

Mapping a Path:

AI-assisted Co-Design Workflow for Infographics of Service Procedures

by

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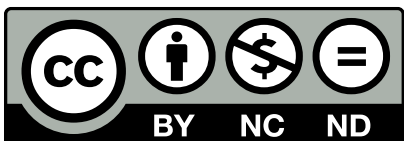
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Abstract

This thesis explores *how* to create infographics to improve access to essential services for immigrants who face language barriers. It proposes a co-creation workflow that combines the power of target communities, experts, and language-model AI to visualize service procedures.

Language barriers are among the top barriers blocking new immigrants' access to essential services in Canada, affecting their overall well-being. Applying the Research through Design (RtD) methodology, this research addresses this problem through a design activity following a Design Thinking process. It introduces the design challenge, the language barriers, and unpacks their impacts through literature review and the author's experience. By scanning and analyzing current solutions, this research converges on the potential solution: infographics. To explore this potential solution, the design activity diverges to examine multiple design considerations from different perspectives through secondary research and contextual work analysis. With the design considerations of ethical, social, and environmental impacts, and combining the feedback from the settlement service experts, the design activity concludes with a workflow as the proposed solution. This workflow includes three components: a series of co-design workshops with the target community, an AI-assisted web platform that accelerates collaboration between settlement service providers and graphic designers, and a mechanism for gathering feedback and initializing iterations.

This workflow sets the foundation for future research and design activities, including conducting the co-design workshop, developing the collaborative platform, and testing the output infographics.

Keywords

infographic, visualization, participatory design, co-creation, co-design,
language barriers, AI, artificial intelligence

Acknowledgements

This research journey began before my graduate program at OCAD University, spanned my entire study period, and extended even further. Throughout these years, I had the fortune of meeting many people and learning from them. Each shaped my research in their unique way.

The Lands

I thank the people who have lived on and protected the lands where OCAD University is situated. These are the treaty lands of the Mississaugas of the Credit First Nation and the ancestral territories of many nations, including the Anishinaabeg, the Haudenosaunee and the Huron-Wendat, who are the original owners and custodians of the land. The city that kindly hosts me, Toronto, is also home to many urban First Nations, Inuit and Métis. I cherish what these lands have been generously sharing with me. I acknowledge my responsibility to protect them for the next and coming generations.

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Thanks to mihyun maria kim¹ for sharing her academic journey and experience in project management, which helped me budget my research. I also admire how she differentiates artists and designers: designers solve problems, while artists raise questions.

¹ Spelled as she prefers.

Thanks to Professor Alexander Manu for mentioning the concept of "wayfinding" systems, which shaped my visual metaphor for this project at exhibitions.

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Co-Contributors

Special thanks to Clara Sparks (alias), Karine Vodopianova, and those who prefer to remain anonymous. You made everything possible.

Dedication

To Gavin.

May you live in a future where no bias arises from language barriers, and no potential is lost to miscommunication; and may I have contributed to that future.

AI Transparency

I wrote this paper without content generated by AI. Microsoft Editor and Grammarly (pro version) were used for proofreading.

I used several AI models or AI-based Apps in the research process for multiple purposes during the development process. Find more in ***AI Use in This Research*** at the end of this paper.

A Note to Readers

My thesis committee and I have made every effort to ensure the accuracy of this work; nevertheless, inadvertent errors or omissions may remain. It would be appreciated if you bring any necessary corrections to my attention:

jczhang@ocadu.ca.

TL; DR

For human readers, you are encouraged to read this paper as is, as it reveals my research journey. However, I recognize its length and your valuable time. Here is a guide if you are only interested in particular topics.

For my design process, read Section 1.2, Section 1.3.4, Section 2.3, Chapter 3, and Section 6.3.2. I also invite you to read [the second point of Section 6.5.2](#).

To learn the co-creation workflow, read Section 3.4 and [Appendix E](#).

For technology solutions, jump to Chapter 4. However, I also encourage you to read Section 3.3 and [the third point of Section 6.5.2](#).

To learn more about language barriers and understand my motivations behind this research, read Chapter 2, Section 1.1, and maybe the [Author's Note](#).

If you are a native English speaker, please read [the Prologue](#) before any other content.

If you are a visual thinker/learner, check Figure 1 in Section 1.3.4 (or [Appendix A](#)) before you dive in.

If any term below blocks your reading, you can find its definitions in this paper in [Appendix K](#): infographic, participatory design, co-design, co-creation, AI, application, App, essential services, policy, procedure, audience, immigrants, newcomer, user, settlement expert.

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Prologue

You are exhausted. You have travelled for quite a long time and haven't eaten for a whole day.

Finally, you find a restaurant. You walk in. Everyone looks friendly, with warm smiles on their face.

This is a good place to relax, you tell yourself.

A waiter is approaching, showing you to a seat, and handing you a menu in a very polite manner.

You are looking at this.

<i>Integer ornare semper auctor.</i>	
<i>Proin dapibus convallis felis non lobortis. Aliquam ac ligula</i>	9,50
<i>quis tortor viverra pulvinar sed sed orci!!! .</i>	
<i>Vivamus tincidunt neque scelerisque.</i>	
<i>Cras sit amet rutrum risus, quis tempus magna. Nulla</i>	29,00
<i>posuere lectus sed nibh tincidunt euismod. Aliquam</i>	
<i>convallis faucibus ex ut vehicular!!!</i>	
<i>Praesent luctus eget magna at placerat.</i>	
<i>Morbi ullamcorper varius bibendum. Suspendisse elementum</i>	259,00
<i>ligula non dui luctus elementum. Pellentesque habitant</i>	
<i>morbi tristique senectus .</i>	
<i>Ut egestas sollicitudin ultricies.</i>	
<i>Aenean eget maximus nibh, eu gravida ligula. Donec finibus</i>	599,00
<i>ut neque nec pharetra. Etiam convallis nibh vel lectus</i>	
<i>porttitor, vel luctus ligula faucibus.</i>	

Don't panic.

