not, this can be explained by random factors (McFadden, 1974). Further, RUT assumes that utility, a latent construct, can be summarized by two components, a systematic component and a random component. Systematic components include attributes explaining differences in choice alternatives and covariates explaining differences in individuals' choices. Random components include all unidentified factors that impact choices, including those relating to inconsistencies within individuals' choice behaviour (Louviere et al., 2010). This is represented by the following basic model (1) for individual *n* choosing alternative *i*.

$$U_{in} = V_{in} + \varepsilon_{in} \tag{1}$$

Where U_{in} is the latent utility that individual *n* associates with choice alternative *i*, which cannot be observed; V_{in} is the systematic utility that individual *n* associates with alternative *i*, which can be explained through decision choice modelling; and ε_{in} is the random component associated with individual *n* and alternative *i* (Louviere et al., 2010).

RUT links observed choices to behavioural assumptions to develop a statistical choice model that explains the observed choices under the assumption of utility-maximizing behaviour by the decision maker. It leads to families of probabilistic decision choice models that describe how choice probabilities respond to changes in choice options, attributes, or covariates representing differences in individuals. These model families include the multinomial logit model (MNL), mixed logit model (MXL), and the latent class model (LCM) (Louviere et al., 2010).

3.1.1 *Introduction to DCE Survey Methodology*

Originating in mathematical psychology (Luce & Tukey, 1964), discrete choice experiments (DCEs), also called choice based conjoint analyses (CBCA), are most widely used in consumer behaviour (Ben-Akiva et al., 2019), health care (Ryan & Farrar, 2000; Lancsar & Louviere, 2008), and transportation (Hensher, 2001) research for product and service design. Fewer studies have used DCEs within the education sector (Cunningham et al., 2015; Davidson et al., 2002; Kuzmanovic et al*.*, 2013; Saleem et al., 2022; Soutar & Turner, 2002), but never for investigations into adult learner preferences for micro-credentials until this study.

DCEs and other SP methods emerged from a desire to understand the demand for goods and services in situations where it was not possible to use revealed preference data to investigate the actual choices made by individuals (Louviere et al., 2010). For example, when a new product or service is under development or is not yet widely available.

In a DCE survey, study participants are asked to repeatedly choose between two or more alternative hypothetical scenarios that describe a program, product, or service of interest in a series of choice tasks. Participants are instructed to select the alternative they most prefer among those presented by evaluating them conjointly. Each alternative is comprised of several attributes and levels to force participants to make trade-offs according to their preferences. Attributes are the dimensions on which programs are described (i.e., the format of instruction). Levels are the specific alternatives within an attribute which require participants to make a trade-off between attributes (i.e., an online program versus an in-person program). In stating a preference, the individual is assumed to choose the alternative that provides them with the greatest benefit, known as utility. The utility of an alternative is assumed to depend on the utilities of its composing attributes and levels (Lancaster, 1966). The attributes and levels defining each alternative and the combination of presented alternatives are systematically varied over multiple-choice tasks throughout the survey to determine the relative importance of each attribute and the desirability of each attribute level. Typically, no more than 20 choice tasks are presented per respondent (Orme, 2020), although Vanniyasingam et al. (2016) recommend asking about 10 to 15 choice tasks to reduce cognitive fatigue which risks response error. DCEs model decision-making behaviour and enable the researcher to determine the relative influence of variations in the levels of each attribute on respondent choices (Lancsar et al., 2007).

3.1.2 *Introduction to Attributes and Levels*

Attributes and levels selection are crucial in DCE design (Shang & Chandra, 2023). Poor selection of attributes or misspecification of levels will produce inaccurate or confusing results (Mangham et al., 2009). One important factor is the number of attributes and levels. As the number of attributes and levels in a DCE increases, each response provides less information, necessitating a balance between specification and efficiency (Pérerz-Troncoso, 2020).

Mangham et al. (2009) recommend selecting no more than ten attributes to ensure the cognitive load for participants is manageable. Reed Johnson et al., (2013) do not recommend a maximum number but note that 70% of existing DCEs use 3 to 7 attributes. A second factor is the quality of the attributes. Attributes should be justifiable by evidence. A literature review is crucial (Pérerz-Troncoso, 2020; Shang & Chandra, 2023). Shang and Chandra (2023, p. 70) provide five criteria for good attributes.

1. Relevance: The chosen attributes should be relevant to the product or service under investigation and to the context of the DCE study.

2. Significance: The chosen attributes should be important and meaningful for individuals in coming to a decision about which alternative they prefer.
3. Clarity: The chosen attributes should be defined in a specific way to avoid attribute ambiguity.
4. Completeness: The chosen attributes should be inclusive and cover all important aspects of the product or service under investigation.
5. Measurability: The chosen attributes should be measurable either qualitatively or quantitatively.

At the same time attributes are selected, the levels should be considered. Levels should be plausible and relevant (Kløjgaard et al*.,* 2012) but do not need to be currently available (Grover & Vriens, 2006). The attribute levels should be designed to ensure respondents are willing to make trade-offs between alternatives (Shang & Chandra, 2023). Green and Srinivasan (1990) warn, that if attribute levels are too narrow or too wide, respondents might perceive the differences between levels as either insignificant or overly significant, leading to dominating levels and non-trading responses. Sawtooth Software (2024) recommends attributes have five or fewer levels. Finally, attributes and their levels should be as mutually exclusive and collectively exhaustive as possible, meaning all possible options are provided. These level recommendations may require the research to reject or refine attributes initially considered (Shang & Chandra, 2023). To help the researcher achieve a collectively exhaustive design, adding a “no choice” or “none” choice as a secondary question is possible (Orme, 2020). This enables respondents to opt for none of the presented program alternatives in a choice task. The “none” choice also helps ensure the presented alternatives are collectively exhaustive because it provides for the possibility of individuals choosing to maintain the status quo (Pérerz-Troncoso, 2020). Attribute and level selection is an iterative process (Pérerz-Troncoso, 2020).

3.2 Benefits of the Selected Method

A DCE is particularly useful in achieving this study's aim and objectives. DCEs are an established quantitative method used to measure respondents' underlying preferences (Louviere et al., 2010; Rao, 2014). DCEs are well suited for modelling real-world decisions that entail trade-offs (Hainmueller et al., 2014), such as those faced by potential adult learners when deciding whether to pursue micro-credential programs. A distinguishing feature of DCEs compared to other survey methods is that alternatives (or choice options) are bundles of attributes that differ along multiple dimensions rather than a single factor. For example, when choosing between learning experiences, adult learners may simultaneously consider such features as time commitment, program format, and cost. A DCE makes it possible to estimate and rank the relative importance of these attributes (Reed Johnson et al., 2013).

Qualitative micro-credential research can identify a range of barriers and facilitators to micro-credential program uptake (Oliver, 2021), and participatory rating or ranking exercises can produce ordinal measures of importance (Pichette et al., 2021; Bruguera et al., 2023). However, when faced with numerous micro-credential program attributes and a need to prioritize between them, neither of these approaches provides concrete guidance for implementers at post-secondary institutions on which combination of attributes will be most preferred or is likely to achieve the greatest uptake among target learners.

DCEs and conjoint analysis address these limitations as they have several methodological advantages compared to other survey methods (Caussade et al., 2005; Swait & Adamowicz, 2001). It is a multivariate technique applied when the objective is to determine the relative importance of different attributes by analyzing the impact that varying combinations of these attributes have on respondent choices (Hainmuller et al., 2014). It sheds light on trade-offs that cannot be readily estimated through standard questionnaires, which are often susceptible to respondents answering in a socially acceptable way, a problem known as social desirability bias (Kim & Kim, 2016). By presenting respondents with multiple pieces of information at once, DCEs provide an enhanced realism relative to ranking or Likert-style survey instruments that elicit preferences on single pieces of information at one time. This distinctive feature makes DCEs less artificial than traditional surveys and thus better suited for capturing preference decisions in information-rich environments (Hainmueller et al., 2014). It can identify where preferences differ between specific groups (Reed Johnson, et al., 2013), which is particularly useful when micro-credential programs target specific groups of potential learners (Pichette & Courts, 2024). Moreover, DCEs can measure the strength of preferences between program attributes, for example, delivery mode, provider reputation, and program cost, in the absence of revealed preference data (Louviere et al., 2010). In the case of micro-credential programs, revealed preference data could take the form of the number of applications, total enrollment figures, or program completion data, which to date is very sparse. It can also model preferences for micro-credential programs and attributes that have not yet been introduced or widely implemented but may be in the future (Hainmueller et al., 2014). Through conjoint analysis, respondents' preferences for the attributes and levels can be statistically deduced (Orme, 2020). Through the utilization of a DCE and conjoint analysis methodologies, the current study is the first in the field to quantify the relative importance of various micro-credential program attributes.

3.3 Hypotheses

The previous two sections identified outcomes of DCE data that potentially have value in this study. The central hypothesis underlying this dissertation in practice is that Canadians prefer specific attributes of micro-credential programs. This has to do with personal characteristics (e.g., age, gender) as well as personal preferences. As an exploratory study, no specific hypotheses were developed about expected differences in preferences between certain respondent subgroups.

Chapter 4
Methods

To understand Canadians' preferences for micro-credential program characteristics, an online survey was designed and analyzed. It contained discrete choice experiment (DCE) choice tasks followed by a socio-demographic questionnaire. The online survey was created and hosted in Lighthouse Studio (version 9.15.9, Sawtooth Software Inc., Provo, UT).

4.1 DCE Instrument Design

A DCE was developed to understand Canadians' preferences for micro-credentials. In a DCE respondents are presented with a series of choice tasks. Each choice task contains several alternative programs, and respondents must repeatedly select the program they most prefer by evaluating the alternatives conjointly. The alternative programs are made up of a limited number of attributes with various levels. To choose and then indicate their preferred program, respondents must make trade-offs between attributes and levels, simulating real-world decision-making processes. The attribute levels defining each program and the combination of programs presented are systematically varied over multiple choice tasks. As will be discussed in a subsequent section, data collected through DCEs enable the calculation of how preference decisions are influenced by different program attributes and their corresponding levels through conjoint analysis methods, such as multinomial logit, hierarchical Bayes, and latent class analyses. DCEs and conjoint analysis are used when determining the joint effect of two or more attribute levels on the total evaluation of a set of alternatives (Hainmueller et al., 2014).

4.1.1 *DCE Attributes and Levels*

Following scholars' recommendations for designing a DCE, the selection of attributes and their levels for the DCE in this study was informed by the research and practice reviewed in the literature review chapter. Of the 11 factors initially identified as being relevant for the selection of micro-credential programs, seven were retained for inclusion in the DCE: Format of instruction, total hours of work to complete the program, time commitment, reputation of the provider, connections to employers and other programs for graduates, reimbursement available, and cost (Table 1). The four factors found during the literature review but not selected were award format, credential stewardship, content, and assessment.

The seven selected attributes and levels were chosen for their presence in micro-credential literature, inclusion in provincial frameworks, and recommendations from the literature concerning the selection of good attributes and levels (Grover & Vriens, 2006; Reed Johnson et al., 2013; Kløjgaard et al., 2012; Pérerz-Troncoso, 2020; Sawtooth Software, 2024; Shang & Chandra, 2023). In choosing the attribute levels for the selected seven attributes, the goal was to reflect variation between available and possible micro-credential programs to ensure realism (Kløjgaard et al., 2012; Grover & Vriens, 2006) while simultaneously minimizing the number of levels to less than five to ensure higher statistical power (Sawtooth Software, 2024). Attributes varied between three to five levels, as shown in Table 1, with each level within the parameters of available or possible micro-credential programs as determined through the literature review.

Table 1

Attributes and Levels for the Discrete Choice Experiment

Attributes	Levels
Format of instruction	In-person Blended (online and in-person) Online
Total hours of work to complete the program	1 – 15 hours 16 – 50 hours 51 – 100 hours 101 – 240 hours 241+ hours
Time commitment	Part-time study (less than 9 hours per week) Full-time study (more than 10 hours per week) Flexible, self-paced study (0 to 40 hours per week)
Reputation of the provider	Fair Good Excellent

Attributes	Levels
Connections to employers and other programs for graduates	None
	Advanced placement and preferred admission to other post-secondary programs
	Employers recruit program graduates
Reimbursement available	None
	Partial
	Full
Cost	$500
	$1,000
	$2,000
	$4,000

To help respondents interpret micro-credentials and the seven attributes and levels in the same way, the following definitions of micro-credentials and the seven attributes were provided to respondents at the beginning of the survey:

> *Micro-credentials* – Micro-credentials are small, focused certifications you can earn from colleges and universities (post-secondary institutions) to prove you know a specific skill or have knowledge of a particular topic. Unlike university degrees or lengthy college courses, micro-credentials are designed to be earned relatively quickly. They are a way to prove your expertise, knowledge, and skills to others, which can help with your job and keeping up-to-date in fast changing fields.
>
> *Format of instruction* – Where the learning occurs (for example, in-person or online).
>
> *Total hours of work to complete the program* – The recommended amount of time to spend on preparation, lessons, and homework.
>
> *Time commitment* – The recommended amount of time to spend on preparation, lessons, and/or homework every week until the program is completed.

Reputation of the provider – The college or university's standing in the community (for example, good or excellent).

Connections to employers and other programs for graduates – The opportunities the program has arranged for graduates of the program.

Reimbursement available – Whether any paid program fees can be returned to a program graduate by an agency, organization, or employer.

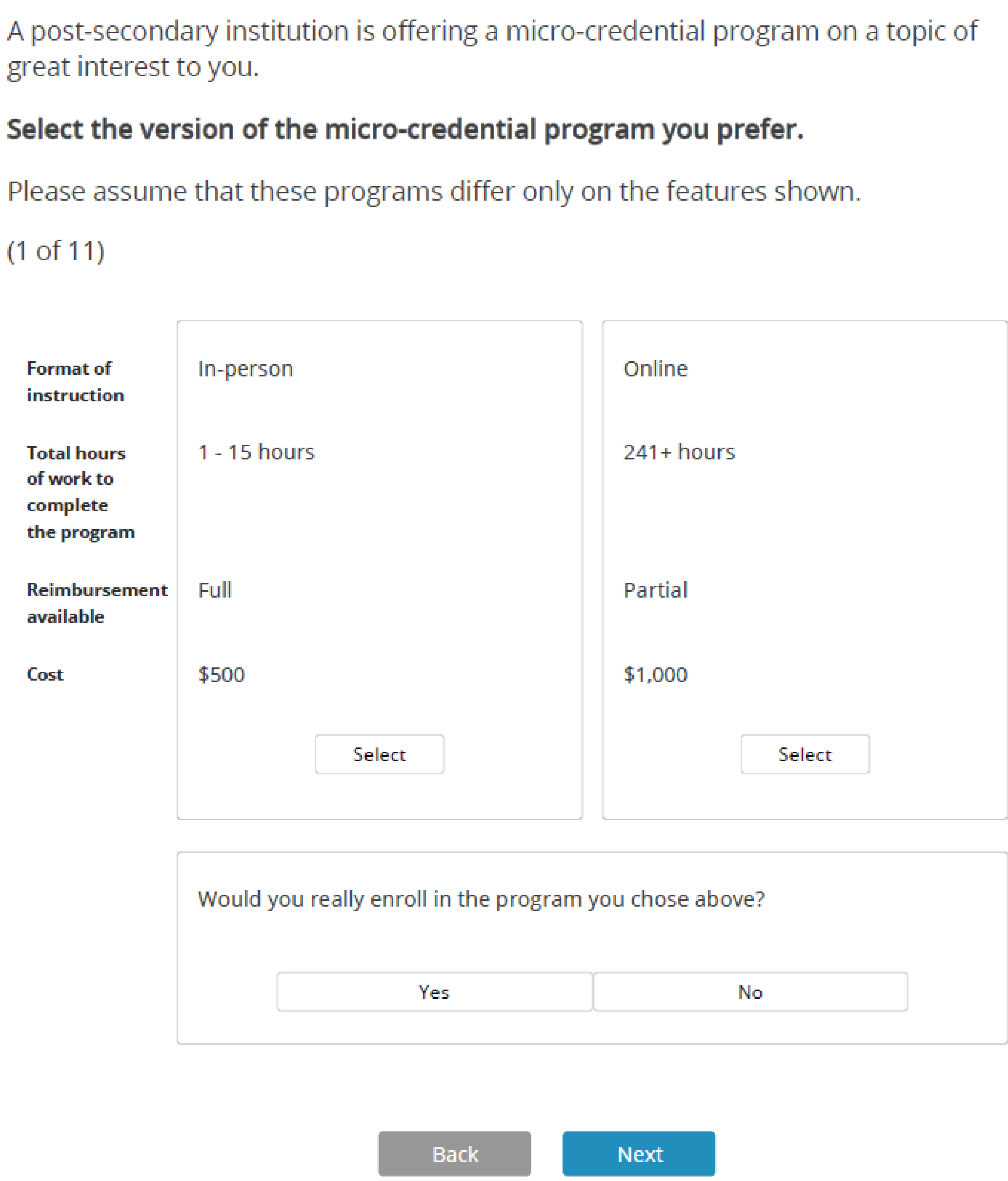
Cost – The program fees that must be paid to begin the program.

To manage the 4,860 (3 x 5 x 3 x 3 x 3 x 3 x 4) hypothetical micro-credential program combinations possible while still allowing the preferences to be inferred for all combinations of attributes, a partial-profile, balanced overlap design was employed. In a partial-profile approach, a subset of the total number of attributes is presented in each choice task but rotated across all choice tasks so that each respondent considers all attributes and levels (Orme, 2020). While typically recommended for studies with eight or more attributes (Reed Johnson et al., 2013), feedback from informal pilot testing revealed that the cognitive load of repeatedly assessing micro-credential program options with five or more attributes is excessively taxing. Therefore, a partial-profile design was employed to reduce the cognitive burden and, thus, response error, creating a design with greater predictive validity (Chrzan, 2010). A choice task design that presented two micro-credential programs with four of the seven attributes in each choice task was selected (Figure 2). No prohibitions were specified to restrict specific combinations of attributes and attribute levels from appearing within a single program profile.

An identical scenario prefaced each choice task to provide the necessary context and reduce the likelihood of introducing omitted variable bias by excluding salient attributes: "A post-secondary institution is offering a micro-credential program on a topic of great interest to you. Select the version of the micro-credential program you prefer. Please assume that these programs differ only on the features shown." A dual-response none question, "Would you really enroll in the program you chose above?" was asked after each choice task (Figure 2). An example of a single-choice task from the DCE is shown in Figure 2.

Figure 2

Sample Choice Task



A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(1 of 11)

Format of instruction	In-person	Online
Total hours of work to complete the program	1 - 15 hours	241+ hours
Reimbursement available	Full	Partial
Cost	$500	$1,000
	Select	Select

Would you really enroll in the program you chose above?

Yes | No

Back | Next

Vanniyasingam et al. (2016) recommend asking about 10 to 15 choice tasks per survey form, though this recommendation depends on the attribute list and sample size. To stay within this recommendation, a design with nine operational choice tasks and two hold-out choice tasks was created.

The two holdout choice tasks were included to check the quality of participants' responses. These two hold-out tasks were fixed to appear in position 5 and position 7 in every form and presented two program alternatives. Only the layout of Task 5 and Task 7 was different; the alternative that appeared on the left in Task 5 was presented on the right in Task 7, and the alternative that appeared on the right in Task 5 appeared on the left in Task 7. The attributes and levels within each of the alternatives were repeated in Task 5 and Task 7. Respondents were expected to be internally consistent and choose the same alternative in Task 5 and Task 7 regardless of its position on the left or the right. The two hold-out tasks were not used in the model estimations but were used in data cleaning to discard respondents who were internally inconsistent as recommended by Allenby et al. (2014) and Orme (2020).

The final DCE survey was structured so that 11 sets of two program profiles of four attributes were presented to respondents for evaluation. Near orthogonality and minimal overlap between attributes and attribute levels in each survey form were achieved using Sawtooth Software's balanced overlap algorithm (Chrzan & Orme, 2000) which produced 300 survey versions.

4.1.2 *Minimum Sample Size*

Orme (2020) suggests that the sample size for DCE should range from 150 to 1,200 respondents and provides the following rule of thumb formula to establish the minimum sample size for multivariate statistical analysis of DCE data.

$$n \geq \frac{500c}{ta} \tag{2}$$

where:

n = number of respondents required

500 = the least amount of times each attribute level must be represented in the DCE to achieve sufficient stability in estimates

c = largest number of levels in all attributes (for main effects)

t = number of choice tasks

a = number of alternatives per choice task (excluding the opt-out alternative)

In this research, the highest number of levels is five, and there are 11 choice tasks (including hold-out tasks) with two alternatives per task. Therefore, the minimum sample size should be at least 114 using this calculation.