Author's Note

“Writing is designing.”

- Rebecca Diederichs, Writing Consultant, Centre for Learning & Teaching at OCAD University, Writing Workshop for Digital Futures, September 17, 2025

I wrote this paper following guidelines borrowed from UX Writing: be clear, concise, honest, and considerate.¹ I do so because I want you, who are interested in this topic, to feel included, whether or not you are an expert in this field or a native speaker of English.

This writing choice is not easy for me because I tend to write long and complex sentences to reflect my thinking process, which often involves pulling things from different perspectives, as well as using an objective tone, which was the muscle memory resulting from law school training, for example, sentences like this one. It is hard to read, especially if you want to read aloud while breathing.

My writing habit grew with my privilege of being proficient in my mother tongue, loving reading since I was a kid, and having a family able to afford my higher education. I speak and write with advanced terms in my mother tongue. My drafts of news, legal documents, and national government reports got passed on the first version. I was proud of my advantages in language, until I came to a strange country

¹ Fenton and Lee, *Nicely Said*, 44.

where my mother tongue is a foreign language. All the advantages disappeared overnight. I suddenly lost my ability to read, write and speak, not physically, but literally.

This experience altered my perspective on language. While spending years struggling to find my path back, I realized that fluency in verbal and written languages is a privilege. It is a privilege that not everyone is born with or able to gain easily. Therefore, sometimes, instead of delivering the message, written languages can also block communication. When blocking happens, it is the designers' responsibility to pave the path.

More than a decade ago, I *chose* to become a visual designer because I believe in two things. I believe in the impact of communication in society building. And I believe in the power of visual design in communication. These two beliefs were reinforced by my recent experience with language. Together, the three forces led to and powered this research, which is to lower the language barrier to accessing essential information through visualization.

Since I am aiming to lower the information barrier, I believe that I shall also lower the barrier for reading this paper. I shall choose my words, phrases, structures and tones mindfully in an easy-to-understand way. I am making these choices for the people I am writing to, the people who may not have the privilege of language fluency.

I want you to feel included.

1. Introduction

“The difficulties newcomers face as part of their settlement experience must be recognized as Canadian problems rather than as ‘immigrant problems.’”¹

- Sarah V Wayland, City of Hamilton, Unsettled: Legal and Policy Barriers for Newcomers to Canada

This research started with my personal experience. While still excited about landing in Canada, with heavy jet lag, I found myself surrounded by tons of settlement tasks. Overconfidently, I made a list and began searching government websites for information. Soon enough, I found myself overwhelmed and could not continue following my list.

The websites I visited were well-designed with accessibility in mind. As a UI/UX² designer, I could tell that for sure. I could read every sentence without problems. However, I found my mind unable to form a *big picture* of the whole procedure and I often looped between pages for the information I was seeking.

I needed a map.

¹ Wayland, ‘Unsettled: Legal and Policy Barriers for Newcomers to Canada’, IV.

² User Interface / User Experience

1.1. Background

This research would not exist if I believed the struggle above was my own. Over the years, I have met many immigrants whose experience echoes mine. From stalled refugee applications to an illegal double deposit demanded by their landlord, from opening a bank account to being discriminated against for “Canadian experience”, I witnessed the unfairness caused by language and information barriers. And these are not just a few individuals’ struggles. Enrolling in design courses at OCAD, I studied a few related topics, from housing to childcare. I learned that the language barrier is one of the top barriers for immigrants, according to both quantitative and qualitative studies. Those findings motivated this research.

As a visual designer, my instinct was to visualize the information. Designing infographics was my favourite and specialty. However, I also know, from my professional experience, that infographic design requires the designers to hold a fair understanding of the topics and can be time-consuming, therefore budget-unfriendly.

While designing a fintech application in early 2023, I explored using image-generative AI to visualize financial concepts (e.g., ETF¹) and service procedures (e.g., how to deposit money). At that moment, all mainstream AI Apps performed this task extremely poorly (see Figure 10). Not only could they not demonstrate the concepts, but some of them also did not even understand what infographics were. Most

¹ Exchange-Traded Fund.

importantly, the outputs were raster images, which meant that people could not edit the images easily to fix even a small typo.

Around the same time, I tested several Figma¹ plugins that were experimenting with transforming the design files into HTML² and CSS³ using AI. They were far away from being product-ready, in my opinion. In most cases, even if the generated code was rendered similar enough to the design, the nesting of elements does not follow the industry standard, nor is it ideal for maintainability.⁴ However, this experiment inspired the idea of using webpage technology to create infographics. I reasoned that if a language model can generate HTML, it can draft an editable infographic by generating the code.

Believing in this solution, I applied to OCAD University for academic support. However, I was preoccupied with one question: how do I make sure the output infographics are understandable across the communities with multiple cultural backgrounds? Fortunately, during my program, I found a research paper that addressed my concern. A graduate student team in Australia, another migrant-destination country with multicultural populations (similar to Canada), had applied co-design workshops to respond to this question. This study offers a starting point to answer my question.

¹ Figma is a User Interface prototype App featured with rich community-powered plugins. Learn more: <https://www.figma.com/>

² HyperText Markup Language.

³ Cascading Style Sheets.

⁴ Over the last three years, this area developed rapidly. By the time this paper was writing, AI has been able to generate webpage from prompts, skipping the design process entirely.

1.2. Research Questions

My primary thesis research question is: ***How might we create infographics to improve access to essential services for immigrant communities?*** This question led to two secondary questions.