Additional consideration was given to the socio-demographics of the sample to evaluate subgroups. A sample size of at least 200 respondents in major socio-demographic categories was desired to have enough respondents for meaningful subgroup analysis. Therefore, to gain more statistical power of the results, this study aimed to recruit 1,000 respondents to ensure large enough subgroups for statically valid results.

4.1.3 *DCE Design Efficiency and Strength*

The final DCE design of 300 forms with 9 sets of operational tasks, 2 hold-out tasks, and two program profiles of four attributes per alternative was tested for design efficiency and strength using Lighthouse Studio's "Test Design" module. 1,000 respondents were assumed. The frequency at which each attribute level appears across the 300 forms is balanced relative to other levels within the same attribute (Table 2). One-way frequency is the number of times each level appears across all survey forms and is above the recommended minimum of 500 occurrences (Orme, 2020). The design strength is 1,500.67, and each parameter's standard error is between .026 and .036, assuming 1,000 respondents and 300 versions (Table 2). This enables an effect size of 0.071 or larger to be detected with a 95% confidence level, given the standard error of .036. Standard errors are within the recommended cut-off of .05 standard errors per attribute level to estimate utilities efficiently and indicate a reliable design (Sawtooth Software, 2024). Comparatively, with the minimum sample size of 114 participants, the design strength is 107.28 and parameter standard errors are between .109 and .072, for a d-efficiency ratio of 92.9. The selected design is stronger and more efficient with 1,000 respondents. Moreover, the final design is responsive to feedback from informal pilot testing to reduce the overall length of the survey and minimize the cognitive load of considering large numbers of attributes or alternatives in each choice task.

Table 2

Attribute Level Frequency and Standard Errors, Assuming 300 Versions and 1,000 Respondents

Attributes	**One-Way Frequency**	**Standard Error**
Format of instruction		
In-person	1,029	0.025
Blended	1,027	0.025
Online	1,030	0.025
Total hours of work to complete the program		
1 – 15 hours	616	0.036
16 – 50 hours	618	0.035
51 – 100 hours	617	0.036
101 – 240 hours	618	0.036
241+ hours	617	0.036
Time commitment		
Part-time study	1,027	0.025
Full-time study	1,030	0.024
Flexible, self-paced study	1,029	0.024
Reputation of the provider		
Fair	1,029	0.025
Good	1,029	0.025
Excellent	1,028	0.024
Connections to employers and other programs for graduates		
No connections	1,028	0.025
Advanced placement and preferred admission to other post-secondary programs	1,030	0.025
Employers recruit program graduates	1,028	0.025
Reimbursement available		

Attributes		One-Way Frequency	Standard Error
	No reimbursement	1,027	0.025
	Partial	1,028	0.025
	Full	1,029	0.025
Cost			
	$500	772	0.031
	$1,000	771	0.030
	$2,000	771	0.031
	$4,000	772	0.030
None		-	0.026

4.2 Socio-Demographic Questionnaire

The second part of the online survey gathered information about the participants' socio-demographic characteristics. Socio-demographic variables included age, education, province or territory of residence within Canada, gender, place of birth (inside or outside of Canada), ethnicity, income, main activity, field of work by education or training, and prior familiarity with micro-credentials. The socio-demographic questionnaire was also designed in Lighthouse Studio. One complete version of the survey is in Appendix 1. In a DCE study, socio-demographic characteristics of respondents can be used as covariates during the analyses, as segmentation variables to determine significant differences between respondent sub-groups, or as predictor variables.

4.3 Statistical Methods

Descriptive statistics were used to analyze key features of the sample, such as age, province of residence, and prior familiarity with micro-credentials. The DCE produced five types of results through conjoint analysis methods, counts, interval-scaled conjoint utilities (also called part-worth utilities), attribute importance scores, shares of preference, and willingness to pay estimates.

4.3.1 *Counts*

The most basic form of conjoint analysis is counting the number of times an attribute level was chosen relative to the number of times it was available as a choice. Counting analysis was performed as an initial diagnostic check of the results. The purpose was to obtain a concise ratio-scaled calculation of main effects that indicate whether the various attribute levels differ significantly in their frequency of choice. If an attribute level was never chosen it could indicate a technical issue with the form distribution or poorly selected levels and further analysis would not be appropriate.

The frequency and statistical significance of attribute level choice were calculated by counting and chi-square tests. However, Orme (2020) recommends caution when interpreting the aggregate count chi-square statistic because aggregate count proportions for levels on which respondents disagree may have equal counts and the chi-square statistic will be zero. While counts show, on average, which levels were preferred for this sample of respondents, they do not help determine how combinations of all attributes added together would be preferred. Other methods of conjoint analysis, multinomial logit, hierarchical Bayes, and latent class are not subject to this difficulty. The count analyses were a preliminary form of analysis.

4.3.2 *Part-worth Utilities*

Part-worth utilities or conjoint utilities can be estimated from multinominal logit (MNL), hierarchical Bayes (HB), or latent class (LC) analyses. Utilities represent the relative desirability of each attribute's level. Higher part-worth utilities indicate that a level is more desirable and has a large positive impact on influencing respondents to choose a program. Lower and negative part-worth utilities indicate that a level is less preferred and may deter respondents from selecting a program. In this study, utilities within an attribute are scaled to sum to zero using effects coding in Lighthouse Studio's design matrix (Orme, 2020). Utilities are interval data. As interval data, it is inappropriate to directly compare utility values between attributes. It is appropriate to compare utility values between levels within an attribute.

In this study, three multivariate models were created at different levels of aggregation to produce part-worth utilities. First, the multinomial logit (MNL) model.[3] The MNL model does not account for any potential learner heterogeneity – it assumes potential learners have the same taste preferences for micro-credential programs – and is thus an overall summary of the population average. A second model was produced using hierarchical Bayes (HB) methods. The HB model ascertained individual preferences and refined the part-worth utility estimates obtained through the MNL model. A third model, a latent class model (LCM), was developed to divide the sample into several classes of participants with similar patterns in their preferences. The following section describes the methods to create each model.

Multinomial Logit (MNL) Model. After conducting the initial counting analyses, a second preliminary analysis was performed using a multinomial logit (MNL) model to estimate the main effects of attribute levels. These main effects quantify the individual impact of each attribute level independently of others. However, the MNL model averages preferences across respondents, which can potentially mask individual or subgroup preferences.

In the MNL model, $P(n_{ij})$ represents the probability that the *n*th person chooses the *j*th alternative in the *i*th choice situation (Louviere et al., 2010). Each respondent is assumed to make decisions based on a multinomial logit function of the program attributes.

$$P(n_{ij}) = \frac{\exp\,(\beta'^{X_{ij}})^{i}}{\sum_j \exp(\beta'\, X_{ij})} \tag{3}$$

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[3] Sawtooth Software's Lighthouse Studio (version 9) user interface refers to this model as the "logit model" (Sawtooth Software, 2024). The accompanying technical documentation states, "Logit analysis is an iterative procedure to find the maximum likelihood solution for fitting a multinomial logit model to the data" and "CBC [choice based conjoint] uses multinomial logit analysis (MNL) to estimate effects for attribute levels" (Sawtooth Software, 2024). "MNL" is used throughout this dissertation for accuracy and clarity as other logit models are available to researchers on different data analysis platforms or with different software.

The MNL model operates under three key assumptions: 1) Fixed beta coefficients (β). The beta coefficients are assumed to be constant across all respondents; 2) Independence of Irrelevant Alternative (IIA). This axiom states that the ratio of the probabilities of choosing between any two alternatives remains unaffected by the presence or absence of other alternatives in the choice set (McFadden, 1974). However, McFadden (1974) acknowledged that violations of the IIA assumption are common; and 3) Independently and identically distributed error terms. The error terms of the alternatives are assumed to be independently and identically distributed following the Gumbel distribution, implying that unobserved factors affecting utility (error) are independently and identically distributed across alternatives and respondents.

The IIA problem can be mitigated by more advanced models such as HB models and latent class models (Hauber et al., 2016). Despite the restrictive assumptions and frequent violations of the IIA assumption, the MNL model is widely used as a diagnostic tool due to its computational simplicity and straightforward interpretation of results (Sawtooth Software, 2024).

In this study, the MNL model was used to provide an initial indication of part-worth utilities and attribute importance. Only the main effects were considered with the MNL model. A 95% confidence interval was used for significance testing throughout. In the results chapter, the mean utility estimate, standard error, and *t*-ratio are reported. A *t*-ratio is calculated by dividing the part-worth utility by the standard error. A *t*-ratio between -1.96 and 1.96 indicates that the variable was not significant with at least 95% confidence. However, Orme (2020) cautions against relying too heavily upon these ratios because utilities are calculated using a zero-centered approach, meaning the *t*-ratios primarily indicate if the utilities are significantly different from zero and not if the levels significantly impact choice decisions.

Upon estimation, measures of model fit were evaluated. A likelihood ratio test[4] compared the log-likelihood of the model to the null model, with degrees of freedom calculated by subtracting the number of attributes from the total number of levels to obtain the number of additional effects in the full model (Sawtooth Software, 2024). McFadden's R^2 (McFadden, 1981) was also computed. This statistic measures how well the model fits the data, ranging from 0, indicating no improvement from a null model, to 1, indicating a perfect fit model where the model accurately predicts observed choices. McFadden R^2 values exceeding 0.2 to 0.4 are considered acceptable (McFadden, 1981). Lastly, root likelihood (RLH) was assessed. RLH is the geometric mean of the likelihood of each alternative within a choice task being selected and ranges from 1/*n* (worst fit) to 1 (best fit), where *n* is the number of alternatives per choice task. In this study, an RLH of less than 0.5 (1/2) would indicate no model fit. The computer program automatically generated the log-likelihood, chi-square, McFadden's R^2, and RLH.

Since the assumptions of the MNL model may have been violated, two models that do not have the same constraints were next used to generate part-worth utility estimates, the HB and latent class models. These two models were created for their ability to identify heterogeneous preference differences within the sample that affected their micro-credential program preferences.

Hierarchical Bayes (HB). This method estimates individual preferences for each participant in the sample, thus capturing heterogeneity in potential learner preferences. In this study, the HB model was used to address the parts of the research question and research objectives concerning Canadians' preferences, attribute influence, and subgroup differences.

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[4] $G = -2ln(L_{null}/L_{model})$

Bayesian statistics follow Bayes' theorem where available knowledge about parameters in a statistical model is updated with the information in observed data (van de Schoot, 2021). HB borrows information from other respondents to compute individual-level results, in this context part-worth utility values, using information from all respondents to all choice tasks in a DCE survey (Orme, 2020). Unlike classical or frequentist methods, which assume a specific model with predefined parameters and then evaluate the data's fit to these assumptions, the Bayesian approach treats the data as given and searches for a model to best fit the data. HB considers the model parameters to be unknown quantities. This approach allows model parameters to be treated as random variables and assigns them probability distributions during estimation.

This study used Lighthouse Studio's (2024) analysis module to create two HB models, a base model and a model with the covariates, age, education level, ethnicity, gender, and whether the respondent was born in Canada. The following description summarizes the software's approach and assumptions for HB modelling as presented in the technical documentation (Sawtooth Software, 2021a). The two models were prepared using similar techniques.

There are two levels in a hierarchical Bayes model used to estimate the part-worth utility values, a higher level and a lower level. At the higher level, it is assumed that individuals' part-worth utilities are described by a multivariate normal distribution which is characterized by a vector of means and a matrix of covariances (Sawtooth Software, 2021a). As given by Sawtooth Software's *The CBC/HB System Technical Paper v5.6* (2021a):

$$\beta_i \sim Normal(\alpha, D) \tag{4}$$

where:

β_i = a vector of part-worth utilities for the individual

α = a vector of means of distribution of the individuals' part-worth utilities

D = a matrix of variances and covariances of the distribution of part-worth utilities across individuals

At the lower level, the assumption is that given an individual's part-worth utilities the probabilities of choosing particular alternatives are governed by a multinomial logit model (Sawtooth Software, 2021a). As expressed formally in the technical documentation (Sawtooth Software, 2021a), the probability of *i*th individual choosing the *k*th alternative in a particular task is:

$$p_\text{k} = \exp(x'_k ß_i) / \textstyle\sum_j \exp(x_j' ß_i) \tag{5}$$

In the case of this study, the probability of selecting a specific micro-credential program from a range of program alternatives, denoted as p_k depends on various factors specific to each program, represented by x_k and the individual's preferences for those features, represented by $ß_i$. According to the equation, the total utility derived from a micro-credential program is calculated by taking the dot product of x_k and $ß_i$. This means multiplying each level of x_k with the corresponding level of $ß_i$ and then summing all of these products. This total utility is then exponentiated. After calculating the exponentiated utility for all alternative micro-credential programs, the probability of selecting a particular program *k* is obtained by dividing its exponentiated utility by the sum of the exponentiated utilities of all alternatives. This process ensures that the probabilities of all possible choices add up to 100%.

The parameters *ß*, α, and D are estimated by an iterative process within the software called Gibbs sampling or a Monte Carlo Markov Chain. Taking a conservative approach, the part-worth utility values (*ß*), the mean vector (α), and the covariance matrix (D) are set to zero at the start of the iterative estimation process. This assumes no prior knowledge or influence from the data until the iterative process updates these values based on observed data patterns (Sawtooth Software, 2021a). Each iteration consists of three steps:

1. A new α estimate is computed using the current estimates of β and D. α is assumed to follow a normal distribution with a mean equal to the average of β and a covariance matrix equal to D, scaled by the inverse of the number of respondents.
2. A new estimate of D is updated using the inverse Wishart Distribution, incorporating the current estimates of β and α.
3. Using the current estimates of α and D, the program employs the Metropolis-Hastings Algorithm to generate new estimates of β.

Throughout this process, the program uses population parameters to guide individual utility estimates toward a normal distribution. When individual responses deviate from the population's overall trends, adjustments are made based on population characteristics. This ensures that utility estimates for each individual are stabilized according to population norms. The iterative process continues until the estimates converge to values that accurately reflect the data. Upon convergence, the program generates multiple utility estimates for each respondent based on the preceding data. A final point estimate of each respondent's utility is derived by averaging these estimates (Sawtooth Software, 2021a). For this study, Gibbs sampling was set to iterate through 20,000 cycles.

Upon estimation, two measures of model fit were evaluated, RLH and McFadden's R^2, and three results per attribute were generated. The three model results are the part-worth utility which combines the individual models into a representative utility estimate and the 95% confidence interval lower bound (2.5th percentile) and upper bound (97.5th percentile) of the possible values for the mean. The standard deviation is also calculated and reported, which is the standard deviation of the part-worth utilities among respondents and indicates the level of heterogeneity among respondents. The two HB models were compared using a likelihood ratio test[5] to compare the goodness of fit.

For the second HB model, five covariates were added to the base model to produce a new model. The five covariates were age, education level, ethnicity, gender, and whether the respondent was born in Canada. After estimation, Bayesian tests were conducted to assess whether these socio-demographic groups differed in their preferences. These Bayesian tests for group difference evaluate the degree of confidence that one part-worth utility score is greater for one group compared to another. It is done by counting how many times out of the final 10,000 alpha draws (where alpha is the current estimate of the population mean utility vector), the part-worth utility estimate was larger for one group than for another (Orme & Chrzan, 2017). The percentage of instances where one group's alpha draws exceeded another group's alpha draws indicates the confidence that one group has higher part-worth utility estimates than another. For example, if 97.5% of alpha draws are higher for an online format of instruction for 24- to 34-year-olds compared to 35- to 44-year-olds, it can be stated with 97.5% confidence that online instruction is more appealing for 24- to 34-year-olds than for 35- to 44- year-olds. Groups where more than 97.5% of the draws were higher for one group than another are considered significant at a 95% confidence interval.

The individual utilities estimated from the HB model were used to address the parts of the research question and research objectives concerning Canadians' preferences, attribute influence, and subgroup differences, specifically differences based on socio-demographic characteristics. It also provided input for the subsequent attribute importance, shares of

[5] $G = -2ln(L_{base}/L_{covariate})$

preferences analyses, and willingness to pay estimates that addressed other components of the research questions and objectives.

Latent Class Model (LCM). This method divides the sample into several classes of participants with similar patterns of preferences. The LCM provides more insight into the structure of respondent preferences than the MNL model and reduces the negative effects of the IIA axiom (Sawtooth Software, 2021b). In comparison to the HB model which calculates individual utilities, the LCM first identifies subgroups with different preference patterns and then estimates the utilities for each identified subgroup (Orme, 2000).

This study used Lighthouse Studio to probabilistically identify potential learner subgroups with distinct preferences through an LCM. The LCM accounts for preference heterogeneity by probabilistically assigning each respondent to a latent class. The number of latent classes is unknown *a priori* and thus a range must be specified when setting up the analysis. This study began the LC analysis with the assumption that there would be between 1 and 10 classes to provide a range of classes for consideration.

The latent class estimation process used by the software follows four steps (Sawtooth Software, 2021b):

1. Initially, select random estimates of each classes' part-worth utility values.
2. Fit respondents' data to the estimated part-worth utility values of each class to compute the probability of each respondent belonging to each class using a MNL logit equation.
3. Using the probabilities as weights, re-estimate the logit weights for each group. Accumulate the log-likelihood over all groups.
4. Repeat steps 2 to 3 until the log-likelihood fails to improve by the convergence limit or reaches the maximum number of iterations.

Following Sawtooth Software's (2021b) recommendations, the convergence limit for this study was set to 0.01 with a maximum of 100 iterations. Therefore, the process was halted when either of these limits was reached. The calculation was set to repeat 5 times from different starting points to ensure replication.

A challenge of the LCM model is determining the number of classes which must be determined by the researcher. This study began the LC analysis with the assumption that there would be between 1 and 10 classes. The number of subgroups emerging from a data set is determined based on statistical criteria combined with the judgement of the researcher. Suggested statistical methods for determining the most appropriate number of classes include using the Akaike Information Criterion (AIC), consistent AIC (CAIC), and Bayesian Information Criterion (BIC), combined with the judgement of the researcher (Green & Hensher, 2003; Hauber et al., 2016; Sawtooth Software, 2024). In this study, the information criteria are based on the log-likelihood and defined as:

$$AIC = -2 * Log\ Likelihood + 2.0 * (nk + k - 1) \tag{6}$$

$$CAIC = -2\ Log\ Likelihood + (nk + k - 1) * (ln\ N + 1) \tag{7}$$

$$BIC = -2\ Log\ Likelihood + (nk + k - 1) * ln\ N \tag{8}$$

where:

k denotes the number of groups

n is the number of independent parameters estimated per group

N is the total number of choice tasks in the data set (Sawtooth Software, 2021b, pp 11-12)

These information criteria can be used to select the appropriate number of classes by either choosing the model with the lowest values or choosing the model for which the addition of another subgroup leads to a diminished change in the information criteria (Sawtooth Software, 2021b).

To test whether a class solution fits the data better than the null solution, the log likelihood, McFadden's R^2, chi-square[6], and relative chi-square[7] are reported. The number of respondents per class is also reported. Orme and Howell (2009) recommend disqualifying class solutions with less than 10% of respondents in any class.

For the selected class solution, the mean utility estimate, standard error, and *t*-ratio are reported. Next, a Kruskal-Wallis H test was conducted to explore socio-demographic differences between the classes based on age, gender, education level, ethnicity, whether the respondent was born in Canada, income, main activity, and prior familiarity with micro-credentials. This information was combined to create descriptive profiles of potential micro-credential learners.

In this study, the LCM was used to address the research objective concerning the existence of subgroup differences. Class membership was also used to segment the sample for subsequent attribute importance, shares of preference analyses, and willingness to pay estimates.

4.3.3 *Attribute Importance Scores*

From each model and for each attribute, an importance score is calculated using the estimated part-worth utilities. In this study, attribute importance scores are used to address the parts of the research question and objectives concerning the relative impact attributes had on respondents' micro-credential program selection and to help describe differences regarding how subgroups of people select preferred micro-credential programs with the same attributes.

Attribute importance is the difference in the range of an attribute's part-worth utility values. Within each attribute, the difference between the part-worth utility value for the highest

[6] Chi-square for latent class solution *y* is obtained as: $\text{chi-square}_y = 2(\textit{Log Likelihood}_y - \textit{Log Likelihood}_{null})$

[7] Relative chi-square = chi-square_y divided by the number of parameters estimated ($nk + k - 1$).

attribute level is subtracted from the part-worth utility value for the lowest attribute level to obtain the range for the attribute. All attribute utility ranges are then summed to produce a utility range total. The attribute utility range is then divided by the utility range total to produce an importance score for each attribute (Sawtooth Software, 2024). The attribute importance score is given by:

$$Attribute\ Importance_i = \frac{U_i^{Max} - U_i^{Min}}{\sum_i^n (U_i^{Max} - U_i^{Min})} \times 100 \tag{9}$$

Where *Attribute Importance*$_i$ is the relative importance of attribute i, U_i^{Max} is the maximum utility of attribute i, U_i^{Min} is the minimum utility of attribute i, and n is the total number of considered attributes. Attribute importance scores are ratio-scaled and reported as a percentage.

This statistic indicates the relative importance of each attribute in respondents' choices. It signals how much of a difference each attribute can make in the total utility of a micro-credential program. Attribute importance can be analyzed at individual, group, or aggregate levels. Importances depend on the particular attribute levels chosen for the study, changing any attribute or attribute level could cause changes to attribute importance. Thus, importance scores are not comparable across studies.

In this study, attribute importance scores are calculated and reported for attributes using utilities estimated from MNL, HB, and LC models. Attribute importance scores from the HB and LC models were used to address the parts of the research question and objectives concerning the impact attributes have on respondents' selection and to help describe differences regarding how subgroups of people select preferred micro-credential programs with the same attributes.

4.3.4 *Shares of Preference*

Shares of preference represent the percentage of respondents who would prefer to enroll in a given micro-credential program rather than not enroll. While attribute importance scores indicate the relative significance of various attributes, shares of preference analyses reveal how changes in attribute levels (e.g., from online to in-person learning) are expected to influence the percentage of respondents who choose a particular program when all attributes are combined into a program (Orme, 2020). In this study, shares of preference analyses were used to model potential learner responses to micro-credential programs. Two shares of preference analyses were conducted.

The first analysis created four hypothetical micro-credential programs with attributes and levels considered in this study: 1) Best-case scenario, 2) Worst-case scenario, 3) Moderate Scenario A, and 4) Moderate Scenario B. Multiple shares of preference analyses transformed the raw part-worth utility estimates from the HB model into shares of preference for subgroups identified through the latent class analysis and for the total sample. The results show the percentage of respondents who prefer to enroll in the hypothetical programs with the specified attributes and levels rather than not enroll in the program. This analysis demonstrates how various micro-credential programs with different attributes are preferred differently by subgroups of potential learners and the sample.

The second shares of preference analysis was a sensitivity analysis. This analysis was conducted to examine changes in rates of preference for a micro-credential program among potential learners directly resulting from altering the program's attributes. In the sensitivity analysis, the levels of one attribute (e.g., format of instruction) were systematically changed while keeping all other attributes and levels constant. This approach makes it possible to detect how changes in a single attribute affect the preference share. The purpose of this analysis was to isolate and illustrate which specific attributes and levels drive preference decisions.

Both analyses were conducted using Lighthouse Studio's Randomized First Choice (RFC) simulation method, as recommended by Sawtooth Software (2024). This simulation method assumes that respondents typically choose the program with the highest utility but includes random error to account for instances where respondents may select a program with a lower utility. This random error acknowledges the inherent uncertainty in the estimated utility values and integrates it into the simulations (Sawtooth Software, 2024). In the analyses, part-worth utilities are summed across the levels corresponding to each micro-credential program option and then exponentiated and rescaled to sum to 100. Shares of preference analyses help identify and explain the most influential factors driving preference to stakeholder audiences without having to explain part-worth utility values to non-technical audiences (Orme, 2020). Thus, shares of preference help explain the results of a DCE to a wider audience so that they can inform strategic decision-making in program design and marketing.

4.3.5 *Willingness to Pay Estimates*

Willingness to pay (WTP) is the premium potential micro-credential learners would be willing to pay for a micro-credential program attribute. It expresses the part-worth utility in monetary terms, representing the approximate amount respondents are willing to pay to improve the level of an attribute. WTP is another common way of making the results of a DCE easier to understand for non-technical audiences. However, WTP results should be interpreted with caution because WTP estimates do not consider the impact of competition and the WTP value is sometimes higher than what can be expected in a real-world situation (Orme, 2021; 2001).

The WTP for level *m* of attribute *i* is derived by dividing the part-worth utility for the specific attribute level by the value of the price vector:

$$WTP_{im} = \frac{\beta_{im}}{\beta_{cost}} \tag{10}$$

where:

β_{im} is the part-worth utility for level *m* of attribute *i*

β_{cost} is the utility vector for the cost attribute

In this study, the lowest utility level for every attribute was set as the baseline value for WTP in the same attribute, and other levels are reported as differences from the baseline value. WTP is not additive across attributes.

4.4 Ethics Statement

This study was conducted with approval from the University of Toronto Research Ethics Board. Informed consent was obtained from all participants involved in the study (Appendix 2). At the beginning of the survey, the participants indicated consent to the collection and further use of their data by clicking on the answer option to proceed to the survey. In the consent form, participants were provided with further details of the survey, e.g., purpose, duration, benefits, and risks. Contact information was provided for any questions that may arise from participants. Participants were free to stop their participation in the study at any time by closing the survey webpage.

4.5 Participants and Recruitment

The online survey was conducted from February to March 2024. Participants were recruited through a commercial survey recruitment firm that compensated participants in the form of credits that may be collected and redeemed for gift cards. Eligible participants for the survey were residents of Canada between 24 and 64 years of age, who have a high school diploma, the ability to read English, and who provided online informed consent. Quota sampling was applied to reflect the English-speaking population in Canada as determined by the 2021 census (Statistics Canada, 2022).

Chapter 5
Results

The analyses to obtain the results in this chapter were conducted in Lighthouse Studio (version 9.15.9, Sawtooth Software Inc., Provo, UT), IBM SPSS Statistics for Windows (version 29.0.2.0), and Microsoft Excel for Windows (version 2404).

5.1 Characteristics of the Participants

1,399 people opened the online survey, of which 1,207 provided informed consent and reached the end of the survey. The data were cleaned to maximize the precision of utility model estimations for individual participants. More specifically, participants were removed from the sample for patterned responses, failing the reliability task, speeding (< 30% of the median time) (Greszki et al., 2014; Chrzan, 2010), or taking more than three hours to complete the survey. It is assumed that these individuals did not pay sufficient attention to the trade-off between presented attributes and levels in the choice tasks (Allenby et al., 2014; Orme, 2020). The final data set for analysis was comprised of 1,005 individuals. This represents 83.2% of the pre-cleaned sample and is in line with Sawtooth's expectations that 15 – 25% of the sample may need to be discarded (Sawtooth Software, 2024). Characteristics of the sample are depicted in Tables 3 to 5.

Table 3

Characteristics of the Sample Representative of the Canadian Population (N = 1,005)

Characteristics	Frequency in Survey (*N* = 1,005)	% in Survey	% in Canadian Population
Age			
24 – 34 years	**196**	**19.5**	**19.3**
20 – 24 years*	7	0.7	6.0
25 – 34 years	189	18.8	13.3
35 – 44 years	**285**	**28.4**	**13.3**
45 – 54 years	**232**	**23.1**	**12.6**
55 – 64 years	**291**	**29.0**	**14.2**
Prefer not to answer	1	0.1	-
Gender			

Characteristics	Frequency in Survey (*N* = 1,005)	% in Survey	% in Canadian Population
Male	**532**	**52.9**	**48.8**
Female	**468**	**46.6**	**50.8**
Other	**5**	**0.5**	**0.3**
Born in Canada			
Yes	**812**	**80.8**	**74.4**
No	**191**	**19.0**	**25.5**
Prefer not to answer	2	0.2	-
Ethnic identity			
White	**722**	**71.8**	**70.0**
Not white	**255**	**25.4**	**30.0**
Arab	6	0.6	1.9
Black	16	1.6	4.3
Chinese	92	9.2	4.7
Filipino	11	1.1	2.6
Indigenous (First Nations)	18	1.8	5.0
Japanese	9	0.9	0.3
Korean	6	0.6	0.6
Latin American	7	0.7	1.6
South Asian	40	4.0	7.1
Southeast Asian	7	0.7	1.1
West Asian	5	0.5	1.0
Mixed	29	2.9	-
Other	15	1.5	-
Prefer not to answer	22	2.2	-

Note. Participants needed to be at least 24 years of age to meet the study's inclusion criteria. Seven participants, 0.7% of the sample, were 24 years old at the time of the survey. The 20 – 24 age group is 6.0% of the Canadian population (Statistics Canada, 2022).

Chi-square goodness-of-fit tests were performed to determine if the proportion of age, gender, whether a respondent was born in Canada, and whether they identified their ethnicity as white were equally distributed within the sample and Canadian population as of the 2021 National Census (Statistics Canada, 2022). Participants who answered "prefer not to answer" were excluded from chi-square analyses for the question they declined to answer. Some categories were combined for this chi-square and subsequent analyses. The age categories 18 – 24 and 25 – 34 years were combined to create one category, 24 – 34 years. The non-white category was created by combining respondents who answered Arab, Black, Chinese, Filipino, Indigenous, Japanese, Korean, Latin American, South Asian, Southeast Asian, West Asian, mixed, and other. The categories for comparison are presented in bold italics in Table 3. By combining categories subgroups that approached the target of 200 participants per subgroup were obtained. Two subgroups failed to reach the 200-participant threshold, age 24 – 34 years (n = 196) and born outside of Canada (n = 191). However, given these groups' importance to the analysis and that each group contained at least 190 individuals, 95.5% of the target, it was decided to proceed with these subgroups in subsequent analyses with the caveat that the total number of individuals in these groups is less than targeted by the analysis plan. The shares by age [X^2 (4, n = 1,004) = 9.005, p = .061], gender [X^2 (2, N = 1,005) = 0.396, p = .820], whether a respondent was born inside or outside of Canada [X^2 (1, n = 1,003) = 2.157, p = 0.142], and whether the participant identified as white or not white [X^2 (1, n = 977) = 0.752, p = .386] are not statistically different from the national population as of the 2021 National Census (Statistics Canada, 2022) (Table 3).

Table 4

Characteristics of the Sample Not Representative of the Canadian Population (N = 1,005)

Characteristics	**Frequency in Survey (*N* = 1,005)**	**% in Survey**	**% in Canadian Population**
Province			
NL	16	1.6	1.4
PE	6	0.6	0.4
NB	21	2.1	2.6
NS	31	3.1	2.1
QC	29	2.9	23.0
ON	439	43.7	38.5
MB	39	3.9	3.6
SK	39	3.9	3.1
AB	156	15.5	11.5
BC	229	22.8	13.5
Income			
Under $100,000	**429**	**42.7**	**89.2**
Under $10,000	18	1.8	8.3
$10,000 to $19,999	27	2.7	11.8
$20,000 to $29,999	27	2.7	15.9
$30,000 to $39,999	29	2.9	12.7
$40,000 to $49,999	52	5.2	11.3
$50,000 to $59,999	60	6.0	9.2
$60,000 to $69,999	68	6.8	7.1
$70,000 to $79,999	46	4.6	5.4

Characteristics	**Frequency in Survey (*N* = 1,005)**	**% in Survey**	**% in Canadian Population**
$80,000 to $89,999	39	3.9	4.2
$90,000 to $99,999	63	6.3	3.3
Over $100,000	**310**	**30.8**	**10.8**
$100,000 to $149,999	157	15.6	7.2
$150,000 and over	153	15.2	3.6
Prefer not to answer	101	10.0	-
Missing	165	16.4	-
Education			
High school diploma or equivalent	**162**	**5.9**	**26.7**
Post-secondary education	**523**	**52.1**	**48.0**
Trades certificate or diploma	55	3.0	8.7
College, CEGEP, or other non-university certificate or diploma (other than trades certificates or diplomas)	209	15.3	18.8
University certificate or diploma below the bachelor's level	37	3.4	3.0
Bachelor's degree	277	30.4	17.5
Post-graduate degree or certificate	**264**	**26.3**	**9.1**
University certificate, diploma, or degree above a bachelor's degree	49	6.3	1.8
First professional degree	16	2.3	0.7
Master's degree	171	28.1	5.7
Earned doctorate	28	5.1	0.9
Prefer not to answer	1	0.2	-

Examination of the province of residence reveals a statistically significant difference in the sample from the national population as of the 2021 National Census (Statistics Canada, 2022) when Quebec is considered, X^2 (9, N = 1,005) = 27.29, p = .001 (Table 4). Excluding Quebec from the chi-square goodness of fit test allows the sample to be statistically representative of the population's distribution within all other provinces (Statistics Canada, 2022), X^2 (8, n = 976) = 9.43, p = .307. The low response rate from Quebec residents is possibly rooted in the survey's exclusive availability in English, which may have deterred or prohibited participation among Quebec's predominantly Francophone population.

Participants' income and education level are not representative of the Canadian population, X^2 (11, n = 840) = 36.47, p = .0001 and X^2 (8, n = 1,004) = 39.394, p = .0000 respectively. Higher levels of education and income are present in the sample (Table 4).

However, given the target market for micro-credentials are those with higher income and at least one post-secondary credential (Pichette & Courts, 2024; Asthana et al., 2023; Kernohan, 2023) and most adult learners are highly educated and have a higher income (OECD, 2020; 2023a), over-representation of these categories in the sample is more representative of potential micro-credential learners offered by Canadian post-secondary institutions. The sample is not statistically representative of all socio-demographic characteristics found within Canada as of the 2021 National Census (Statistics Canada, 2022), but the sample is highly comparable to the population of Canada excluding Quebec and the Territories and appears to be similar to the target market for micro-credentials (Pichette & Courts, 2024).

Table 5

Characteristics of the Sample

Demographic Characteristics	**Frequency in Survey (*N* = 1,005)**	**% in Survey**
Prior familiarity with micro-credentials		
Yes	**318**	**31.4**
No	**642**	**63.9**
Not sure	45	4.5
Time since full-time student		
Less than 10 years	**229**	**22.8**
Less than 5 months ago	17	1.7
6 months – 1 year ago	10	1.0
2 – 4 years ago	108	10.7
5 – 9 years ago	94	9.4
10 years or more	**760**	**75.6**
10 – 19 years ago	232	23.1
20 – 29 years ago	226	22.5
30 – 39 years ago	187	18.6
40 or more years ago	115	11.4
Prefer not to answer	16	1.6
Main activity		
Working at a job or business	**643**	**66.8**
Not working at a job or business	**295**	**29.4**
Looking for work	45	4.7
Going to school	12	1.2
Family responsibilities	61	6.3
Maternity or parental leave	3	0.3
Own illness or disability	69	7.2
Travelling	11	1.1
Volunteering	17	1.8

Demographic Characteristics	Frequency in Survey (*N* = 1,005)	% in Survey
Other	77	8.0
Prefer not to answer	24	2.5
Field of work (education or training)		
Art, culture, recreation, and sport	44	4.7
Business, finance, and administration	139	14.7
Education	82	8.7
Farming	4	0.4
Healthcare	92	9.8
Management	53	5.6
Manufacturing and processing	33	3.5
Natural and applied sciences	24	2.5
Sales and customer service	73	7.7
Skilled trades and transportation	64	6.8
Social sciences and religion	20	2.1
Telecommunications and information technology	77	8.2
Other	198	21.0
Prefer not to answer	40	4.2

Additional information about the sample, prior familiarity with micro-credentials, length of time since the respondent was a full-time student, main activity, and field of work by education or training are presented in Table 5. Notably, 31.4% of respondents indicated some prior familiarity with micro-credentials.

5.2 Conjoint Analysis

5.2.1 *Counts*

The counting analysis revealed statistically significant main effects for all attributes: format of instruction, total hours of work to complete the program, time commitment, reputation of the provider, connections to employers and other programs for graduates, reimbursement available, and cost. The within-attribute chi-squared test indicates that levels of these attributes differed significantly in their frequency of choice and are thus appropriate for further analysis. If the within-attribute test did not differ significantly, the survey design would be unable to be analyzed with conjoint methodologies, MNL, HB, and LCA, and could indicate that the selected attributes and levels were inappropriate or a technical issue with the survey's administration. This was not the case. All attributes were statistically significant at < .01.

Table 6

Counting Analysis of Main Effects

Attribute	Within Attribute Chi-square	Significance	Proportion
Format of instruction	47.55	< .01	-
In-person			0.44
Blended			0.52
Online			0.55
Total hours of work to complete the program	69.38	< .01	-
1 – 15 hours			0.58
16 – 50 hours			0.54
51 – 100 hours			0.50
101 – 240 hours			0.46
241+ hours			0.42
Time commitment	57.89	< .01	-
Part-time study			0.54
Full-time study			0.43
Flexible, self-paced study			0.54
Reputation of the provider	277.26	< .01	-
Fair			0.35
Good			0.52
Excellent			0.63
Connections to employers and other programs for graduates	189.26	< .01	-
No connections			0.38
Advanced placement and preferred admission to other post-secondary programs			0.51
Employers recruit program graduates			0.61
Reimbursement available	167.94	< .01	-
No reimbursement			0.39
Partial			0.50
Full			0.61
Cost	323.91	< .01	-
$500			0.64
$1,000			0.59
$2,000			0.46
$4,000			0.31

5.2.2 *Multinomial Logit Model*

The part-worth utility values in the multinomial logit (MNL) model were calculated for each level so that the values best match the choices made by respondents. In this study, the MNL was created to give a first indication of the main effects of the attributes with their corresponding levels.

Utilities represent the relative desirability of each attribute's level. A negative utility score indicates that the defined level deters respondents from selecting the micro-credential program in which it appears, whereas a positive utility score implies that the attribute level makes the micro-credential program more desirable. A larger absolute utility value indicates a greater relative influence of each attribute on respondents' choices and is represented by the importance score. A higher importance score signals a greater influence of the attribute on respondents' choices of micro-credential programs.

Table 7 shows the estimated part-worth utilities for attribute levels and the relative importance of different micro-credential program attributes estimated by the MNL model. The most important attribute is cost (23.24%) followed by the reputation of the provider (19.87%). These two attributes cover over 40% of the total importance, indicating that, on average, these attributes are major determinants of micro-credential program choice for potential learners. By comparison, time commitment (7.61%) and format of instruction (7.97%) appear, on average, to be of lower relative importance to potential micro-credential learners.

Table 7 also presents zero-centered part-worth utility scores derived from the MNL model which are important because utilities show how desirable each attribute level is. Within each attribute, the least desirable option receives a negative value, and the most desirable option receives a positive value. For example, online learning (0.197) is preferred over in-person learning (-0.236), and part-time learning (0.155) is preferred over full-time learning (-0.258). While "partial reimbursement" receives a negative utility value, this does not necessarily indicate that it was an unattractive option. Instead, the negative utility value indicates that all else being equal, potential learners are more likely to choose or favour "full reimbursement." The utility for cost is negative (-0.360), which means that potential learners prefer lower-cost programs.

Table 7

Estimated Attribute Importance and Part-worth Utilities Based on the MNL Model

Attribute	Importance	Utility	Std. Error	*t*-ratio
Format of instruction	**7.97%**			
In-person		-0.236	0.025	-9.264*
Blended		0.039	0.025	1.592
Online		0.197	0.025	7.959*
Total hours of work to complete the program	**11.17%**			
1 – 15 hours		0.290	0.035	8.186*
16 – 50 hours		0.162	0.035	4.648*
51 – 100 hours		0.021	0.036	0.576*
101 – 240 hours		-0.156	0.036	-4.289*
241+ hours		-0.317	0.037	-8.524*
Time commitment	**7.61%**			
Part-time study		0.155	0.025	6.152*
Full-time study		-0.258	0.025	-10.109*
Flexible, self-paced study		0.102	0.025	4.120*
Reputation of the provider	**19.87%**			
Fair		-0.601	0.027	-22.263*
Good		0.124	0.025	4.940*
Excellent		0.477	0.025	19.213*
Connections to employers and other programs for graduates	**15.88%**			
No connections		-0.445	0.026	-16.821*
Advanced placement and preferred admission to other post-secondary programs		0.028	0.025	1.111
Employers recruit program graduates		0.417	0.025	16.697*
Reimbursement available	**14.26%**			
No reimbursement		-0.380	0.026	-14.472*
Partial		-0.014	0.025	-0.562

Attribute		Importance	Utility	Std. Error	*t*-ratio
	Full		0.394	0.025	15.796*
Cost (Importance)		**23.24%**			
Cost (Utility)			-0.360	0.014	-25.151*
None			0.909	0.022	40.987*

Note. p < .05 for t-ratios greater than 1.96 or less than -1.96.