To answer *How*, first we need to define *What*. We need to learn *what kind of infographics work for immigrant communities* in Canada. Respecting cultural diversity, this research does not believe in a one-for-all answer. Therefore, instead of trying to define the design guideline, this research asks: ***What design process might maximize the degree of understandability and inclusivity of infographics optimized for immigrant communities?*** Within the scope of this research, this paper addresses this question through secondary research and expert/user interviews.

Second, as a woman in technology and a graduate student in the Digital Futures program at OCAD University, I wondered whether technology could accelerate the process or lower the cost to create such infographics. And this wonder led to another question: ***How might we apply the available technology, such as AI, to support the creation of infographics?*** To answer this question, I developed a prototype using web and AI technologies, following the principles I drew from this first secondary question.

1.3. Research Worldviews, Methodologies, Methods, and Research/Design Activities

1.3.1. Worldviews

Research worldviews are “general philosophical orientation[s] about the world and the nature of research that a researcher brings to a study.”¹ Worldviews are the foundation of how a researcher designs their research approaches (qualitative, quantitative, or mixed methods) and what research methods they choose.

Pragmatic Worldview

This research applies the pragmatic worldview, which focuses on the research questions and outcomes instead of the methods.² The pragmatic worldview is often paired with mixed methods (both qualitative and quantitative), using “all approaches available to understand the problem”³. It is considered as an ideal philosophy for design activity.⁴

Applying the pragmatic worldview, the researcher is aware of the social contexts of this research, accepts plural realities, and recognizes the researcher’s

¹ Creswell, *Research Design*, ch. 1.

² Kaushik and Walsh, ‘Pragmatism as a Research Paradigm and Its Implications for Social Work Research’, 2.

³ Rossman & Wilson, cited in Creswell, *Research Design*, 39.

⁴ Findeli et al., *Research Through Design and Transdisciplinarity*, 81.

freedom to choose suitable research methods, techniques, and procedures¹ based on their life experiences and professional expertise.

Transformative Worldview

The transformative worldview recognizes the importance of addressing powers and privileges during the research process², aiming for positive changes for participants and meaningful reform for institutions³. It sees the researcher as “one who recognizes inequalities and injustices in society and strives to challenge the status quo”.⁴

This research did not apply the transformative worldview directly (it designed but has not piloted the workflow). However, the research was conducted with the beliefs of the transformative paradigm in mind: respect, beneficence, and justice⁵. It designed the workflow aiming to engage and empower the target audience through their participation in this research.

1.3.2. Methodology

Research through Design (RtD)

RtD allows this research to generate knowledge through a design process.

In his 1993 paper “Research in Art and Design”, Christopher Frayling exemplified three types of research that can be considered as *Research through Art*

¹ Creswell, *Research Design*, 39–40.

² Mertens, ‘Transformative Paradigm’, 213.

³ Creswell, *Research Design*, 38.

⁴ Mertens, ‘Transformative Paradigm’, 212.

⁵ Mertens, ‘Transformative Paradigm’, 216.

and Design. They are *material research*, *development work*, and *action research*.¹

This description is often critiqued as vague.² Several researchers tried to define RtD more clearly. Zimmerman and Forlizzi at Carnegie Mellon University define RtD as “a research approach that employs methods and processes from design practice”³.

While Sevaldson, a professor at Oslo School of Architecture and Design, simply defines it as “[a]ny research where the design practice is central in generating knowledge”⁴

Researchers/designers also try to build standards for RtD. For the Human-Computer Interaction (HCI) research community, Zimmerman et al. argue the importance of design **artifacts** in RtD: “...researchers make prototypes, products, and models to codify their own understanding of a particular situation and to provide a concrete framing of the problem and a description of a proposed, preferred state”⁵. They also summarized a six-phase design **process** that is commonly applied in RtD in HCI: *Define*, *Discover*, *Synthesize*, *Generate*, *Refine*, *Reflect*⁶. Findeli et al. proposed three domains a RtD **conclusion** could contribute to: design knowledge, design practice and user satisfaction, and design education.⁷ For Zimmerman and Forlizzi, the **outcomes** of RtD should be either “extensible

¹ Frayling, *Research in Art and Design*, 1:5.

² Findeli et al., *Research Through Design and Transdisciplinarity*, 72; Koskinen, *Design Research through Practice*, 1.1.

³ Zimmerman and Forlizzi, ‘The Role of Design Artifacts in Design Theory Construction’, 42.

⁴ Sevaldson, ‘Discussions & Movements in Design Research’, 11.

⁵ Zimmerman and Forlizzi, ‘The Role of Design Artifacts in Design Theory Construction’, 42.

⁶ ‘The Role of Design Artifacts in Design Theory Construction’, 43.

⁷ *Research Through Design and Transdisciplinarity*, 72.

constructs” or “new processes, design methods, and empirical evaluations”¹. The **types of theory** that come from RtD can be conceptual work, applicability of conceptual perspectives from other disciplines, manifestos, frameworks, or standards of RtD².

It is worth noting that, as Batista pointed out, the original categories did not include new design activities, such as service design or experience design.³ The development of RtD is also focused on design *artifacts*, not methods. For this reason, while designing a workflow, this research applies this methodology with flexibility.

1.3.3. Methods

Literature Review

A literature review is “systematic syntheses of previous work around a particular topic”⁴ This research uses literature review to define and understand the design challenge and its current solutions. Literature review is also the main research method to inform design choices, for example, how to involve with target audience and what is the role of AI in this research.

¹ Zimmerman and Forlizzi, ‘The Role of Design Artifacts in Design Theory Construction’, 44.

² Gaver, ‘What Should We Expect from Research through Design?’, 938.