The MNL model corroborates results from the counting analysis by again indicating that respondent choices for micro-credential program options were significantly affected by attribute levels [X^2 (17, N = 1,005) = 3,534.97, p = .0000]. The *t*-ratios for all but three levels are statistically significant. The *t*-ratio indicates whether a utility value is different from zero. However, Orme (2020) cautions against relying too heavily upon these ratios because utilities are calculated using a zero-centered approach, meaning that the *t*-ratios primarily indicate if the utilities are significantly different from zero and not if the levels significantly impact choice decisions. While the utility and importance results of the model, Table 7, suggest some common preferences within the sample, the magnitude of the effect is most likely over or understated because the MNL model does not account for heterogeneity (differences in tastes) as evidenced by higher values of standard error within some attributes, namely the attribute total hours of work to complete the program (Table 7), and overall indicators of model fit, Table 8.

Table 8

Overall Significance of the MNL Model

Iteration		Chi-square	Fit Statistic (RLH)
	1	3412.83	0.43
	2	3534.25	0.44
	3	3534.97	0.44
	4	3534.97	0.44
	5	3534.97	0.44
Log-likelihood for this model		-11,446.66	
Log-likelihood for null model		-13,214.15	

Iteration	Chi-square	Fit Statistic (RLH)
Difference	1,767.48	
McFadden's R^2	0.13	
Chi-square	3,534.97	
Degrees of freedom	17	
***p*-value**	0.00000	

The log-likelihood for this model is -11,446.66. This is statistically significantly different from the value of the null model (-13,214.15), indicating the MNL model predicts choices significantly better than the null model. However, a second measure to determine goodness of fit is McFadden's R^2 in which values range between 0 and 1.[8] Values exceeding 0.2 to 0.4 are considered acceptable (McFadden, 1981). Although the model significantly differs from the null model, its fit (McFadden $R^2 = 0.13$) relative to the McFadden R^2 benchmark does not exceed the minimum threshold of 0.2. A third indicator of model fit is the root likelihood (RLH). RLH is the geometric mean of the likelihood of each alternative within a choice task being selected and ranges from $1/n$ (worst fit) to 1 (best fit), where n is the number of alternatives per choice task. In this study, an RLH of less than 0.5 would indicate no model fit. The RLH of 0.44 is an additional indicator of the MNL model's poor fit to the data.

Although the indicators of poor model fit from the MNL model might appear concerning, such outcomes are expected in analyses where heterogeneous preferences among respondents are not adequately captured by the model. Averaging all respondents' preferences into a single model can lead to inaccuracies and higher error rates if there are diverse preferences among respondents or subgroups that the model is unable to capture. Models that

[8] Also called Pseudo R^2 or reported as percent certainty (McFadden R^2 x 100) in Sawtooth Software outputs.

can capture diverse preferences include HB and LC models. The results from these two models are described next. The MNL model was not retained for further analysis.

5.2.3 *Hierarchical Bayes Model*

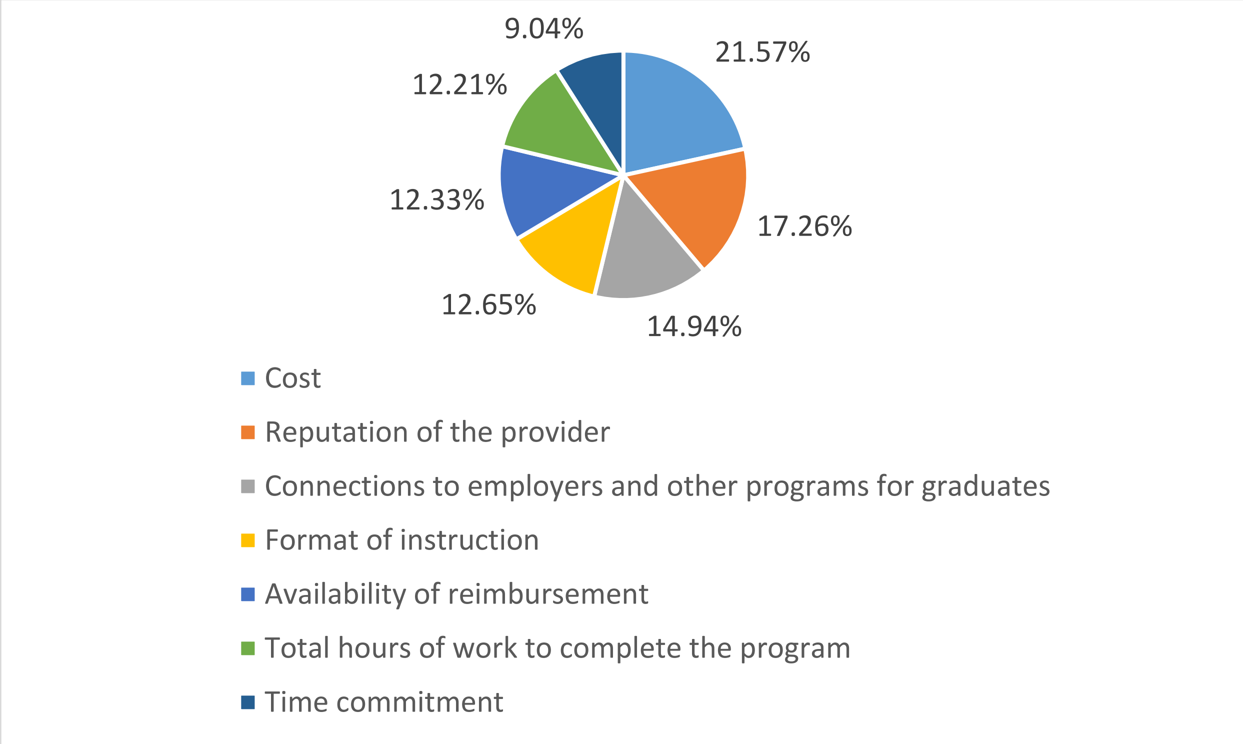
A hierarchical Bayes (HB) model can model preference heterogeneity and therefore account for diverse choice behaviour. By considering the preference of each respondent, the model calculates individual-level part-worth utilities for the different levels of the seven attributes. Each respondent's utilities are then used to calculate individual-level attribute importance scores. For presentation, individual-level part-worth utilities and importance scores are averaged.

The HB model was run using default alpha parameters and 20,000 iterations of the algorithm, the first 10,000 of which were discarded as stabilization iterations used for convergence. Two goodness of fit measures, the average root-likelihood (RLH) and McFadden's R^2 scores were respectively 0.642 and 0.538 and indicate acceptable model fit (McFadden, 1981). As expected, the HB model outperformed the MNL model in terms of model fit. These fit measures indicate that the utility estimates generated by the HB model are more accurate than those produced by the MNL model.

Figure 2 shows the mean importance scores for the micro-credential attributes. Estimated utilities and importance scores are also summarized in Table 10. On average, cost was the most important factor for the micro-credential program choice decisions (21.57%) and was followed in hierarchical order by reputation of the provider (17.26%), connections for program graduates (14.94%), format of instruction (12.65%), reimbursement available (12.33%), total hours to complete the program (12.21%), and weekly time commitment (9.04%).

Figure 3

Importance Scores for Micro-credential Program Attributes



A one-factor ANOVA with repeated measures was performed to assess whether differences in the attribute importance score was statistically significant. Mauchly's test indicated that the assumption of sphericity was violated, $X^2(20) = 1{,}860.34$, $p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .62$). The results show a statistically significant difference between importance scores, F (3.73, 3,741.65) = 280.89, $p = <0.01$, partial $\eta^2 = 0.22$.

Post-hoc pairwise comparisons with a Bonferroni adjustment revealed that 18 out of 21 pairwise differences were statistically significant (Table 9). The following pairs were not statistically different, suggesting that any observed differences may have been influenced by factors such as sampling variability or measurement error, or that these pairs were perceived as similarly important by respondents.

- Format of instruction – total hours of work to complete the program
- Format of instruction – reimbursement available
- Total hours of work to complete the program – reimbursement available.

Table 9

Post-Hoc Pairwise Comparison of Attribute Importances

Attribute	Attribute	Mean Diff.	Std. Error	*p*	Lower 95% CI	Upper 95% CI
Format of instruction	Total hours of work to complete the program	0.03	0.32	0.10	-0.59	0.66
	Time commitment	3.34	0.24	<.001	2.87	3.81
	Reputation of the provider	-5.00	0.39	<.001	-5.77	-4.23
	Connections to employers and other programs for graduates	-2.43	0.38	<.001	-3.17	-1.68
	Reimbursement available	0.19	0.35	0.55	-0.49	0.88
	Cost	-9.05	0.46	<.001	-9.96	-8.14
Total hours of work to complete the program	Time commitment	3.31	0.23	<.001	2.86	3.75
	Reputation of the provider	5.03	0.36	<.001	-5.74	-4.33
	Connections to employers and other programs for graduates	-2.46	0.34	<.001	-3.13	-1.78
	Reimbursement available	0.16	0.29	0.55	-0.41	0.74
	Cost	-9.08	0.37	<.001	-9.81	-8.35
Time commitment	Reputation of the provider	-8.34	0.31	<.001	-8.95	-7.73
	Connections to employers and other programs for graduates	-5.76	0.30	<.001	-6.34	-5.18
	Reimbursement available	-3.15	0.27	<.001	-3.68	-2.61
	Cost	-12.39	0.39	<.001	-13.15	-11.63
Reputation of the provider	Connections to employers and other programs for graduates	2.58	0.25	<.001	2.08	3.08
	Reimbursement available	5.20	0.22	<.001	4.77	5.63
	Cost	-4.05	0.46	<.001	-4.95	-3.15
Connections to employers and other programs for graduates	Reimbursement available	2.62	0.26	<.001	2.10	3.13
	Cost	-6.63	0.48	<.001	-7.57	-5.68
Reimbursement available	Cost	-9.24	0.39	<.001	-10.01	-8.48

Three attributes, cost, reputation of the provider, and connections for program graduates contribute more than 50% towards a choice for a micro-credential program. The remaining four attributes, on average, contribute to a more limited extent toward a preference for a micro-credential program. The three statistically insignificant pairwise comparison attributes together contribute 37.2% towards the choice of a micro-credential program.

Table 10

Estimated Average Importances and Attribute Part-worth Utilities Based on the HB Model

Attribute	Importance	Utility	Std. Deviation	Lower 95% CI	Upper 95% CI
Format of instruction	**12.65%**		**8.18**	**12.14**	**13.15**
In-person		-24.46	44.12	-27.18	-21.73
Blended		5.22	15.78	4.24	6.19
Online		19.24	50.75	16.1	22.38
Total hours of work to complete the program	**12.21%**		**5.76**	**11.86**	**12.57**
1 – 15 hours		32.06	30.61	30.17	33.96
16 – 50 hours		17.73	22.82	16.32	19.14
51 – 100 hours		-1.16	18.99	-2.33	0.02
101 – 240 hours		-15.14	28.51	-16.9	-13.38
241+ hours		-33.5	28.94	-35.29	-31.71
Time commitment	**9.04%**		**4.63**	**8.75**	**9.32**
Part-time study		15.81	18.35	14.67	16.94
Full-time study		-31.31	23.74	-32.78	-29.84
Flexible, self-paced study		15.50	20.75	14.22	16.79
Reputation of the provider	**17.26%**		**7.05**	**16.82**	**17.69**
Fair		-68.49	29.04	-70.29	-66.7
Good		16.18	13.20	15.36	16.99
Excellent		52.32	21.51	50.99	53.65
Connections to employers and other programs for graduates	**14.94%**		**7.28**	**14.49**	**15.39**
No connections		-47.78	35.16	-49.95	-45.60
Advanced placement and preferred admission to other post-secondary programs		3.21	19.94	1.97	4.44
Employers recruit program graduates		44.57	34.48	42.44	46.70
Reimbursement available	**12.33%**		**5.41**	**12.00**	**12.67**
No reimbursement		-42.15	18.01	-43.26	-41.03
Partial		-2.04	10.48	-2.68	-1.39
Full		44.18	21.18	42.87	45.49
Cost (Importance)	**21.57%**		**10.35**	**20.93**	**22.21**
Cost (Utility)		-40.24	25.65	-41.76	-38.59
None		110.57	193.25	98.62	122.52

In addition to attribute importance, part-worth utility estimates from the HB model indicate the relative preferences potential learners associate with specific micro-credential program characteristics (Table 10). Part-worth utility estimates are zero-centred to enable within-attribute comparisons. Results show that respondents prefer programs with a lower cost.

They also show respondents prefer providers with an excellent reputation (52.32), which is associated with the highest level of utility, over those with a good reputation (16.18). Providers with a fair reputation were not preferred (-68.49). Respondents strongly preferred micro-credential programs with external connections, specifically those with a higher preference for micro-credential programs from which employers recruited program graduates (44.57) rather than for those that enabled advanced placement or preferred admissions to other programs (3.21). Micro-credential programs with no external connections were not preferred (-47.78). Online programs (19.24) were preferred by respondents over blended (5.22) and in-person (-24.46) programs. Additionally, respondents preferred micro-credential programs from which full reimbursement (44.18) was possible over micro-credential programs offering partial reimbursement (-2.04) or no reimbursement (-42.15). Also favoured were shorter micro-credential programs, requiring 1 to 15 hours (32.06) or 16 to 50 hours (17.73) of estimated work to complete the program. Longer micro-credentials programs requiring 51 to 100 (-1.16), 101 to 240 (-15.14), or 241 or more hours of work (-33.50) were less preferred. Weekly time commitment was the weakest driver of choice. Yet, respondents still identified their preference for micro-credential programs taken on a part-time (15.81) or flexible (15.50) schedule over micro-credential programs taken on a full-time basis (-31.31). The mean intercept for the potential learner’s decision threshold, the none parameter, is high and positive (110.57). This value represents the point at which enrolling in a micro-credential program has more utility than not enrolling in a micro-credential program. The sum of a program’s utilities must have a positive magnitude greater than the none threshold for a potential learner to enroll in the micro-credential program. Notably, the none parameter has a high standard deviation. This indicates that there could be substantial variation in preference for enrolment in a preferred micro-credential program among respondents. Bayesian tests for group differences were conducted to determine if preference differences could be accounted for by socio-demographic factors.

Bayesian tests of difference evaluate the degree of confidence that the part-worth utility for a particular attribute is greater for one group compared to another group. This study used Bayesian tests for subgroup differences to investigate whether preference differences could be explained by five socio-demographic characteristics: age, education, ethnicity, gender, and whether the respondent was born in Canada.

To create sufficient category sizes for tests of group difference, the age categories 18 – 24 and 25 – 34 years were combined to create one category, 24 – 34 years. As was done for the chi-square analyses of participant characteristics, categories for ethnic identity were white and not white. In this analysis only, those who described their gender as “other” were excluded due to too small a category size for meaningful statistical interpretation and no option for meaningfully combining these respondents with another category. Excluding this category does not mean to say that this category of respondents is not of interest to this analysis but is a consequence of a very small category size for this demographic group. The education categories, trades certificate or diploma, College, CEGEP, or other non-university certificate or diploma, university certificate or diploma below the bachelor’s level, and bachelor’s degree were combined to create the category post-secondary education. The post-graduate degree or certificate category was created by combining university certificate, diploma, or degree above a bachelor’s degree, first professional degree, master’s degree, and earned doctorate. Participants who answered “prefer not to answer” to the age, education, ethnicity, and whether they were born in Canada questions were also excluded from this analysis (n = 26). This made up approximately 2.6% of the sample. A total of 31 respondents were omitted from the sample

(3.1%). The reference categories were as follows: age: 24 – 34 years, gender: male, education: high-school diploma or equivalent, ethnicity: white, and born in Canada: yes.

Bayesian tests for differences (Orme & Chrzan, 2017) revealed minimal statistically significant variations in utility scores among learner subgroups based on age, gender, ethnicity, and whether they were born inside or outside of Canada. Statistically significant differences occurred in the socio-demographic categories of ethnic identity and whether a respondent was born in Canada. Complete data tables are available in Appendix 3. Non-white respondents displayed a higher preference for post-secondary institutions with good reputations (25.73 versus 17.0 for white respondents), greater disutility for programs lacking external connections (-58.20 versus -39.59), and stronger preferences for micro-credential programs linked to employers (55.27 versus 38.05). Additionally, respondents born outside of Canada viewed blended learning programs more negatively (-1.73) compared to those born in Canada (6.22).

Significant differences emerged based on education levels. Respondents with a high school diploma preferred blended learning programs less (-9.54) than those with post-secondary (7.45) or graduate degrees (7.82). They preferred shorter programs (1 – 15 hours = 49.11) and disliked longer programs (101 – 240 hours = -20.21). They also showed greater aversion to programs without external connections for graduates (-49.62) and were more sensitive to program costs (-51.30 compared to -41.89 for post-secondary and -25.74 for graduate degree holders). Respondents with post-secondary education had the least preference for full-time study (-36.90), while those with graduate degrees showed significant disutility for micro-credential programs offering advanced placement or preferred admissions to other post-secondary programs (-11.33 versus 6.82 for post-secondary and 6.04 for high school diploma holders). Complete data tables are available in Appendix 3.

Despite these findings, adding the five socio-demographic covariates did not significantly improve model fit (RLH = 0.652 and McFadden's R^2 = 0.554 for the HB model with covariates). Given the diversity of taste preferences within the socio-demographic categories examined, LCA was used to identify subgroups based on preference patterns rather than socio-demographic characteristics. The utility estimates from the base Hierarchical Bayes (HB) model, which did not include covariates, were retained for future market simulations.

5.2.4 *Latent Class Model*

The latent class analysis (LCA) identifies segments in the data based on respondents' preferences for micro-credential program characteristics, grouping individuals into homogenous preference classes and reporting a probability of class membership for each respondent. In this study, LCA used the individual utility profiles created as respondents answered the DCE tasks in the survey to probabilistically assign an individual to one of several latent classes. Rather than rely on socio-demographic characteristics, LCA relies on patterns of decision-making behaviour.

Latent class models (LCMs) with one to ten maximum likelihood solutions were estimated and replicated three times from random starting numbers; ensuring that a solution reflected an accurate estimate. The one-group solution is identical to the MNL model solution reported earlier and is included here for comparison purposes. The number of classes was determined based on increases in the goodness of fit of the models, Table 11, and the number of participants in each class, Table 12.

Table 11

Summary of the Best Replications for the Latent Class Analysis

Group	Log-likelihood	McFadden R^2	AIC	CAIC	BIC	Chi-square	Relative Chi-square
1 (MNL model)	-11,446.70	0.138	22,925.33	23,061.82	23,045.82	3,534.97	220.94
2	-10,101.50	0.236	20,268.90	20,550.40	20,517.40	6,225.40	188.65
3	-9,862.47	0.254	19,824.94	20,251.47	20,201.47	6,703.35	134.07
4	-9,759.58	0.261	19,653.15	20,224.69	20,157.69	6,909.15	103.12
5	-9,687.29	0.267	19,542.58	20,259.14	20,175.14	7,053.72	83.97
6	-9,626.61	0.272	19,455.22	20,316.80	20,215.80	7,175.08	71.04
7	-9,578.65	0.275	19,393.30	20,399.89	20,281.89	7,271.00	61.62
8	-9,543.23	0.278	19,356.46	20,508.07	20,373.07	7,341.84	54.38
9	-9,498.21	0.281	19,300.42	20,597.05	20,445.05	7,431.87	48.89
10	-9,466.69	0.284	19,271.37	20,713.02	20,544.02	7,494.92	44.35

To determine the optimal number of classes in the sample, the model with the minimum Akaike information criterion (AIC), consistent AIC (CAIC), and Bayesian information criterion (BIC) are generally preferred (Sawtooth Software, 2021b). In this study, this would be the solution with four classes (BIC = 20,157.69; CAIC = 20,224.69) or ten classes (AIC = 19,271.37). However, an inflection point is a better indicator of the optimal number of classes than the absolute magnitude of the scores (Sawtooth Software, 2021b). In this analysis, the results show a larger decrease in AIC values from a one-class solution to a two-class solution, and again from a three-class solution. Beyond that, the decrease is much smaller. The higher the number of classes, the better the model fit as indicated by log likelihood values, McFadden's R^2 values, chi-square, and relative chi-square statistics. The log likelihood and relative chi-square values decrease as model complexity increases. McFadden's R^2 and chi-square values also increase as model complexity increases. As above, an inflection point at the four-class solution is observed for the log likelihood, McFadden's R^2, and chi-square values which points to four classes being the appropriate number of classes. It is also recommended to remove solutions with small class sizes (< 10%) (Orme & Howell, 2009). Considering the obtained class sizes, Table 12, the seven, eight, nine, and ten-class solutions contain small class sizes and thus can be disqualified. The goodness of fit of the four-class solution (McFadden R^2 = 0.261) is acceptable

(McFadden, 1981) and larger than the MNL model (0.138), indicating an improved fit. Taken together, these analyses support a four-class solution.

Table 12

Latent Class Analysis Segment Sizes

	Class Size (%)									
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	100.0									
2	39.3	60.7								
3	22.9	28.7	48.3							
4	30.5	17.5	29.2	22.7						
5	23.4	18.0	12.1	18.0	28.6					
6	16.9	10.4	28.0	19.8	10.7	14.2				
7	17.4	11.8	9.7	16.5	19.7	14.3	10.6			
8	11.8	13.1	7.8	10.4	13.9	9.7	15.4	17.9		
9	13.5	13.1	10.4	9.1	8.2	11.3	11.7	9.2	13.5	
10	9.8	14.	11.4	4.5	5.9	7.8	16.7	5.4	9.8	14.9

Preference Differences Between the Classes. The latent profile analysis shown in Table 13 reveals clear differences between classes in the attributes and levels that affect potential learner decision-making for micro-credential programs. The four classes are: 1) Knowledge seekers (22.7%, n = 225); 2) Convenience learners (30.5%, n = 332); 3) Online opposers (17.5%, n = 158); and 4) Disinclined and skeptical (29.2%, n = 290). The names denoting each class are figurative and created to best describe each class's uniqueness based on their distinct attributes and levels revealed by LCA.

Table 13

Importances and Part-worth Utilities of Attributes (Zero-centered Differences) per Class

Attribute		Class 1 **Knowledge Seekers (22.7%)**	Class 2 **Convenience Learners (30.5%)**	Class 3 **Online Opposers (17.5%)**	Class 4 **Disinclined and Skeptical (29.2%)**
Format of instruction		**6.68%**	**14.98%**	**20.80%**	**6.63%**
	In-person	-31.01	-52.78	70.88	-27.28
	Blended	15.73	0.69	3.80	8.15
	Online	15.28	52.09	-74.68	19.13

Attribute	Class 1 **Knowledge Seekers (22.7%)**	Class 2 **Convenience Learners (30.5%)**	Class 3 **Online Opposers (17.5%)**	Class 4 **Disinclined and Skeptical (29.2%)**
Total hours of work to complete the program	**9.75%**	**8.96%**	**12.51%**	**14.92%**
1 – 15 hours	34.60	27.38	39.79	53.29
16 – 50 hours	28.97	16.78	-0.02	25.85
51 – 100 hours	-15.41	8.07	21.43	-4.24
101 – 240 hours	-14.54	-16.90	-13.40	-23.73
241+ hours	-33.63	-35.33	-47.80	-51.17
Time commitment	**5.44%**	**8.41%**	**9.82%**	**7.54%**
Part-time study	15.83	16.41	37.90	17.45
Full-time study	-22.25	-37.65	-30.83	-35.11
Flexible, self-paced study	6.42	21.24	-7.07	17.66
Reputation of the provider	**20.67%**	**19.35%**	**14.28%**	**18.50%**
Fair	-78.03	-75.89	-56.60	-72.82
Good	11.36	16.37	13.22	16.15
Excellent	66.67	59.53	43.38	56.67
Connections to employers and other programs for graduates	**19.48%**	**16.17%**	**9.66%**	**11.85%**
No connections	-68.45	-58.72	-31.17	-45.28
Advanced placement and preferred admission to other post-secondary programs	0.51	4.22	-5.26	7.62
Employers recruit program graduates	67.94	54.50	36.43	37.66
Reimbursement available	**16.72%**	**10.23%**	**16.91%**	**15.83%**
No reimbursement	-61.11	-31.64	-64.23	-51.07
Partial	5.16	-8.32	10.06	-8.65
Full	55.95	39.97	54.17	59.72
Cost (Importance)	**21.26%**	**21.90%**	**16.02%**	**24.73%**
Cost (Utility)	-42.51	-43.80	-32.04	-49.47
None	-203.53	60.66	173.40	482.49

The LCA identified four meaningful and unique preference-based segments: one focused on future employment prospects, one on program convenience, one on the format of instruction, and one on personal value. Each of these is described in greater detail after the section describing socio-demographic differences between classes below.

Socio-demographic Differences Between Classes. Kruskal-Wallis H test[9] was conducted to explore whether there are meaningful differences among potential learners in the four classes. Socio-demographic information collected by the survey questions was used in this analysis. The same demographic categories created for the Bayesian tests of socio-demographic group difference were used for this analysis. The dominant socio-demographic characteristics for the variables and mean rank of pairs found to be statistically different are presented in Table 14. No differences between the potential learners' preferences were found based on their ethnicity or whether the respondent was born in Canada. However, the age, gender, and education level, income, main activity, and prior familiarity with micro-credentials did differentiate the populations of the members in each of the latent classes.

Table 14

Dominant Demographic Characteristics by Latent Class (%)

Demographic Characteristic	Class 1 **Knowledge Seekers (22.7%)**	Class 2 **Convenience Learners (30.5%)**	Class 3 **Online Opposers (17.5%)**	Class 4 **Disinclined and Skeptical (29.2%)**	**Kruskal-Wallis H Test**
Age	35 - 44 years 32.4[b]	35 – 44 years 33.4[b]	24 – 34 years 48.1[a]	55 – 64 years 37.6[b]	55.12**
Gender	Male 57.4[b]	Female 57.6[a]	Male 69.6[b]	Male 53.3[b]	34.05**
Education level	Post-secondary education 63.1[b]	Post-secondary education 61.1[b]	Post-graduate degree or certificate 50.6[a]	Post-secondary education 59.7[b]	46.87**
Ethnicity	White 66.2	White 71.1	White 78.5	White 73.4	7.41
Born in Canada	Yes 76.4	Yes 83.6	Yes 83.5	Yes 80.0	4.66

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[9] Skewness and kurtosis values confirmed importance and part worth utility scores were not normally distributed. As a result, the Kruskal Wallis H test was used in place of one-way ANOVAs to detect significant differences between classes of respondents. To lower the probability of committing a type I error, a Bonferroni correction of was applied.

Demographic Characteristic	Class 1 **Knowledge Seekers (22.7%)**	Class 2 **Convenience Learners (30.5%)**	Class 3 **Online Opposers (17.5%)**	Class 4 **Disinclined and Skeptical (29.2%)**	**Kruskal-Wallis H Test**
Income	Under $100,000 64.4[b]	Under $100,000 64.9[b]	Over $100,000 62.9[a]	Under $100,000 57.3[b]	29.85**
Main activity	Working at a job or business 62.0[b]	Working at a job or business 75.2[a]	Working at a job or business 69.0	Working at a job or business 65.9	11.80**
Prior familiarity with micro-credentials	No 67.1[b]	No 56.3[b]	Yes 54.4[b]	No 80.3[a]	78.79**

** p < .001
Note: Significant results are reported between most different groups with a superscript (such that group characteristics identified with a superscript a are statistically different from groups indicated with a superscript b.

Description of the Latent Classes. The LCA preference information and socio-demographic information were combined to produce four descriptive profiles of potential learners.

Class 1 – Knowledge Seekers (22.7%). One characteristic feature of knowledge seekers was the importance of connections to employers and other programs for graduates (19.48%) and the lowest relevance for time commitment (5.44%) compared to the other three classes. Micro-credential program cost (21.26%) was the most important attribute for knowledge seekers relative to all other attributes. Concerning the part-worth utilities of the different attribute levels, this class yielded the highest scores among classes for employers to recruit program graduates (67.94) and for a micro-credential provider with an excellent reputation (66.67). This class also expressed the least desire for a program with no external connections (-68.45) and a micro-credential from a provider with the lowest reputation level presented, fair (-78.03). Very low importance was given to time commitment, but full-time programs were least preferred. Most notably among classes, the knowledge seekers have the lowest decision threshold to enroll in a micro-credential program as evidenced by the negative value for the dual-response none-option (-203.53). This suggests that knowledge seekers are very willing to enroll in their preferred micro-credential program: The point at which not enrolling in a micro-credential program provides less value than enrolling is very low for this class. This class is mainly comprised of individuals between 34 and 44 years of age (32.4%). Nearly 80% of people in this class have some form of post-secondary education (63.1% have a post-secondary degree and 24.4% have a post-graduate degree or certificate), 62.0% are working at a job or business, and 64.4% of people within this class report having an income under $100,000. This class is 22.7% of the population.

Class 2 – Convenience Learners (30.5%). Total hours of work to complete the program (8.96%) and the availability of reimbursement (10.23%) were relatively not important to convenience learners compared to other classes. Conversely, program cost (21.90%) was the most important attribute relative to all other attributes. Convenience learners exhibited the highest part-worth utility scores among classes for online learning (52.09) and flexible, self-paced study (21.24). The class strongly rejected full-time study (-52.78) as the format of instruction. Convenience learners were slightly more willing to accept a good provider (16.37) than other classes, although they strongly rejected providers with a fair reputation (-75.89). While preferring full reimbursement (39.97) over no reimbursement (-31.64) or partial reimbursement (-8.32), the part-worth utility value for full reimbursement among convenience learners is the lowest for all classes. A low positive utility for the dual response none option (60.66) suggests that members of this class will decide to enroll in a micro-credential program only if its program characteristics closely meet their preferred micro-credential program choice characteristics. Compared to the rest of the survey population, these potential learners in this class are more likely to be female (57.6% of class membership) and are most likely to be working at a job or for a business (75.2% of class membership). This is the largest class (30.5%) within the population.

Class 3 – Online Opposers (17.5%). A distinguishing trait of class 3, online opposers, is the very high importance of instructional format (20.80%) compared to other classes. This class has an extreme preference for in-person instruction (70.88) and rejects online learning (-74.68). Because of the importance placed on the format of instruction by members of this class, other attributes are less important compared to other classes. The three most important attributes for this class in descending order are instructional format (20.80%), availability of reimbursement (16.91%), and program cost (16.02%). The reputation of the provider (14.24%) ranked fourth in importance for online opposers, whereas other classes ranked a provider's reputation as the second most important attribute. Online opposers also indicated very low importance for connections to employers and other programs for graduates (9.66%) relative to the other classes. As indicated by the part-worth utilities of the different attribute levels, in addition to an extreme preference for in-person learning, this class exhibited a high value for programs lasting 1 to 15 hours (39.79) or 51 to 100 hours (21.43) as well as part-time study (37.90). The sole class to have a negative utility for online learning, online opposers are also the only class to have a disutility for micro-credential programs lasting 16 to 50 hours (-0.02), those that permit flexible self-paced study (-7.07), and micro-credential programs offering advanced placement and preferred admission to other post-secondary programs to graduates (-5.26). Members of this class are less price sensitive to program cost (-32.04) than other classes, but members still prefer lower cost programs over more expensive ones. In accordance with the positive part-worth value for the none option (173.40), online opposers appeared reluctant to indicate that they would enroll in micro-credential programs. Relative to the other classes, more of these class members tend to be within the youngest age category (24 – 34 years, 48.1%), be male (69.6%), have a post-graduate degree or certificate (50.6%), have a higher percentage of respondents with incomes above $100,000 (62.9%), and have more respondents who were familiar with micro-credentials before beginning the survey (54.4%). Online opposers are the smallest class, 17.5% of the population.

Class 4 – Disinclined and Skeptical (29.2%). The disinclined and skeptical class placed the greatest importance on program cost (24.73%) compared to the other classes. The format of instruction (6.63%) and time commitment (7.54%) were not important attributes. In accordance with the high positive part-worth value compared to other classes, this class strongly preferred short programs of 1 to 15 hours (53.29) and full reimbursement (59.72) of micro-credential program fees. The disinclined and skeptical class preferred providers with an excellent reputation (56.67) relative to other levels of this attribute. The distinguishing feature of the disinclined and skeptical class is the high utility of the dual response none option (482.49). This class appeared to strongly reject enrolling most micro-credential programs. For these class members, not enrolling in a micro-credential program is often more preferred than enrolling in a micro-credential program. Relative to other classes, these class members are likely to be in the oldest age category (55 – 64 years, 37.6%). Within this class, a higher percentage indicate high school as their highest level of education (20.7%) than the percentage found in other classes. This class also had the least familiarity with micro-credentials before starting the survey with 80.3% of class members reporting they were not familiar with micro-credentials before beginning the survey. The disinclined and skeptical class is the second largest class (29.2%).

The impact of respondent class membership on preferred micro-credential programs is examined next through shares of preference analyses. It highlights how different subgroups prefer and prioritize attributes. Understanding differences between class preferences can inform micro-credential program design choices so that programs better align with potential learner preferences.

5.3 Market Simulations

For policymakers, course designers, university administrators, and other stakeholders, perhaps the greatest value of conjoint analyses comes from what-if market simulations that reveal the effect of individual and latent class preferences by illustrating changes in preference as attribute levels are changed. Simulations were carried out using the individual part-worth utilities estimated from the HB model and the respondent's probable membership in one of four latent classes.

5.3.1 *Shares of Preference Analyses*

Simulated market scenarios using the calculated part-worth utilities of each respondent were created to estimate respondents' likelihood of enrolling in a hypothetical micro-credential program. This was done to estimate how much the demand for micro-credentials among potential learners would change by altering program attribute levels.

First, four hypothetical micro-credential program scenarios were created. A worst- and best-case scenario based on the levels with the lowest and highest average utility ratings estimated by the HB model and two moderate scenarios, Table 15. Using the individual part-worth utilities estimated from the HB model, shares of preference for each scenario were estimated using the default shares of preference settings in Sawtooth Software's Market Simulator. The resulting shares of preference are the percentage of people for whom the utility of a program exceeds the none part-worth utility threshold in the absence of competition. In other words, the percentage of people who report they would prefer to enroll in micro-credential programs with the attributes and levels described by the four scenarios rather than not enroll in the program.

Table 15

Descriptions and Shares of Preference (95% CI) for the Hypothetical Micro-credential Programs

Variable	Worst-case	Micro-credential Program A	Micro-credential Program B	Best-case
Description				
Format of instruction	In-person	In-person	Online	Online
Total hours of work to complete the program	241+ hours	1 - 15 hours	16 – 50 hours	1 – 15 hours
Time commitment	Full-time	Part-time	Flexible	Part-time
Reputation of the provider	Fair	Fair	Good	Excellent
Connections to employers and other programs for graduates	None	None	Advanced placement and preferred admission to other post-secondary programs	Employers recruit program graduates
Reimbursement available	None	None	Partial	Full
Cost	$4,000	$500	$2,000	$500
Shares of preference (%)				
Knowledge seekers	7.9 (5.6; 10.2)	50.0 (45.7; 54.3)	91.5 (89.7; 93.3)	99.5 (99.3; 99.7)
Convenience learners	0.1 (0.0; 0.1)	9.4 (7.6; 11.3)	57.7 (54.6; 60.7)	97.6 97.0; 98.2)
Online opposers	5.6 (3.7; 7.5)	27.0 (22.9; 31.1)	31.8 (28.0; 35.6)	70.2 (65.9; 74.5)
Disinclined and skeptical	0.0 (0.0; 0.0)	0.6 (0.4; 0.9)	3.0 (2.3; 3.7)	38.0 (34.6; 41.4)
Total	2.7 (2.0; 3.3)	18.7 (17.0; 20.5)	45.4 (43.0; 47.8)	76.5 (74.5; 78.5)

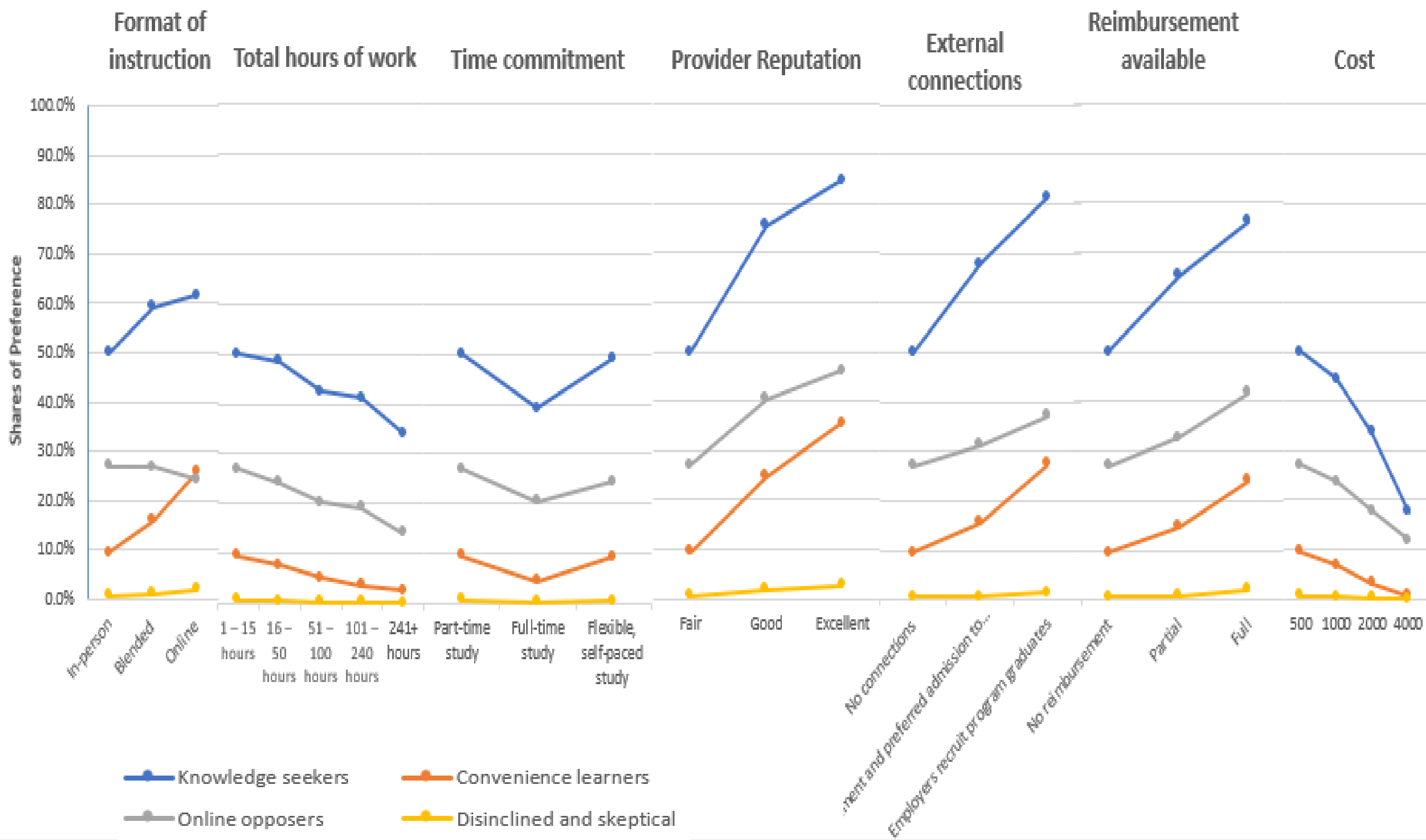
As expected, the worst-case scenario has the lowest predicted potential learner preference (2.7%) and the best-case scenario has the highest predicted potential learner preference (76.5%). As an in-person program, Micro-credential Program A is calculated to have a larger share of preference for online opposers (27.0%) than convenience learners (9.4%) or the disinclined and skeptical (0.6%) latent classes. Micro-credential Program B is appealing to the majority of convenience learners (57.7%) and knowledge seekers (91.5%) but is not preferred by the majority of online opposers (31.8%) or disinclined and skeptical (3.0%) classes. These results show that micro-credentials could be an educational option among potential learners in Canada given appealing program attributes.

5.3.2 *Sensitivity Analyses*

To examine how a change in share of preference for a micro-credential program among potential learners is a direct result of altering the micro-credential's program attributes, the level of one attribute (e.g., the reputation of the provider) was systematically changed while keeping all other attributes at a constant level. Estimates for how the level change affected shares of preference were recorded. Results of the attribute changes on shares of preference for Micro-credential Program A (Table 15) by latent class are visualized in Figure 4.