³ *The Ontology of Design Research*, 16.

⁴ Card, ‘Literature Review’.

Competitive Analysis (Cooperative Analysis)

Competitive analysis is an “evaluation of competitors’ ability”.¹ This research uses two-by-two matrix charts for the competitive analysis, placing current solutions and drawing the goal for the design process. I prefer the term “cooperative” rather than “competitive” because I see the current solution as *cooperators*, not *competitors*, as they are meant to work together.

Semi-structured Interview

Semi-structured interview is a kind of interview containing “open-ended questions interspersed with questions of clarification, further meaning-making, and critical reflection within the interview”.² This research uses semi-structured interviews to interview settlement experts to learn their knowledge on the design challenge, prepare for future research, and collect feedback on the drafted workflow and prototype. I prepared a list of open-ended questions with potential follow-up questions to guide the interviews. During the interview, I adjusted the flow based on the interviewees’ expertise, interests, and reactions.

Thematic Analysis

Thematic analysis is a “process of looking over data to identify ... noticeably repetitive pieces of data” and cluster them into themes.³ This research uses thematic analysis to analyze the raw data from the semi-structured interviews. I

¹ Qatar Financial Center, ‘Competitive Analysis’.

² Galletta, ‘Semi-Structured Interview’.

³ Stokes, ‘Thematic Analysis’.

initialled codes from my interview notes, then coded the transcript while developing new codes until themes had formed.

Reflexivity Analysis

Reflexivity recognizes and reflects the influence of the researchers' own backgrounds on the research.¹ This method emerged in the field of ethnography during worldviews changing in 1980s.² I applied reflexivity analysis before, during and after this research. At the beginning of this paper, I revealed my personal experience and how it motivated this project. Through the design and prototype chapters, I explained how my professional knowledge and preferences informed the design decisions. At last, I presented my reflections alongside the findings.

1.3.4. Research/Design Activities

This research adapts **Research through Design**³ methodology. It addresses the research questions by exploring possible solutions through design activities that follow the Design Thinking process under a pragmatic worldview.

A Design Thinking (DT) process is “a flexible way of working...from ideas to outcomes”.⁴ It provides a set of mindsets and methods through the creation process, balancing desirability for humans, economic viability, and technical

¹ Olmos-Vega et al., ‘A Practical Guide to Reflexivity in Qualitative Research’, 244.

² O'Reilly, ‘Reflexivity’.

³ Frayling, *Research in Art and Design*, 1:5.

⁴ IDEO, ‘The Design Thinking Process’.

feasibility.¹ DT usually follows a rhythm of divergent and convergent thinking to progress.²

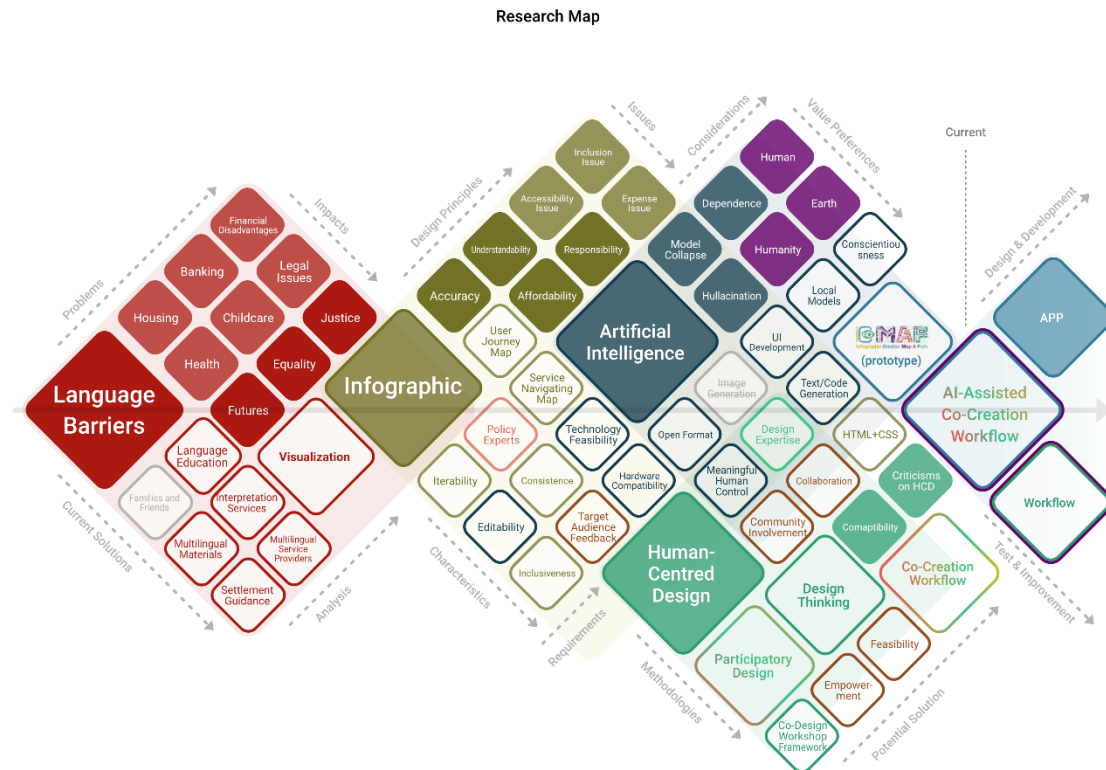


Figure 1 The Design Thinking Process of This Research, created by the author of this paper.

My design process started with understanding the challenge: language barriers. While accepting my own experience as valid research data, I also conducted a literature review to investigate previous studies on language barriers, their consequences for immigrants, and current solutions. I analyzed the current solutions using “cooperative analysis” (competitive analysis) on two-by-two matrix charts and then set the goal of the design process. This activity serves double

¹ IDEO, ‘Design Thinking by IDEO’.