Figure 4

Changes to Shares of Preference by Varying the Attributes



In Figure 4, the four latent classes are represented by different coloured lines: Knowledge seekers are blue; Convenience learners are orange; Online opposers are grey; and Disinclined and skeptical are yellow. The *y*-axis displays shares of preference as a percentage and the *x*-axis includes all levels considered by the study, organized into columns, starting with the attribute format of instruction on the leftmost side and ending with cost on the right. The Figure 4 depicts how shares of preference for Moderate Scenario A will change for each of the four latent classes if only one attribute is varied while all other levels are held constant. For example, if Moderate Scenario A is offered in a blended or online format, as opposed to an in-person format, the appeal of the micro-credential program for knowledge seekers is predicted to increase from 50%, which is the shares of preference for in-person instruction, to approximately 60% for a micro-credential program offered in a blended format, to approximately 63% for an online program. Considering the second column, total hours of work, if the format of instruction is returned to in-person instruction but the total number of hours to complete the program increases from 1 – 15 hours to 16 – 50 hours or 51 – 100 hours, the appeal of the micro-credential program for knowledge seekers is predicted to decrease from 50% to approximately 48% for a program that is 16 to 50 hours in duration to approximately 42% for a program that is 51 to 100 hours.

The results of the sensitivity analyses reveal that changing the reputation of the provider leads to substantial increases in the percentage of respondents who would enroll in Micro-credential Program A in comparison with the none option. More specifically, Micro-Credential Program A from a provider with an excellent reputation instead of one with a fair reputation, would increase the share of preference among potential learners by 19.2 to 34.6 percentage points for three of the four latent classes. The main driver for increasing micro-credential program preference would however be program cost. The results show that micro-credential programs costing $500 to $1,000 would be more attractive than not enrolling in any program to more than 40.0% of knowledge seekers. The results also show that changes to total hours of work to complete a micro-credential program or time commitment required do not result in substantial increases in the percentage of potential learners who prefer a micro-credential program, especially when compared to the impact of other attributes. These results are in line with the attribute importance findings reported in Tables 10 and 13.

5.3.3 *Willingness to Pay Analyses*

Willingness to pay (WTP) is the approximate price potential learners are willing to pay for a more preferred attribute. For example, all other attributes being equal, the willingness to pay an additional cost to enroll in a micro-credential program from a provider with an excellent reputation versus a fair reputation. The WTP values reported in Table 16 convert differences in utility part-worth values reported in Tables 10 and 13 to monetary equivalents reported in Canadian dollars. WTP values of zero indicate the least preferred feature of an attribute as specified in Table 10 or Table 13. Negative WTP values indicate an expected discount. WTP estimates are not additive across attributes.

Table 16

Willingness to Pay Estimations (CDN$)

Attribute	Average	Knowledge Seekers	Convenience Learners	Online Opposers	Disinclined and Skeptical
Format of instruction					
In-person (reference level)	$0	$0	$0	$0	$0
Blended	$800	$900	$800	-$200	$700
Online	$1,300	$1,100	$1,900	-$1,000	$1,500
Total hours of work to complete the program					
241+ hours (reference level)	$0	$0	$0	$0	$0
101 – 240 hours	$500	$600	$400	$1,100	$500
51 – 100 hours	$800	$800	$700	$1,200	$900
16 – 50 hours	$1,300	$1,300	$1,200	$1,700	$1,500
1 – 15 hours	$1,600	$1,400	$1,500	$2,300	$1,900
Time commitment					
Full-time study (reference level)	$0	$0	$0	$0	$0
Flexible, self-paced study	$1,100	$900	$1,200	$900	$1,200

Attribute	Average	Knowledge Seekers	Convenience Learners	Online Opposers	Disinclined and Skeptical
Part-time study	$1,100	$1,000	$1,100	$1,300	$1,200
Reputation of the provider					
Fair (reference level)	$0	$0	$0	$0	$0
Good	$2,100	$2,200	$2,000	$2,400	$1,900
Excellent	$3,000	$3,000	$2,900	$3,400	$2,800
Connections to employers and other programs for graduates					
No connections (reference level)	$0	$0	$0	$0	$0
Advanced placement and preferred admission to other post-secondary programs	$1,300	$1,400	$1,200	$1,100	$900
Employers recruit program graduates	$2,400	$2,700	$2,400	$2,100	$2,000
Reimbursement available					
No reimbursement (reference level)	$0	$0	$0	$0	$0
Partial	$1,100	$1,300	$900	$1,200	$900
Full	$2,100	$2,200	$1,900	$2,600	$2,300

Knowledge seekers would be willing to pay up to $1,100 to take an online micro-credential over one that is offered in-person, whereas online opposers would be willing to pay up to $1,000 to take an in-person micro-credential instead of an online program. As for the reputation of the provider, while online opposers would be willing to pay up to $3,400 for a micro-credential from a provider with an excellent reputation, convenience learners would be willing to pay up to $2,900. Knowledge seekers would pay more for a micro-credential program from which employers recruit program graduates than other groups. Overall, these results show that different classes place a different premium on different micro-credential program attributes and levels. Although Orme (2021; 2001) warns that WTP results should be interpreted with caution because WTP estimates do not consider the impact of competition, thus the WTP value is sometimes higher than what can be expected in a real-world situation.

Chapter 6
Discussion and Conclusion

In recent years, the scientific literature about micro-credentials has increased (Tamoliune et al., 2023; Thi Ngoc Ha et al., 2023). There remains, however, limited evidence from learners (Brown & Nic-Giolla-Michil, 2022; Bruguera et al., 2022) that can be of practical significance to inform and direct the creation of micro-credential programs that cater to the preferences of learners. To address this gap and gain a better understanding of potential learners' preferences, this research sought to answer the question: What are Canadians' preferences and willingness to pay for attributes related to micro-credential programs delivered by post-secondary institutions? It was answered by surveying 1,005 Canadians who completed a discrete choice experiment (DCE) to determine the utility they attributed to seven different attributes of micro-credential programs. The data analyses combined conjoint, latent class, and market simulation analyses to explore aggregate, individual, and subgroup-level preferences. Subgroups were formed based on similar decision profiles and stated preferences rather than socio-demographic data. These three forms of analyses at different levels of granularity enabled the establishment of an empirical baseline of Canadians' preferences for micro-credential programs offered by post-secondary institutions at a national scale.

The results from this study demonstrate that the preference to enroll in a micro-credential is jointly influenced by program cost, the reputation of the provider, connections to employers and other programs for graduates, and the format of instruction. To a lesser extent, potential learners are also influenced by the amount of reimbursement available, total hours to complete the program, and time commitment. The application of a latent class model, which allows segmentation to emerge based on stated preference, revealed the four-segment latent class model to be a good fit to the micro-credential program choices made by potential learners in this study. Considerable variations in preferences for connections to employers and preferences for in-person or online learning between the four segments were found. Practical implications of these preference differences were demonstrated through hypothetical market simulations. These simulations predicted varying rates of enrollment into a micro-credential program by the four subgroups and differing amounts that subgroups would be willing to pay for preferred attributes. The study also found one subgroup largely unwilling to enroll in micro-credential programs unless they are offered with their most preferred attributes. These results provide insights into potential learner preferences for micro-credential program attributes at a national scale and point to several conclusions, implications, and directions for future research.

This study recorded that 31.4% of respondents had some familiarity with micro-credentials before beginning this study. Previous studies in Canada (Pichette et al., 2021), the United States (Gauthier, 2020), and Europe (Brown, et al., 2021) found less than 25% of respondents were familiar with micro-credentials before participating in their respective studies, unless they were or had recently enrolled in a continuing education program (Bruguera et al., 2023). More recent European Union studies found that 30 to 40% of respondents were familiar with micro-credentials (CEDEFOP, 2022), with this share rising to 54.3% when the sample was adult learners who had completed a continuing education course within the last 5 years (Bruguera et al., 2023). Although the sample groups of this and previous studies are not directly comparable, the increasing awareness of micro-credentials is noteworthy, confirming Leong et al.'s (2020) hypothesis that micro-credentials would continue to grow. Nevertheless, it also suggests that potential learners continue to find micro-credentials unfamiliar, which may limit their understanding of the potential benefits associated with earning a micro-credential due to a lack of awareness and inadequate information.

From the conjoint analysis, this study finds that potential micro-credential learners are extremely price sensitive. The decision to enroll in a micro-credential program is highly and consistently influenced by program cost, with lower costs programs being preferred. Since high perceived costs can discourage individuals from taking part in an activity (Barron & Hulleman, 2015), high micro-credential program fees are likely to discourage enrollment in micro-credential programs. A situation projected by this study's market simulations in which projected uptake declined from approximately 50% to below 20% as costs increased for the subgroup most likely to enroll in a micro-credential. Additionally, potential learners may be concerned that pursuing multiple micro-credentials, each with their own cost, could result in a higher overall expense compared to a comprehensive program of study, making them reluctant to choose higher cost options during the DCE.

While cost is a crucial factor, this study also found that potential learners are willing to pay a premium for attributes they deem important. Specifically, learners are willing to pay more for a micro-credential from an institution with an excellent reputation, programs from which employers recruit graduates, and those that match their preferred format of instruction as demonstrated by the outcomes of the hypothetical market simulations on expected learner enrollment. This willingness to pay more may be because a higher price is often perceived as an indication of higher quality. Thus, post-secondary institutions offering micro-credential programs with these attributes can charge a premium price. However, McGreal and Olcott (2022) caution higher educational institutions against viewing micro-credentials as a "cash cow" because "someone always has to pay." The ability for an institution to meet potential learners' attribute preferences presupposes prior investment of institutional resources to create micro-credential programs potential learners will gravitate towards.

The choice analysis and market simulations revealed that potential learners prioritize the reputation of the micro-credential provider. This finding complements previous international studies, which found that employers also place significant value on the credibility of the institution awarding a credential (Selvaratnam & Sankey, 2020; Ashcroft et al., 2021). This emphasizes the importance of institutional reputation in the competitive marketplace of adult learning in general and micro-credentialing in particular. It suggests a common trend where both learners and employers view institutional reputation as a key indicator of quality. Post-secondary institutions with established quality assurance mechanisms and ranking systems may project these aspects of their brand onto their micro-credentials, thereby increasing their perceived value among potential learners. Furthermore, a micro-credential from a provider with an excellent reputation may be perceived by potential learners to increase employer recognition.

However, the reputation of an institution is an unreliable proxy for what specific micro-credentials represent. Findings from this support Ralston's (2021) concerns that institutional reputation will supplant quality assurance for micro-credentials. The value of a micro-credential partially lies in the specific knowledge, skills, and capabilities it imparts to graduates, which may not be accurately reflected by the institution's reputation. Therefore, while institutional reputation can guide initial perceptions and is important to potential learners, a deeper evaluation of the micro-credential's content, outcomes, and quality is essential. More reliable indicators of micro-credential program quality than provider reputation are needed.

As theorized by earlier papers on micro-credentials (Gallagher, 2016; 2018; Gauthier; 2020; Oliver, 2019; 2021; Selvaratnam & Sankey, 2020; Brown et al., 2021), this study found that potential learners strongly prefer micro-credential programs with connections to employers. It may also indicate that potential learners fear any micro-credentials they earn will not be valued by employers. Recall that the phrasing of this attribute level was "employers recruit program graduates," which presupposes employer recognition of the micro-credential and value of the learning which occurred during the program. Bruguera et al. (2023) found that European learners were concerned about the value of micro-credentials to future employers. Moreover, in the context of digital badges, Glover (2016) found students' perceived value of badges to be contingent on employer recognition. This combined evidence points to a critical concern held by potential learners that micro-credentials might not be valued in workplaces or by hiring managers. It underscores the importance of collaborations between offering institutions and industry partners to design micro-credential programs that meet the needs of learners and employers.

It has been suggested that micro-credentials prepare learners for "gig" jobs contrary to the aspirational goal for education to "prepare individuals to live lives they have reason to value, and not just in the specifics required of particular jobs" (Wheelahan & Moodie, 2022 p. 1279). The findings from this research found that potential learners prefer micro-credentials with connections to employers in support of the positions of Dobbs et al (2023) and Oliver (2021) who consider micro-credential learners to mainly be motivated for work related purposes. These findings call attention to the practical orientation of potential learners who are seeking to enhance their employability through micro-credentials.

The findings suggest that most potential learners prefer flexibility and convenience in micro-credential programs. There is an overwhelming preference for micro-credentials lasting between 1 to 15 hours and 16 to 50 hours, suggesting a tendency among learners to favour shorter, more immediately applicable programs. This finding echoes the results of a European study (Bruguera et al., 2023), which also found preferences for shorter programs.

Although most potential learners preferred online learning, a distinct subgroup that highly prefers micro-credentials offered in an in-person format was found. Possibly because of their negative prior experiences with online learning or perhaps because of the value these potential learners attribute to face-to-face interactions and networking, the motivation for preference choice is unknowable from the results of this study. Nevertheless, this outcome provides a more nuanced picture of learner preferences than was previously known.

Finally, preference for micro-credentials was found to be influenced by program attributes in a hierarchical order not solely determined by the socio-demographic factors examined by this study. Pichette and Courts (2024) observed that demand for micro-credentials is highest among learners who are employed full time and have median or high incomes. Adding to this understanding, this study found that individuals appear willing to enrol in micro-credentials regardless of age, gender, ethnicity, or place of birth provided the program's attributes are suited to their individual preferences. This may be because people from diverse backgrounds share the same desire for further education or feel equally at risk in changing workplaces (Brown & Souto-Otero, 2020). Consequently, major differences in preferences based on examined socio-demographic categories were not evident. It may also be the case that the perceived benefits, flexible formats, lower cost, and short-term nature of micro-credentials may have near-universal appeal due to the increasing need for lifelong learning and upskilling across various demographics (OECD, 2020). The research suggests a diverse range of micro-credential programs with different attributes are needed to accommodate the different types of learner preferences found.

6.1 Implications for Practice

Incorporating potential learners' preferences during the program design phase may be useful for enhancing the accessibility, attractiveness, and uptake of these new credentials. The findings from this study have several important implications for post-secondary institutions involved in the development and promotion of micro-credential programs.

Within the general population, there remains a high degree of unfamiliarity with micro-credentials despite encouraging evidence of increased awareness. Post-secondary institutions seeking to offer micro-credentials must accurately communicate the scope, content, and value of their micro-credentials so that potential learners fully understand the offering. These messages could also be amplified by other stakeholder groups, such as unions, industry organizations, employers, and governments. Statements to the general public about micro-credential recognition, portability, and quality are key for raising awareness of these credentials among potential learners. This communication should be clear, straightforward, and from a trusted source to achieve maximum impact.

Micro-credentials must be recognized and understood by post-secondary institutions and employers for them to have value for potential learners. Micro-credential frameworks, such as those developed by Ontario and British Columbia, are critical to ensuring a common understanding and validation of what a micro-credential represents in terms of purpose and the knowledge, skills, and abilities of the credential holder, and where micro-credentials fit in the larger credential ecosystem. The expansion and development of coordinating frameworks at provincial, national, and international levels, have also been called for by other researchers (Brown et al., 2021; Oliver, 2021; Tamoliune et al., 2023; Thi Ngoc Ha et al., 2023), will facilitate micro-credentials' recognition among stakeholder groups. Post-secondary institutions should prioritize the development and dissemination of agreed upon frameworks.

Potential learner preference for micro-credentials from post-secondary institutions with an excellent reputation was evident from this study. Amplifying the recommendation from McGreal and Olcott (2022), it is recommended that post-secondary institutions align micro-credential programs with existing institutional mandates. Institutions implementing micro-credentials should consider leveraging existing institutional strengths. For example, they can prioritize micro-credential program development within their most popular or highly ranked faculties.

In this study, it is likely that some respondents equated institutional reputation with a quality program. However, quality indicators based upon deeper evaluations of micro-credential program content and outcomes would be better indications of program quality than provider reputation. Indeed, there is general agreement that quality standards for micro-credentials are critical (OECD, 2021). Establishing systematic quality assurance procedures, in conjunction with micro-credential program frameworks, to validate the value and impact of micro-credential programs could help gain trust from potential learners and employers and, in turn, lower reliance on potentially unreliable measures. Moreover, quality indicators would be helpful to differentiate micro-credential programs offered by post-secondary institutions from private providers in the crowded adult learning marketplace (Nic Giolla Mhichíl et al., 2023; McGreal & Olcott, 2022). By better defining what is meant by micro-credentials, agreeing upon a framework, and committing to a robust quality assurance system to validate the value and impact of micro-credentials, post-secondary institutions can ensure the delivery of high-quality micro-credential learning experiences to potential learners.

Within a business or policy-based funding model, post-secondary institutions should develop a pricing strategy that reduces costs for learners and reflects the value of the micro-credential. Potential micro-credential learners are price sensitive with cost being the most important decision factor for most learners. While learners are willing to pay for micro-credentials with attributes they value, post-secondary institutions should also seek additional funding from public or private sources. For example, external funding, such as grants from provinces, private foundations, or industry partners may be found. Institutions may also be able to access corporate or industry training budgets or explore revenue-sharing models, in which external stakeholders financially contribute to the development and delivery of micro-credentials and the post-secondary institution receives a share of the revenue generated by the program. Collaborative micro-credential development projects at regional, provincial, or national levels with regulatory bodies may also be considered to meet the standards and qualification requirements of the funding organization while sharing costs and leveraging economies of scale. These efforts could reduce the cost of the credential for learners.

Micro-credentials should be accessible. While providers with an excellent reputation and lower cost programs were widely preferred, this study also uncovered more nuanced target populations for micro-credentials based on program attributes that were previously unknown. Potential learners' preferences for online learning, shorter programs, and connection to employers, as found in this research, should be incorporated into future program development. However, in-person learning formats were not universally rejected. It is therefore recommended that post-secondary institutions not view micro-credentials as an online-only offering. Post-secondary institutions might consider developing different program models to cater to these diverse learner preferences. For example, one model may be offered online, be able to be completed in under 15 hours, and ladder into other micro-credential or degree offerings. This model would be particularly appealing to convenience learners. A second model, catering to knowledge seekers, could be offered in a blended format, be completed within 16 to 50 hours, and include connections to employers requiring the knowledge, skills, and abilities taught by the micro-credential. A third, in-person model designed to be completed part-time in 51 to 100 hours would likely appeal to online opposers. Other models with other attribute levels could be created to suit the diverse preferences of potential learners. Providing modularity to cater to heterogeneous groups will undoubtedly prove challenging. But by better defining where offerings fit within the larger educational ecosystem through frameworks and standards, this challenge may be mitigated.

These recommendations for post-secondary institutions emphasize the need for clear communication, quality assurance, employer and industry engagement, and diverse micro-credential program models to effectively address learner preferences. Post-secondary institutions should convey the value and scope of micro-credentials to raise awareness among potential learners and establish robust frameworks and quality standards to help build trust, ensuring that micro-credentials are recognized and valued by employers. Additionally, offering various learning formats and outcomes for graduates at a fair cost can accommodate diverse learner preferences, making micro-credentials more accessible and appealing. The hope is that by adopting these recommendations, post-secondary institutions can support potential learners in enhancing their skills through high-quality and flexible learning environments that promote and facilitate lifelong learning.

6.2 Limitations

Some limitations of this study warrant consideration. First, the Canadian sample was not statistically representative of the Canadian population. However, it closely mirrored target learners for micro-credential programs (Pichette & Courts, 2024). For example, the education level and income of respondents in the sample were higher than that of the Canadian population. This imbalance reduces the generalizability of the results. In addition, selection bias through the survey firm and online panel cannot be ruled out. Nevertheless, the sample is broadly similar to the population of Canada who could consider enrolling in a micro-credential offered by a post-secondary institution and was obtained through a professional survey firm specializing in population research. But this is not the same as the generalizability from a truly random sample. Future studies focused samples on specific geographic areas or professional fields, for example, could help build a more nuanced and complete picture of the types of micro-credential programs most attractive to potential learners.

As is the case with all DCE studies, the preferences examined were limited to the attributes selected. Respondent preferences in relation to micro-credential content or topic area were not considered as they were beyond the scope of this study. They were not selected as attributes. While the inclusion of these and all potentially influential attributes would best describe a micro-credential program, content and topic area did not meet the criteria of good attributes identified by previous scholars (Grover & Vriens, 2006; Reed Johnson et al., 2013; Kløjgaard et al., 2012; Pérerz-Troncoso, 2020; Sawtooth Software, 2024; Shang & Chandra, 2023). To follow the recommended practice to ensure stable part-worth values and create a survey that respondents could complete within a reasonable amount of time, the attributes included in the study were limited to seven. The inclusion of additional attributes and levels may have resulted in differing preferences but may have increased cognitive fatigue and inattention, risking unreliable results. In addition, there may be a relationship between the two time attributes and between the two financial attributes used in this study. While including fewer, more, or other attributes and levels would have yielded different findings, the attributes and levels in the study design capture micro-credential program attributes considered relevant as ascertained through the literature review.

The wording of the attributes and levels may have been interpreted differently across respondents or respondents may have predispositions regarding micro-credential programs and thus understood the choice task scenarios differently. Although the DCE literature recommends quantifying and simplifying levels to reduce ambiguity and variability in interpretation (Hauber et al., 2016), the conceptual nature of this research made this implausible. As such, definitions were provided at the beginning of the survey in an attempt to address this limitation.

As a method, DCEs are prone to hypothetical bias (Louviere et al., 2010). This means that respondents may indicate a preference even though this choice does not necessarily reflect their real preferences or expressed preferences may not translate into choices made in real enrollment contexts. The random utility theory upon which DCE is based assumes that the value of a program equals the sum of the part-worth utilities associated with its component attributes (Lancsar et al., 2007). In the experimental context of a DCE, highly preferred program characteristics may compensate for less desirable program characteristics. For example, as the DCE progresses, respondents may adopt simplifying heuristics rather than thoroughly consider the combined contribution of all presented attributes if their most preferred or least preferred attribute levels are presented. While there is congruence between the responses of participants in choice-based conjoint surveys and real-life scenarios (Hainmueller et al., 2014), the experimental design does not model all forms of information that might influence a potential learner. Respondents may have answered in the way they considered socially desirable. One way to solve these limitations are to conduct interviews with Canadians about their preferred micro-credential program characteristics in a future study. Within an interview setting, an environment of trust between the researcher and respondent can be created. In combination with additional background of the respondents, more realistic answers can be obtained. Afterward, the data from the interview study could be compared with the results from this study to verify the results presented here. Additionally, the preferences stated by the respondents of the DCE survey may not accurately reflect potential learners' preferences by the time post-secondary institutions offer the full range of hypothetical micro-credential programs presented in this study – if they are ever available. This may be overcome through longitudinal studies to investigate real choice decisions at different points in time. Or by conducting research in a more realistic environment, for example by working with post-secondary institutions offering micro-credentials to access participants with 'real-world' experience, although this would come at the expense of a national sample.

Despite these limitations, this study provides quantitative preference data concerning Canadians' preferences for micro-credential programs offered by post-secondary institutions. It is a foundation from which further scholarly discussion about micro-credential preferences may occur and be extended through future research to gain a better understanding of micro-credentials in post-secondary education.

6.3 Directions for Future Research

This dissertation identified diverse preferences and willingness to pay for micro-credential program characteristics through a quantitative study in an experimental context. It did not address respondent preferences related to micro-credential content or topic areas. The need for future research to focus on content preference is acute. Additionally, future research should examine learner preferences for the depth of knowledge in micro-credential programs, as this study only indirectly assessed this through the total hours required to complete a program. The time measures used in this study, time commitment and total hours of work to complete the program inadequately capture the complexity, breadth, and depth of knowledge that learners prefer and are worthy of investigation. In addition, the literature presents some empirical evidence that perception of the quality of a post-secondary institution can be influenced by subjective factors such as attitudes and motivations (Holfve-Sabel, 2006). This study did not investigate these factors, but they may be interesting for further research initiatives in this area. Also, as quality standards are adopted, the impact of these new standards on micro-credential program preferences should be considered in future studies. Investigating these attributes and factors will provide deeper insights into potential learner preferences.

As the granularity of socio-demographic factors considered by this study was limited, future research is needed to explore how micro-credential program attributes resonate with specific socio-demographic characteristics or sub-groups. For example, Hu and Hossler (2000) distinguish learners' willingness to pay from learners' ability to pay. This study investigated the former in the context of micro-credentials. While potential learners may express a willingness to pay more for preferred program attributes, actual enrollment decisions may still be constrained by the realities of their financial situations. Socio-economic factors were found to impact undergraduate university choice (Bruce & Edgington, 2008; Callendar & Jackson, 2008), so may have some relevance to micro-credential program choice. Future research into any effects of socio-economic status on micro-credentials choice may uncover nuances in preferences that were not evident in this study.

Exploring micro-credential preferences among different learner populations using other methods and at various levels of analysis is also needed. For example, employing qualitative or mixed-method approaches, additional subgroups, or more detailed demographic data can offer a more comprehensive insight into the types of micro-credential programs that are most appealing and beneficial to learners. For example, Ositelu et al. (2021) found differences between micro-credential learners according to specific field of study. It would be worthwhile to conduct DCEs in other languages and countries as well as with specific subgroups to compare and contrast micro-credential preferences.

Longitudinal studies to investigate real choice decisions over time and the long-term career impacts on graduates would complement and extend the results of this study. Short credentials focused on filling specific skill gaps in fields with acute labour shortages, such as health and technology, are thought to benefit learners through higher economic returns for earners (Meyer et al., 2020; Ntwari & Fecteau, 2020; OECD, 2022; 2023a). Future longitudinal studies would especially benefit from collaborations with post-secondary institutions that offer micro-credentials to access participants with real-world experiences.

There is further scope for research into potential learner preferences for micro-credentials. This includes additional attributes or characteristics that may influence preferences, and whether micro-credential programs prove to have short- or long-term benefits to learners. By addressing these areas, future research can provide a more comprehensive understanding of learner preferences and improve the design, implementation, and relevance of micro-credential programs by post-secondary institutions. As a relatively unexplored area of research and practice, there is still much to be learned about micro-credential learners and programs.

With the increase of new micro-credential choices for adult learners, this dissertation in practice serves to support post-secondary institutions in micro-credential program design and implementation. Micro-credential program design choices should consider the preference of potential learners, recognizing that most potential learners are motivated by program cost and provider reputation, whereas a subset will make decisions on program cost and format of instruction. With these understandings, post-secondary institutions can better tailor micro-credential program options to the benefit of learners.

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Appendix 1
Survey

Thank you for your willingness to participate in this study.

This study is about micro-credentials.

Micro-credentials are small, focused certifications you can earn from colleges and universities (post-secondary institutions) to prove you know a specific skill or have knowledge of a particular topic. Unlike university degrees or lengthy college courses, micro-credentials are designed to be earned relatively quickly. They are a way to prove your expertise, knowledge, and skills to others, which can help with your job and keeping up-to-date in fast changing fields.

Before today, had you ever heard of micro-credentials?

- ◯ Yes
- ◯ No
- ◯ I don't know

Back Next

0% 100%

In the first section you'll be asked about different micro-credential programs. These micro-credential programs are offered by Canadian colleges and universities accredited by provincial or territorial governments.

Imagine that you are considering enrolling in an educational program on a topic of great interest to you (for example, computer programming, art history, data analysis). You will see different types of programs and be asked **which version you prefer.**

The programs you see will have different types of features. These features are:

> **Format of instruction** = Where the learning occurs (for example, in-person or online).
>
> **Total hours of work to complete the program** = The recommended amount of time to spend on preparation, lessons, and homework.
>
> **Time commitment:** The recommended amount of time to spend on preparation, lessons, and/or homework every week until the program is completed.
>
> **Reputation of the provider:** The college or university's standing in the community (for example, good or excellent).
>
> **Connections to employers and other programs for graduates:** The opportunities the program has arranged for graduates of the program.
>
> **Reimbursement available:** Whether any paid program fees can be returned to a program graduate by an agency, organization, or employer.
>
> **Cost:** The program fees that must be paid to begin the program.

After reviewing the presented features, choose the program you prefer.

You will also be asked if you **would really enroll in the program you chose above** with a yes/no question. By choosing "No" you indicate that you'd enroll in another educational program or would not enroll in any educational program.

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(1 of 11)

Format of instruction	In-person	Online
Total hours of work to complete the program	1 - 15 hours	241+ hours
Reimbursement available	Full	Partial
Cost	$500	$1,000
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

0% 100%

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(2 of 11)

Time commitment	Part-time study (less than 9 hours per week)	Flexible, self-paced study (0 to 40 hours per week)
Reputation of the provider	Excellent	Excellent
Connections to employers and other programs for graduates	Advanced placement and preferred admission to other post-secondary programs	None
Cost	$2,000	$4,000
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

0% 100%

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(3 of 11)

Total hours of work to complete the program	241+ hours	51 - 100 hours
Time commitment	Full-time study (more than 10 hours per week)	Flexible, self-paced study (0 to 40 hours per week)
Reputation of the provider	Fair	Good
Reimbursement available	Full	None
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

0% 100%

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(4 of 11)

Format of instruction	Blended (online and in-person)	Blended (online and in-person)
Time commitment	Part-time study (less than 9 hours per week)	Full-time study (more than 10 hours per week)
Connections to employers and other programs for graduates	Employers recruit program graduates	Employers recruit program graduates
Reimbursement available	Full	None
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

0% 100%

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(5 of 11)

Format of instruction	Blended (online and in-person)	Online
Total hours of work to complete the program	16 - 50 hours	51 - 100 hours
Time commitment	Part-time study (less than 9 hours per week)	Flexible, self-paced study (0 to 40 hours per week)
Connections to employers and other programs for graduates	Advanced placement and preferred admission to other post-secondary programs	Employers recruit program graduates
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(6 of 11)

Format of instruction	Online	Online
Total hours of work to complete the program	101 - 240 hours	51 - 100 hours
Reputation of the provider	Good	Fair
Connections to employers and other programs for graduates	None	Advanced placement and preferred admission to other post-secondary programs
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(7 of 11)

Format of instruction	Online	Blended (online and in-person)
Total hours of work to complete the program	51 - 100 hours	16 - 50 hours
Time commitment	Part-time study (less than 9 hours per week)	Flexible, self-paced study (0 to 40 hours per week)
Connections to employers and other programs for graduates	Employers recruit program graduates	Advanced placement and preferred admission to other post-secondary programs
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(8 of 11)

Total hours of work to complete the program	1 - 15 hours	16 - 50 hours
Time commitment	Full-time study (more than 10 hours per week)	Full-time study (more than 10 hours per week)
Connections to employers and other programs for graduates	Advanced placement and preferred admission to other post-secondary programs	Employers recruit program graduates
Cost	$500	$1,000
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(9 of 11)

Format of instruction	In-person	Blended (online and in-person)
Reputation of the provider	Excellent	Fair
Reimbursement available	Partial	Partial
Cost	$2,000	$4,000
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

0% 100%

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(10 of 11)

Format of instruction	In-person	In-person
Total hours of work to complete the program	16 - 50 hours	51 - 100 hours
Time commitment	Part-time study (less than 9 hours per week)	Flexible, self-paced study (0 to 40 hours per week)
Cost	$4,000	$2,000
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

A post-secondary institution is offering a micro-credential program on a topic of great interest to you.

Select the version of the micro-credential program you prefer.

Please assume that these programs differ only on the features shown.

(11 of 11)

Total hours of work to complete the program	101 - 240 hours	16 - 50 hours
Reputation of the provider	Excellent	Good
Connections to employers and other programs for graduates	Employers recruit program graduates	None
Reimbursement available	None	Partial
	Select	Select

Would you really enroll in the program you chose above?

Yes No

Back Next

In this next section you'll be asked questions about your background and interests.

Back Next

0% 100%

Which of the following age groups are you in?

- ○ 18 – 24 years
- ○ 25 – 34 years
- ○ 35 – 44 years
- ○ 45 – 54 years
- ○ 55 – 65 years
- ○ 66 and over
- ○ Prefer not to answer

What is the highest certificate, diploma, or degree that you have completed?

- ○ Less than high school diploma or its equivalent
- ○ High school diploma or a high school equivalency certificate
- ○ Trades certificate or diploma
- ○ College, CEGEP, or other non-university certificate or diploma (other than trades certificates or diplomas)
- ○ University certificate or diploma below the bachelor's level
- ○ Bachelor's degree (e.g., B.A., B.A. (Hons), B.Sc., B.Ed.)
- ○ University certificate, diploma, or degree above a bachelor's degree
- ○ First professional degree (e.g., degrees in law (LL.B), medicine (M.D.), dentistry (D.D.S., D.M.D.), veterinary medicine (D.V.M.), optometry (O.D.), divinity)
- ○ Master's degree (e.g., M.A., M.Sc., M.Ed., M.B.A.)
- ○ Earned doctorate (e.g., Ph.D., D.Sc., D.Ed.)
- ○ Prefer not to answer

Where do you live?

- Newfoundland
- Prince Edward Island
- New Brunswick
- Nova Scotia
- Quebec
- Ontario
- Manitoba
- Saskatchewan
- Alberta
- British Columbia
- Yukon
- Northwest Territories
- Nunavut
- Outside of Canada
- Prefer not to answer

Next

What is your gender?

- Male
- Female
- Or please specify
- Prefer not to answer

Were you born in Canada?

- Yes
- No
- Prefer not to answer

Back Next

0% 100%

In what year did you first come to Canada to live?

Back Next

0% 100%

Are you:

- Arab
- Black
- Chinese
- Filipino
- Inuk (Inuit)
- Indigenous (First Nations)
- Japanese
- Korean
- Latin American
- Métis
- South Asian (e.g., East Indian, Pakistani, Sri Lankan)
- Southeast Asian (e.g., Vietnamese, Cambodian, Latotian, Thai)
- West Asian (e.g., Iranian, Afghan)
- White
- Mixed
- Other
- Prefer not to answer

Back Next

0% 100%

When was the last time you were a full-time student?

- Less than 5 months ago
- 6 months – 1 year ago
- 2 – 4 years ago
- 5 – 9 years ago
- 10 – 19 years ago
- 20 – 29 years ago
- 30 – 39 years ago
- 40 + years ago
- Prefer not to answer

Back Next

0% 100%

In what country did you complete secondary (high) school?

Back Next

0% 100%

In what country did you obtain your highest certificate, diploma, or degree?

Back Next

0% 100%

What is your living arrangement?

- Living alone
- Couple with no children living in the home
- Couple with child(ren) less than 18 years old in the home
- Lone parent with child(ren) less than 18 years old in the home
- Other living arrangement
- Prefer not to answer

Back Next

0% 100%

How many dependent children live in your home at least 50% of the time?

Back Next

0% 100%

What is your annual income?

- Under $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 and over
- Prefer not to answer

How many people does this income support?

- 1
- 2
- 3
- 4
- 5
- 6 or more
- Prefer not to answer

Back Next

0% 100%

What is your main activity? (choose one)

- ◯ Working at a job or business
- ◯ Looking for work
- ◯ Going to school
- ◯ Family responsibilities
- ◯ Maternity or parental leave
- ◯ Own illness or disability
- ◯ Travelling
- ◯ Volunteering
- ◯ Other
- ◯ Prefer not to answer

What do you consider your field of work (by experience or training)?

- ◯ Art, culture, recreation, and sport
- ◯ Business, finance, and administration
- ◯ Education
- ◯ Farming
- ◯ Healthcare
- ◯ Management
- ◯ Manufacturing and processing
- ◯ Natural and applied sciences
- ◯ Sales and customer service
- ◯ Skilled trades and transportation
- ◯ Social sciences and religion
- ◯ Telecommunications and information technology
- ◯ Other
- ◯ Prefer not to answer

Do you have Canadian work experience in this field of work?

- ◯ Yes
- ◯ No
- ◯ Prefer not to answer

Back Next

0% 100%

The survey asked you to consider **"a micro-credential program on a topic of great interest to you."**

When completing the survey, what was the general topic area you imagined for the micro-credential program?

- ◯ Art, culture, recreation, and sport
- ◯ Business, finance, and administration
- ◯ Education
- ◯ Farming
- ◯ Healthcare
- ◯ Management
- ◯ Manufacturing and processing
- ◯ Natural and applied sciences
- ◯ Sales and customer service
- ◯ Skilled trades and transportation
- ◯ Social sciences and religion
- ◯ Telecommunications and information technology
- ◯ Other
- ◯ Prefer not to answer

For what reasons would you take a micro-credential program on the abov topic? (check all that apply)

- ☐ To get a job
- ☐ To advance my professional career
- ☐ To work in a different field
- ☐ To keep my job or do my present job better
- ☐ Prerequisite for future education
- ☐ Interest in the subject
- ☐ For self-improvement
- ☐ Other
- ☐ Prefer not to answer

What one reason would be your **main** reason for taking a micro-credentia

program on the above topic?

- ○ To get a job
- ○ To advance my professional career
- ○ To work in a different field
- ○ To keep my job or do my present job better
- ○ Prerequisite for future education
- ○ Interest in the subject
- ○ For self-improvement
- ○ Other
- ○ Prefer not to answer

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The survey asked, **"Would you really enroll in the program you chose above?"**

When you answered **"No"**...

What factors influenced your choice to not enroll? (check all that apply)

- [ ] Not sure if it would be worth it
- [ ] Conflict with your work schedule
- [ ] Family responsibilities
- [ ] Too busy at work
- [ ] Cost was too expensive/could not afford the cost
- [ ] Health issues
- [ ] Technological challenges
- [ ] Transportation challenges
- [ ] Lack of confidence
- [ ] Other
- [ ] Prefer not to answer

What one factor would be **most** important to your decision **not to enroll** in a program?

- ○ Not sure if it would be worth it
- ○ Conflict with your work schedule
- ○ Family responsibilities
- ○ Too busy at work
- ○ Cost was too expensive/could not afford the cost
- ○ Health issues
- ○ Technological challenges
- ○ Transportation challenges
- ○ Lack of confidence
- ○ Other
- ○ Prefer not to answer

Back Next

Thank you for your participation.

This is the end of the survey.

Questions about the research:

If you have questions about the research in general, about your role and your rights as a participant in the study, or would like to see a summary of the research results when they are available, please feel free to contact Lauren Barrows (lauren.barrows@mail.utoronto.ca) or Elizabeth Dhuey (elizabeth.dhuey@utoronto.ca).

If you have any questions regarding your rights as a human subject and participant in this study, you may contact the University of Toronto Ethics Review office at: (416) 946-3273 or ethics.review@utoronto.ca.

The Human Research Ethics Program (HREP) may access study-related data and/or consent materials for quality assurance purposes. All information accessed by the HREP will be upheld to the same level of confidentiality that has been stated by the research team.

Note:

When respondents take the survey in regular mode they will be redirected to the url below after clicking the button:

https://s.cint.com/Survey/Complete?ProjectToken=8bc1aff1-b60d-40ac-be98-b071c89ef3b7

Click to end the survey

0% 100%

Appendix 2
Informed Consent

Informed Consent

Thank you very much for agreeing to participate in this study about micro-credential programs offered by Canadian colleges and universities. This page explains what is involved in this study so you can make an informed decision about whether you wish to take part in it. This research is being conducted by Lauren Barrows, a doctoral student at the University of Toronto. This study is for partial completion of an EdD in International Educational Leadership and Policy at the University of Toronto. The supervisory team for this study is comprised of Dr. Elizabeth Dhuey, Dr. Anna Katyn Chmielewski, and Dr. Michal Perlman at the University of Toronto. Results may be published in academic journals or presented at conferences, but nothing that is published will specifically identify any participant. This research has been approved by the Ethics Committee of the University of Toronto.

Purpose of the study:

The purpose of this study is to understand what characteristics of micro-credential programs matter to working-age Canadians. You were selected for this survey because you are 1) between 24 and 65 years of age, 2) have a high school diploma, 3) are able to read English, and 4) reside in Canada.

What you will be asked to do:

In this survey, you will complete an exercise that involves choosing between different micro-credential programs. You will also be asked some questions about your background, what topic area you might wish to learn more about through a micro-credential program and why you would want to learn more about this topic area. The purpose of these additional questions is to help me understand which aspects of micro-credential programs matter for whom. The survey is conducted online and should take you about 20 minutes to complete.

Voluntary participation:

Your participation in the study is completely voluntary. Your decision regarding participation will not influence the nature of your relationship with Maru/Blue. The researcher will not have access to any identifying information about participants.

Confidentiality:

All information you provide will be held in confidence and your responses will be de-identified. Any identifying information you provided to Maru/Blue, the firm that recruited you to participate in this study, is not available to the researcher. Survey responses are collected through Sawtooth Software, which uses servers with multiple layers of security to protect the privacy of the data (e.g., encrypted websites and password protected storage). Your data will be safely stored in a password-protected computer in a password-protected file. The data will be kept for twenty years after completion or publication and then destroyed. If the study is published, no identifying information will be used.