² IDEO, ‘The Design Thinking Process’.

functions: it is the background review of the *research* and the secondary research on the design challenge in the *design process*.

After setting the goal of the solution, I examined the design choices through secondary research on infographics, AI technology, and participatory design. These previous studies informed me as I drafted the workflow and defined the principles for the prototype. Applying these principles, I developed and iterated a prototype that demonstrates the workflow and proves the technology's feasibility. Lastly, to inform future iterations, I presented the drafted workflow and prototype to a few settlement experts through semi-structured interviews. Their feedback was collected and analyzed through thematic analysis.

In the end, I returned to the research layer. Applying the reflexivity analysis research method, I examined the scope, reflected on my decisions, summarized the findings of this research, and planned future activities.

1.4. Outcomes

There are two outcomes of this research: a drafted workflow for creating infographics of service procedures, combining the power of communities, settlement experts, graphic designers, and AI. And a prototype of an App that accelerates this collaboration.

2. *a challenge*: Literature and

Contextual Review on Language

Barriers

“The language is the only barrier.”¹

- a participant, quoted in A Qualitative Look at Serious Legal Problems Facing Immigrants in London and Toronto, Ontario by Alina Sutter and Victoria Esses

If you are still puzzled by the menu in the prologue, do not worry about your sanity. What you were reading does not belong to any real language. It is *Lorem Ipsum*, a placeholder text traditionally used in graphic design and publishing². No one understands it.

However, *someone* understands the feelings you were experiencing: shock, confusion, frustration, disappointment, and even betrayal. These feelings belong to almost every immigrant who is new to this country.

¹ Sutter and Esses, *A Qualitative Look at Serious Legal Problems Facing Immigrants in London and Toronto, Ontario*, 33.

² Wikipedia, ‘Lorem ipsum’.

2.1. Immigrants

Since World War I, **Canada has been a country of immigrants**. Its immigrant population has been growing at a steady rate in the last four decades. (see Figure 2) According to the *2021 Census of Population*, nearly a quarter of the Canadian population were landed immigrants or permanent residents. In big cities, such as Toronto, Montréal and Vancouver, the percentages of immigrants have already surpassed 50% in certain areas.¹ Statistics Canada predicts that half of the Canadian population (and 4 out of 5 Torontonians) will be immigrants or the children of immigrants in 2041². While not every immigrant comes with fluency in Canada's official languages, either English or French.

¹ Statistics Canada, 'Immigrants Make up the Largest Share of the Population in over 150 Years and Continue to Shape Who We Are as Canadians', 3–4, 17.

² Statistics Canada's Centre for Demography, *Canada in 2041: A Larger, More Diverse Population with Greater Differences between Regions*, 1, 9.

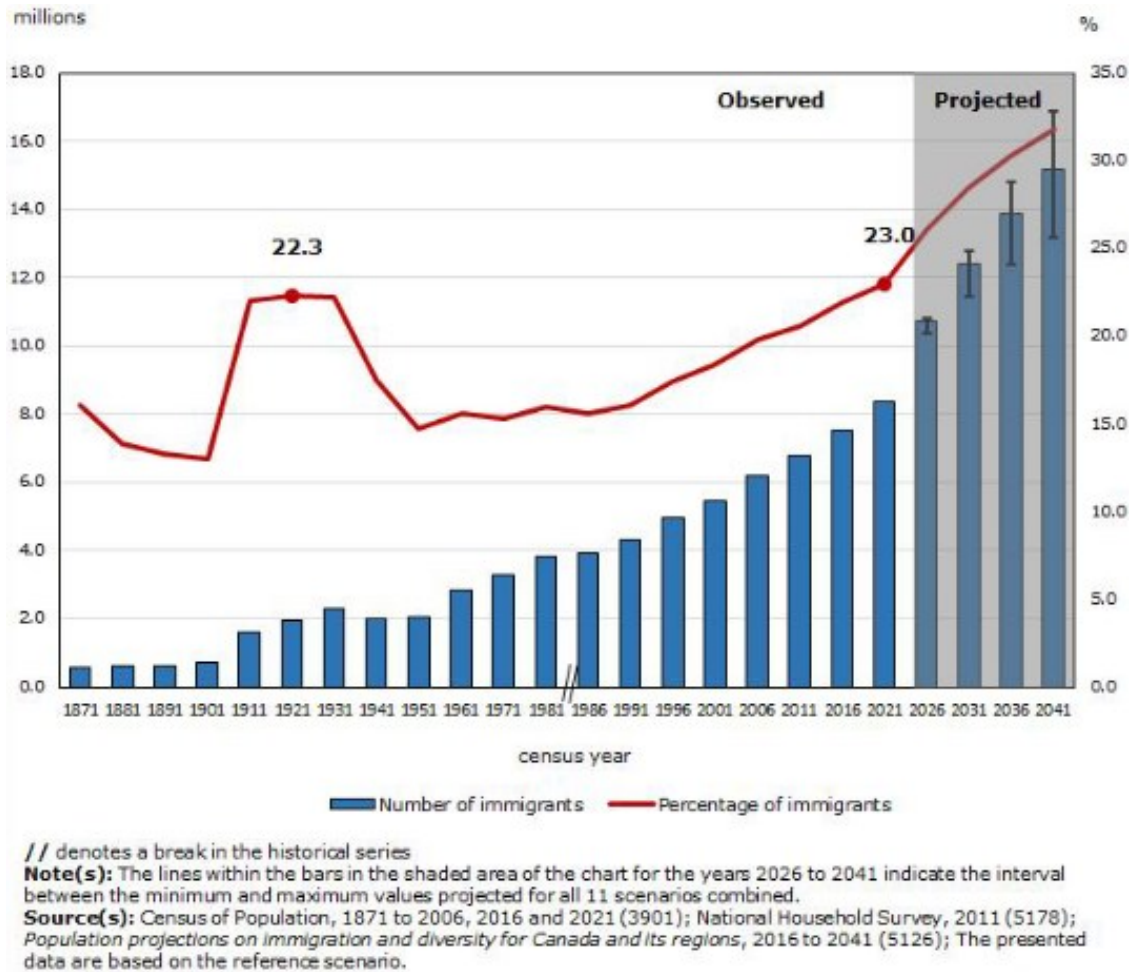


Figure 2 Nearly one in four people in Canada is an immigrant, the highest proportion of the population in more than 150 years.¹ Licence granted by Statistics Canada.²

Most of the immigrants do not speak the official languages as their mother tongues. According to a 2022 report by Statistics Canada, 69.4% of the immigrants landing between 2016 and 2021 did not have either of the official languages as their first language.

The average reading and writing levels of landing immigrants are not sufficient for tasks that require language skills. Using English as an example,

¹ Statistics Canada, 'Immigrants Make up the Largest Share of the Population in over 150 Years and Continue to Shape Who We Are as Canadians', 3.

² <https://www.statcan.gc.ca/en/terms-conditions/open-licence>

according to 2012 Edition of the *Canadian Language Benchmark (CLB)* official standard, while a person with writing skills of level 5 to 6 can take notes about how to get a driver's license and fill out an application form for it,¹ they need to have a reading skill of level 9 to be able to “extract information from policy and procedure manuals...to reorganize [it] into step-by-step procedures”². A 2010 study funded by *Citizenship and Immigration Canada (CIC, former IRCC)* found that the average English level of the examples measured by the CLB Assessment is 6.5.³ Another 2010 study on the *Language Instruction for Newcomers to Canada (LINC)* program suggests more than three-quarters of their clients are below level 5⁴ (see Figure 3). A 2018 report on language assessment by YMCA of Greater Toronto shows the average reading and writing skills are just above level 4.⁵ These numbers⁶ mean that most immigrants who participated CLB assessment do not have enough language skills to accomplish the tasks that involve policies and procedures.

¹ Pawlikowska-Smith, *Canadian Language Benchmarks*, 125–26.

² Pawlikowska-Smith, *Canadian Language Benchmarks*, 102.

³ Derwing, *An Examination of the Canadian Language Benchmark Data from the Citizenship Language Survey*, 4.

⁴ Evaluation Division, *Evaluation of the Language Instruction for Newcomers to Canada (LINC) Program*, 2, 7.

⁵ YMCA of Greater Toronto, *Stats Presentation*, 9.

⁶ To understand these data better, you need to know two factors. One is that the highest score of CLB assessment is 8. Those whose English is better than level 8 will be counted as 8. This factor lowers the average score. Two is that, based on my experience, CLB score is only required for government-funded immigration-related services, for examples, LINC program and job service programs. Therefore, those who do not access these services, no matter their English is better or worse, are not counted into the analysis because they never took this assessment.

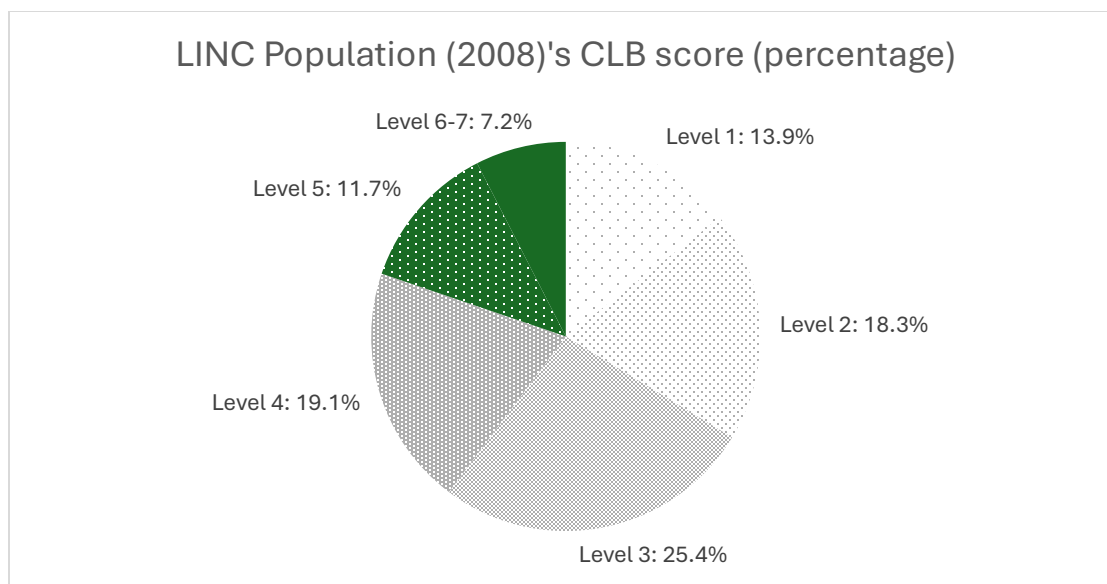


Figure 3 LINC Population (2008)'s CLB score (percentage), made by the author based on data from the survey ¹