<u>Risks and discomforts:</u>

This study is low risk. But questions my elicit feelings of psychological discomfort or anxiety due to thinking about your ability to take further education, retain or obtain employment in the future, or reflect on your past educational choices. Since participation in this study is voluntary, if you are not comfortable answering a question, simply skip it or select "prefer not to answer". Also, you can stop your participation at any time, for any reason, during the session without penalty by closing the survey. As your responses will be de-identified, once the survey has been submitted, your responses cannot be withdrawn.

<u>Benefits of the research and benefits to you:</u>

By participating in this study, you may gain a better understanding of what matters to you when you consider training or educational programs. Your participation will also contribute to my understanding of what Canadians want to see in micro-credential programs. I hope that the information that I get from the study will assist in the development of new micro-credential programs.

<u>Remuneration/Compensation:</u>

You will not be compensated by the researcher. You will be compensated by Maru/Blue, the research firm, as outlined in Maru/Blue's compensation policy. You must complete the survey before you can receive points as identified by Maru/Blue. Please note that you are still eligible for compensation from Maru/Blue if you choose not to answer some of the questions in the survey. Please visit the Maru/Blue website about incentives and rewards for further information about the compensation process (https://maruvoicecanada.zendesk.com/hc/en-us/categories/115001577587-Rewards).

<u>Questions about the research:</u>

If you have questions about the research in general, about your role and your rights as a participant in the study, or would like to see a summary of the research results when they are available, please feel free to contact Lauren Barrows (lauren.barrows@mail.utoronto.ca) or Elizabeth Dhuey (elizabeth.dhuey@utoronto.ca).

If you have any questions regarding your rights as a human subject and participant in this study, you may contact the University of Toronto Ethics Review office at: (416) 946-3273 or ethics.review@utoronto.ca.

The Human Research Ethics Program (HREP) may access study-related data and/or consent materials for quality assurance purposes. All information accessed by the HREP will be upheld to the same level of confidentiality that has been stated by the research team.

Please print this screen if you want a copy of this page for your own records.

By clicking the "next" button below, I consent to participate in the "Preferences for Micro-credentials offered by Canadian Colleges and Universities" project conducted by Lauren Barrows. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by clicking this button.

If you do not consent to participate in the study, please close your browser now.

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0% 100%

Appendix 3
Socio-demographic Group Differences

A3.1 Gender

	Male Utility				Female Utility				
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**% alpha draws**
In-person	-14.10	48.31	-18.20	-9.99	-33.39	41.11	-37.11	-29.66	38.29
Blended	3.78	23.22	1.81	5.76	5.89	18.31	4.22	7.55	61.32
Online	10.31	53.60	5.75	14.87	27.50	46.92	23.24	31.76	45.68
1 – 15 hours	32.04	36.79	28.91	35.16	33.53	29.24	30.88	36.18	66.76
16 – 50 hours	16.30	39.12	12.97	19.63	15.27	28.46	12.69	17.85	31.37
51 – 100 hours	-5.32	21.78	-7.17	-3.46	1.59	15.90	0.15	3.03	44.48
101 – 240 hours	-6.07	35.27	-9.07	-3.07	-17.98	24.70	-20.22	-15.74	38.20
241+ hours	-36.95	40.92	-40.43	-33.47	-32.41	31.23	-35.24	-29.58	54.02
Part-time study	17.97	23.29	15.99	19.95	15.64	18.26	13.99	17.30	53.76
Full-time study	-28.52	27.75	-30.88	-26.16	-33.50	23.13	-35.60	-31.41	47.82
Flexible, self-paced study	10.56	24.64	8.46	12.65	17.86	19.36	16.11	19.62	58.55
Fair	-59.42	35.41	-62.44	-56.41	-74.06	30.79	-76.86	-71.27	44.86
Good	16.17	16.94	14.73	17.61	23.30	16.83	21.77	24.83	60.60
Excellent	43.25	25.19	41.11	45.40	50.76	20.94	48.86	52.66	37.03
No connections	-41.66	44.23	-45.42	-37.89	-48.37	32.02	-51.27	-45.46	45.13
Advanced placement	-0.93	27.66	-3.29	1.42	5.20	20.85	3.31	7.09	68.36
Employers recruit	42.59	39.14	39.26	45.92	43.17	31.50	40.31	46.03	52.94
No reimbursement	-34.83	21.25	-36.64	-33.02	-42.31	27.40	-44.79	-39.82	37.18
Partial	-9.32	12.92	-10.42	-8.22	1.65	15.11	0.28	3.02	72.16
Full	44.14	25.20	42.00	46.29	40.66	21.72	38.69	42.63	33.10
Cost	-37.92	29.83	-40.46	-35.38	-40.49	23.14	-42.59	-38.39	52.70
None	108.80	200.33	91.76	125.84	109.33	164.30	94.43	124.23	63.02

A3.2 Born in Canada

	Utility Yes				Utility No				
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**% alpha draws**
In-person	-24.73	46.86	-27.95	-21.50	-16.72	41.88	-22.67	-10.76	9.48
Blended	6.23	21.47	4.75	7.70	-1.73	17.23	-4.18	0.72	**98.68***
Online	18.50	52.27	14.90	22.10	18.44	46.27	11.87	25.02	34.52
1 – 15 hours	29.63	32.56	27.39	31.87	43.72	34.17	38.86	48.58	**2.07***
16 – 50 hours	11.56	33.98	9.22	13.90	34.31	30.48	29.97	38.64	**0.49***
51 – 100 hours	0.49	19.47	-0.85	1.83	-11.75	17.59	-14.25	-9.25	95.45
101 – 240 hours	-9.04	31.90	-11.24	-6.84	-21.15	27.05	-24.99	-17.30	91.96
241+ hours	-32.64	36.30	-35.14	-30.14	-45.13	37.58	-50.48	-39.79	91.71
Part-time study	15.76	21.48	14.28	17.24	21.61	18.52	18.98	24.25	7.33
Full-time study	-29.49	26.16	-31.29	-27.69	-36.23	23.45	-39.56	-32.90	96.18
Flexible, self-paced study	13.73	22.62	12.17	15.29	14.62	22.29	11.45	17.79	29.82
Fair	-68.46	34.43	-70.83	-66.09	-57.61	31.36	-62.07	-53.15	3.30
Good	18.73	17.54	17.52	19.93	22.56	15.61	20.34	24.78	44.58
Excellent	49.74	24.05	48.08	51.39	35.04	17.89	32.50	37.59	96.77
No connections	-43.18	39.22	-45.88	-40.48	-51.48	37.71	-56.84	-46.12	47.41
Advanced placement	1.03	25.37	-0.72	2.77	5.71	22.28	2.54	8.87	11.80
Employers recruit program graduates	42.16	35.76	39.70	44.62	45.77	35.49	40.73	50.82	85.97
No reimburseme nt	-37.92	24.45	-39.61	-36.24	-39.50	25.29	-43.10	-35.91	17.18
Partial	-5.64	14.66	-6.65	-4.63	1.69	14.81	-0.41	3.80	41.49
Full	43.57	24.16	41.90	45.23	37.81	20.90	34.84	40.78	94.33
Cost (Utility)	-38.25	27.01	-40.11	-36.39	-43.44	25.88	-47.12	-39.76	95.15
None	110.51	183.1 9	97.90	123.12	100.9 2	189.0 7	74.03	127.80	53.67

A3.3 Ethnic Identity

	Utility White				Utility Not White				
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**% alpha draws**
In-person	-23.71	48.09	-27.22	-20.20	-21.89	40.23	-26.58	-17.19	60.15
Blended	4.26	20.83	2.74	5.78	6.22	21.57	3.71	8.74	95.18
Online	19.45	52.86	15.59	23.31	15.67	46.55	10.23	21.10	7.30
1 – 15 hours	31.97	33.50	29.53	34.42	33.86	33.69	29.93	37.79	27.05
16 – 50 hours	15.59	35.86	12.97	18.21	16.65	30.68	13.07	20.23	12.00
51 – 100 hours	-2.31	19.75	-3.75	-0.87	-0.78	19.60	-3.07	1.51	83.27
101 – 240 hours	-10.64	32.80	-13.03	-8.24	-13.46	27.51	-16.67	-10.25	62.99
241+ hours	-34.61	36.81	-37.30	-31.92	-36.26	36.97	-40.58	-31.95	69.52
Part-time study	16.73	21.61	15.16	18.31	17.07	19.67	14.77	19.37	25.81
Full-time study	-31.78	26.37	-33.71	-29.86	-28.23	24.01	-31.03	-25.42	95.68
Flexible, self-paced study	15.05	22.89	13.38	16.72	11.16	21.48	8.65	13.66	11.08
Fair	-66.67	34.22	-69.16	-64.17	-65.72	33.81	-69.66	-61.77	8.01
Good	17.00	16.73	15.78	18.23	25.73	16.94	23.75	27.71	**99.08***
Excellent	49.66	24.40	47.88	51.44	39.99	20.19	37.63	42.34	10.37
No connections	-39.59	39.44	-42.46	-36.71	-58.20	34.66	-62.25	-54.16	**0.64***
Advanced placement	1.53	25.90	-0.36	3.42	2.93	21.94	0.37	5.49	30.94
Employers recruit program graduates	38.05	34.98	35.50	40.60	55.27	34.58	51.24	59.31	**99.83***
No reimbursement	-34.03	21.49	-35.60	-32.46	-48.94	28.46	-52.26	-45.62	**1.25***
Partial	-6.32	12.72	-7.25	-5.39	1.19	18.57	-0.97	3.36	89.43
Full	40.35	23.33	38.64	42.05	47.74	23.72	44.98	50.51	94.86
Cost	-39.55	28.02	-41.60	-37.51	-38.17	23.77	-40.95	-35.40	79.02
None	117.01	184.89	103.51	130.50	87.00	180.64	65.92	108.09	24.20

A3.4 Age

	Utility 24 - 34				Utility 35 - 44				Utility 45 - 54				Utility 55 - 64			
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**
In-person	-1.26	55.42	-9.04	6.52	-31.52	42.87	-36.51	-26.54	-36.65	42.16	-42.09	-31.22	-19.10	38.34	-23.51	-14.70
Blended	-4.61	26.79	-8.37	-0.85	2.01	16.29	0.12	3.91	14.22	19.31	11.73	16.71	6.38	18.68	4.24	8.53
Online	5.87	62.77	-2.94	14.68	29.51	47.25	24.01	35.00	22.43	49.75	16.01	28.85	12.72	44.24	7.64	17.80
1 – 15 hours	30.20	42.65	24.22	36.19	33.79	28.56	30.46	37.11	22.10	30.62	18.15	26.04	41.06	30.84	37.52	44.61
16 – 50 hours	-5.42	46.61	-11.96	1.13	10.10	22.98	7.43	12.78	35.18	27.97	31.57	38.78	20.50	29.03	17.17	23.84
51 – 100 hours	1.87	26.07	-1.79	5.52	3.73	15.89	1.88	5.58	-6.23	18.48	-8.61	-3.85	-6.42	17.00	-8.37	-4.47
101 – 240 hours	3.65	42.97	-2.38	9.68	-6.23	25.80	-9.23	-3.23	-16.22	25.37	-19.49	-12.95	-22.82	25.91	-25.80	-19.84
241+ hours	-30.30	49.09	-37.19	-23.41	-41.39	29.72	-44.85	-37.93	-34.82	33.78	-39.18	-30.46	-32.32	35.04	-36.35	-28.30
Part-time study	29.89	27.35	26.06	33.73	17.35	16.60	15.41	19.28	8.74	17.92	6.43	11.05	13.98	18.13	11.90	16.07
Full-time study	-37.14	33.71	-41.87	-32.41	-34.06	22.51	-36.67	-31.44	-29.35	24.37	-32.49	-26.21	-24.46	21.88	-26.97	-21.95
Flexible, self-paced study	7.24	29.86	3.05	11.44	16.71	19.34	14.46	18.96	20.61	21.57	17.83	23.39	10.48	18.30	8.37	12.58
Fair	-38.94	27.35	-42.78	-35.11	-72.10	30.14	-75.61	-68.60	-73.11	32.69	-77.32	-68.89	-73.93	33.70	-77.80	-70.05
Good	10.89	13.22	9.04	12.75	15.10	17.38	13.08	17.12	24.34	16.61	22.19	26.48	25.60	16.36	23.72	27.48
Excellent	28.05	18.76	25.42	30.69	57.00	23.11	54.31	59.69	48.77	21.18	46.04	51.50	48.33	21.81	45.82	50.83
No connections	-38.80	54.07	-46.39	-31.21	-48.20	30.41	-51.74	-44.66	-53.38	35.45	-57.96	-48.81	-38.78	35.47	-42.86	-34.71
Advanced placement	0.86	35.69	-4.15	5.87	3.46	18.71	1.29	5.64	7.42	21.96	4.58	10.25	-3.22	22.21	-5.77	-0.66
Employers recruit program graduates	37.94	48.39	31.15	44.73	44.74	31.47	41.08	48.40	45.97	31.24	41.94	50.00	42.00	32.38	38.28	45.72

	Utility 24 - 34				Utility 35 - 44				Utility 45 - 54				Utility 55 - 64			
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**
No reimbursement	-40.66	31.16	-45.04	-36.29	-41.87	22.13	-44.44	-39.29	-26.83	16.83	-29.00	-24.66	-42.09	24.33	-44.89	-39.30
Partial	2.05	17.36	-0.39	4.48	-7.17	14.68	-8.88	-5.46	-7.78	9.83	-9.05	-6.51	-2.66	15.37	-4.43	-0.89
Full	38.62	25.42	35.05	42.18	49.04	22.78	46.39	51.69	34.61	20.58	31.96	37.27	44.75	23.38	42.06	47.44
Cost	-27.67	34.27	-32.48	-22.86	-35.31	22.07	-37.88	-32.74	-43.66	23.94	-46.75	-40.58	-47.07	24.27	-49.86	-44.28
None	92.58	166.97	69.14	116.01	83.44	173.64	63.25	103.64	120.60	193.31	95.67	145.53	134.23	193.35	112.02	156.45

Age Alpha Draws

	% alpha draws					
Attributes	**24-34 / 35-44**	**24-34 / 45-55**	**24-34 / 55-64**	**35-44 / 45-55**	**35-44 / 55-64**	**45-54 / 55-64**
In-person	77.83	77.86	75.88	77.81	75.94	72.37
Blended	18.50	17.21	17.81	24.48	25.22	25.56
Online	53.06	54.96	56.12	46.79	48.20	51.32
1 – 15 hours	6.77	7.76	6.73	5.13	4.53	4.86
16 – 50 hours	43.42	40.56	42.42	28.19	29.83	31.20
51 – 100 hours	42.41	43.58	43.61	51.87	51.87	51.93
101 – 240 hours	85.79	86.15	86.64	86.88	87.40	87.26
241+ hours	68.83	67.94	67.80	72.99	72.93	71.41
Part-time study	66.20	67.63	67.05	64.56	64.07	63.71
Full-time study	69.70	67.84	67.12	72.09	71.39	70.34
Flexible, self-paced study	24.81	25.02	25.84	24.68	25.47	26.45
Fair	67.39	66.63	67.00	73.34	73.66	64.34
Good	15.32	13.12	12.78	17.29	17.13	16.80
Excellent	65.73	69.03	68.82	57.78	57.39	65.55
No connections	92.14	92.24	91.50	94.42	93.85	93.07
Advanced placement	33.09	32.96	34.59	32.38	33.85	33.39
Employers recruit program graduates	23.21	23.15	23.35	19.38	19.50	21.01
No reimbursement	70.94	66.30	71.70	50.96	57.04	54.42
Partial	34.16	36.84	31.64	20.56	17.58	16.13
Full	41.46	44.14	42.74	72.14	70.63	74.02
Cost	71.77	71.93	72.52	75.06	75.47	73.87
None	36.39	34.97	33.05	22.92	21.04	23.76

A3.5 Education

	Utility High School				Utility Post-Secondary				Utility Post- Graduate			
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**
In-person	-15.76	41.42	-22.15	-9.36	-28.97	42.36	-32.42	-25.52	-15.10	53.86	-21.60	-8.59
Blended	-9.54	19.25	-12.51	-6.56	7.45	18.37	5.95	8.95	7.82	23.87	4.94	10.71
Online	25.29	47.91	17.89	32.69	21.52	47.96	17.61	25.43	7.27	57.86	0.28	14.26
1 – 15 hours	49.11	30.42	44.41	53.81	29.92	30.22	27.45	32.38	27.98	38.91	23.28	32.68
16 – 50 hours	12.79	27.02	8.62	16.97	21.53	29.21	19.15	23.92	5.39	44.96	-0.04	10.83
51 – 100 hours	-9.81	17.83	-12.57	-7.06	-0.09	17.89	-1.55	1.36	-0.94	23.18	-3.74	1.86
101 – 240 hours	-20.21	22.23	-23.65	-16.78	-19.64	24.46	-21.64	-17.65	11.97	37.43	7.45	16.50
241+ hours	-31.88	35.28	-37.33	-26.43	-31.72	34.27	-34.51	-28.92	-44.41	41.41	-49.41	-39.40
Part-time study	4.97	15.36	2.60	7.34	18.14	19.62	16.54	19.74	21.22	24.35	18.28	24.17
Full-time study	-13.66	19.48	-16.66	-10.65	-36.89	23.36	-38.80	-34.99	-27.89	28.81	-31.37	-24.41
Flexible, self-paced study	8.69	17.58	5.97	11.40	18.75	20.48	17.08	20.42	6.67	26.62	3.45	9.88
Fair	-67.59	32.53	-72.62	-62.57	-66.78	32.60	-69.43	-64.12	-64.83	38.00	-69.42	-60.24
Good	23.62	16.56	21.07	26.18	18.68	16.92	17.30	20.05	18.63	17.96	16.46	20.80
Excellent	43.97	20.16	40.85	47.08	48.10	22.83	46.24	49.96	46.20	27.12	42.92	49.48
No connections	-49.62	31.86	-54.54	-44.70	-49.66	36.23	-52.61	-46.71	-31.29	45.38	-36.78	-25.81
Advanced placement	6.04	18.39	3.20	8.88	6.82	21.53	5.07	8.58	-11.33	29.82	-14.94	-7.73
Employers recruit program graduates	43.59	28.36	39.21	47.97	42.83	34.31	40.04	45.63	42.63	42.20	37.53	47.73

	Utility High School				Utility Post-Secondary				Utility Post- Graduate			
Attributes	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**	**Mean**	**SD**	**Lower 95% CI**	**Upper 95% CI**
No reimbursement	-35.18	20.64	-38.37	-31.99	-37.10	23.55	-39.02	-35.18	-42.58	28.24	-45.99	-39.17
Partial	-9.18	13.35	-11.24	-7.12	-5.19	13.67	-6.31	-4.08	1.03	17.07	-1.03	3.09
Full	44.36	23.47	40.73	47.98	42.29	22.67	40.44	44.14	41.55	25.82	38.43	44.67
Cost	-51.30	23.43	-54.92	-47.68	-41.89	23.23	-43.78	-40.00	-25.74	30.78	-29.46	-22.02
None	135.71	190.07	106.36	165.07	103.89	183.93	88.90	118.89	102.12	179.60	80.41	123.83

Education Alpha Draws

	% alpha draws		
Attributes	**High School / Post Secondary**	**High School / Post Graduate**	**Post-Secondary / Graduate**
In-person	4.94	22.11	81.45
Blended	**99.95***	**99.98***	80.22
Online	39.02	8.36	6.10
1 – 15 hours	**1.61***	**0.52***	24.31
16 – 50 hours	80.05	37.85	13.02
51 – 100 hours	88.03	78.54	51.48
101 – 240 hours	54.88	**99.41***	**99.98***
241+ hours	59.29	28.59	23.39
Part-time study	**98.83***	91.58	29.95
Full-time study	**0.11***	14.08	**98.60***
Flexible, self-paced study	95.50	44.93	3.88
Fair	59.59	34.12	21.37
Good	15.34	28.54	68.54
Excellent	83.04	82.76	58.20
No connections	64.07	**98.46***	**98.51***
Advanced placement	45.67	**1.94***	**0.63***
Employers recruit program graduates	36.40	37.22	47.05
No reimbursement	38.92	15.67	15.00
Partial	71.92	**97.56***	93.30

	% alpha draws		
Attributes	**High School / Post Secondary**	**High School / Post Graduate**	**Post-Secondary / Graduate**
Full	29.23	13.60	28.72
Cost	**98.32***	**99.98***	**99.98***
None	3.93	3.62	35.77