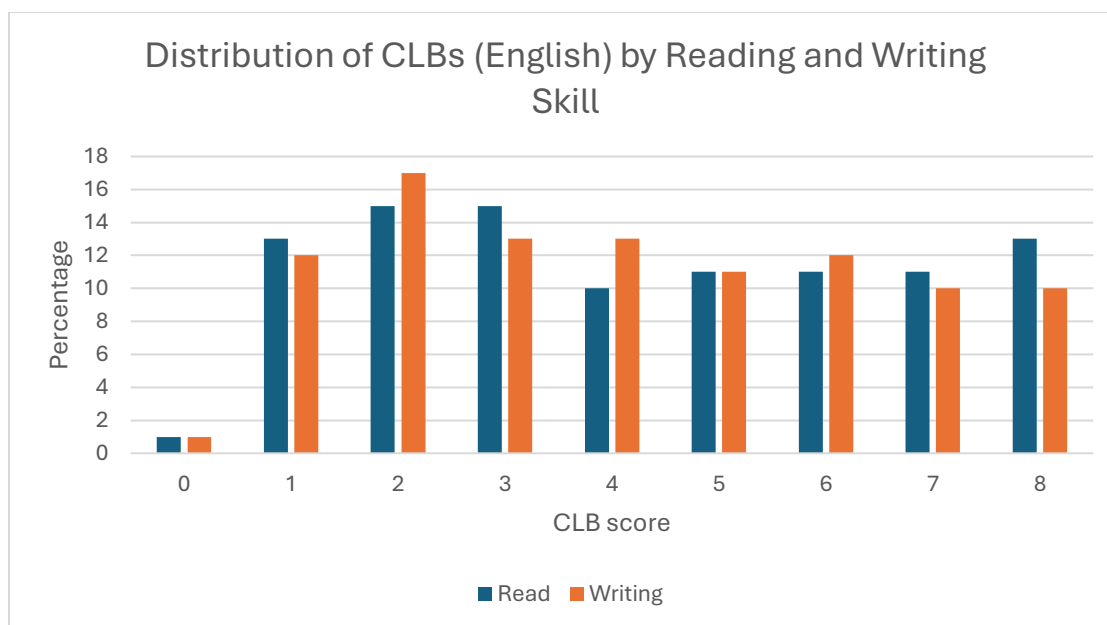


Figure 4 CLB score (percentage), made by the author based on data from the report ²

Providing information or services via websites or Apps may exacerbate the language barrier. In a study based on authorized secondary data, Jakob Nielsen, a usability pioneer and co-founder of Nielsen Norman Group, concluded

¹ Evaluation Division, *Evaluation of the Language Instruction for Newcomers to Canada (LINC) Program*, 7.

² YMCA of Greater Toronto, *Stats Presentation*, 9.

that users would only read about 20% of a Web page that contains about 600 words.

People read even less when there are more words.¹ And government service instructions tend to be (much) longer. For instance, the page “Get a G driver’s licence: new drivers” by the Ontario Government² contains 1445 words, without counting the *external* links leading to *more* readings. In a qualitative report in British Columbia, 30% of cases described government websites as difficult to understand, therefore unhelpful.³

Language barrier impacts immigrants’ daily life. Recently, a 2025 report by North East Toronto Local Immigration Partnership (NETLIP) shows that language is listed as one of the top barriers by participants across 5 out of 6 neighbourhoods of Toronto, one of the largest cities in Canada, blocking them from accessing “health care, legal support, employment, and emergency services ”.⁴ A case study in a 2021 report identified that language is at the top of the barriers causing stress and trauma for refugees who are searching for housing.⁵ In healthcare services, the language barrier causes lower engagement in prevention and screening programs and therefore higher emergency department service for immigrant populations.⁶

¹ Nielsen, ‘How Little Do Users Read?’

² Ministry of Transportation, ‘Get a G Driver’s Licence’.

³ Verhage, *A Qualitative Look at Serious Legal Problems Faced by Immigrants in Greater Victoria and Vancouver, British Columbia*, 31, 42.

⁴ NETLIP (North East Toronto Local Immigration Partnership), *NETLIP Focus Group Analysis Report 2025: Insights on Newcomer Needs and Service Gaps Across Neighbourhood Clusters in North York and Scarborough*.

⁵ Preisler, *Student Report No. 3*, 32.

⁶ Bowen, *Language Barriers in Access to Health Care*, 61.

In summary, a significant portion of the Canadian population is immigrants with limited official language proficiency, which blocks them from accessing essential services and supports in all aspects of their lives.

2.2. Language Barriers

From big things (where should we rest tonight) to small things (where to find a SIM¹ card), or the things that should be big but small (where is the TTC² bus stop³), the newcomers are facing many tasks when they start their life in a strange country. On the webpage for newcomers by the federal Government of Canada, there are 21 categories⁴ of the settlement-related services. As helpful as they are, navigating through these services is overwhelming. Because, not only are the newcomers facing a new environment and handling multiple essential issues under time pressure, but they are also doing so through a language they are not fluent in.

Several studies pointed out that **language is one of the top barriers for newcomers to start their new life in Canada**.⁵ In 2019, *Canada Revenue Agency (CRA)* found that many participants struggle with “understanding medical, legal, banking, and insurance documents”, which impacts their ability to undertake

¹ Subscriber Identity Module, a thumb-sized circuit for mobile phone.

² Toronto Transit Commission (a public transit service provider in Toronto).

³ This is a true story of my first landing day. Getting used to the huge bus stop signs with all the stops listed at my hometown, I could not identify the white metal bar next to me as a TTC bus stop even Google Map showed that I was standing on it.

⁴ Immigration, ‘Settling in Canada’.

⁵ Bowen, *Language Barriers in Access to Health Care*; Bajwa et al., ‘Refugees, Higher Education, and Informational Barriers’; Statistics Canada, *Settlement Services Provided to Immigrants to Canada, 2020*; Preisler, *Student Report No. 3*; Sutter and Esses, *A Qualitative Look at Serious Legal Problems Facing Immigrants in London and Toronto, Ontario*; Canada Revenue Agency, *Ethnography of Vulnerable Newcomers’ Experiences with Taxes and Benefits*; Browning, ‘For Refugees, Better Language Learning Means Better Integration | Citizens for Public Justice’; Brown et al., ‘Newcomer Families’ Experiences with Programs and Services to Support Early Childhood Development in Canada’; Wayland, ‘Unsettled: Legal and Policy Barriers for Newcomers to Canada’; NETLIP (North East Toronto Local Immigration Partnership), *NETLIP Focus Group Analysis Report 2025: Insights on Newcomer Needs and Service Gaps Across Neighbourhood Clusters in North York and Scarborough*.

administrative tasks.¹ These settlement-related administrative tasks burden newcomers heavily because they are dealing with both linguistic and cultural unfamiliarity right after their landing.²

Language and cultural barriers lead to financial disadvantage and violation. A CRA report found that language barriers can block immigrants from accessing information about benefits.³ The same report found that immigrants who cannot speak/read official languages are “particularly vulnerable to being taken advantage of”.⁴ **Language barriers also create difficulties in accessing the justice system⁵, worsen newcomers’ unfamiliarity with Canadian law⁶, and block immigrants from protecting their rights.⁷** Presented by Community Foundations of Canada and the Law Commission of Canada, a 2006 study by Wayland pointed out that the lack of official language proficiency impacts service access and decision-making about legal issues.⁸ Moreover, **language barriers worsen the situations of already vulnerable populations.** Data shows that those whose English levels are lower are females, refugees, and people who are from East Asia and Southeast

¹ Canada Revenue Agency, *Ethnography of Vulnerable Newcomers’ Experiences with Taxes and Benefits*, 17.

² Canada Revenue Agency, *Ethnography of Vulnerable Newcomers’ Experiences with Taxes and Benefits*, 19–20.

³ Canada Revenue Agency, *Ethnography of Vulnerable Newcomers’ Experiences with Taxes and Benefits*, 17, 24.

⁴ Canada Revenue Agency, *Ethnography of Vulnerable Newcomers’ Experiences with Taxes and Benefits*, 17, 24.

⁵ Currie, ‘The Legal Problems of Everyday Life’, 2.

⁶ Wayland, ‘Unsettled: Legal and Policy Barriers for Newcomers to Canada’, 8.

⁷ Currie, ‘The Legal Problems of Everyday Life’, 2.

⁸ Wayland, ‘Unsettled: Legal and Policy Barriers for Newcomers to Canada’, 19.

Asia¹. And these immigrant groups have already faced tougher situations than others. A study based on the 2014 Canadian Financial Capability Survey (CFCFS) shows that immigrant women score lowest on financial knowledge², which is more likely to place them at a financial disadvantage. A 2021 quality study published by the Department of Justice Canada shows that refugee and family-class immigrants are particularly likely to be unable to resolve legal issues due to the language barrier, making them more vulnerable to misinformation or disinformation.³ Lastly, immigrants who were born in Asia are facing larger cultural differences than those who share Western cultural backgrounds. They also have to put more effort into improving their official language skills because their mother tongues are significantly different than English or French.⁴

Language barrier impacts immigrants' future opportunities and creates long-term, even multi-generational disadvantage for the population. A qualitative study on refugees' experience finds that the lack of language skills affects their ability to access information for educational pathways.⁵ The lack of language skills can also harm the next generation of immigrants. A 2020 review paper concludes that low official language proficiency of parents, especially

¹ Derwing, *An Examination of the Canadian Language Benchmark Data from the Citizenship Language Survey*, iii, 5–6.

² Drolet, *Gender Differences in the Financial Knowledge of Canadians*, 5.

³ Currie, 'The Legal Problems of Everyday Life', 33.

⁴ Statistics Canada, 'Immigrants Make up the Largest Share of the Population in over 150 Years and Continue to Shape Who We Are as Canadians', 12–14.

⁵ Bajwa et al., 'Refugees, Higher Education, and Informational Barriers', 59–60.

mothers, limits their children's opportunities to access educational services and health supports.¹

¹ Brown et al., 'Newcomer Families' Experiences with Programs and Services to Support Early Childhood Development in Canada', 188–90.

2.3. Current Solutions

From the government and service providers' sides, there *are* working solutions to assist newcomers in accessing essential services. These include official language education¹, multilingual materials², interpretation services³, the guidance provided by the settlement agencies⁴ (settlement guidance), and connecting immigrants with the service providers who share their mother tongues⁵ (multilingual service providers). However, most of these solutions are limited by the service providers' budgets or are not fast enough to overcome the barriers to daily tasks⁶.

Language education provides fundamental and long-term support. Not only does it improve the immigrants' overall language skills, but it also introduces them to Canadian norms and culture, which empowers them to better navigate the services. Additionally, the in-person classes provide opportunities for newcomers to meet and exchange information and experiences. However, it takes a long time to achieve the goal of service access. Studies show that students need to spend more than 1000 hours (more than one year for a 3-hour-per-day student) to gain a

¹ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 20; Bajwa et al., 'Refugees, Higher Education, and Informational Barriers', 62.

² Caulford, 'Helping Newcomers Overcome Barriers to Health Care', 400; Currie, 'The Legal Problems of Everyday Life', 45.

³ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 20, 24; Bowen, *Language Barriers in Access to Health Care*, 97–98; Caulford, 'Helping Newcomers Overcome Barriers to Health Care', 400.

⁴ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 20; Bajwa et al., 'Refugees, Higher Education, and Informational Barriers', 62.

⁵ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 20.

⁶ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 19.

measurable benchmark rise.¹ Language classes are also resource-intensive and, consequently, easily disrupted. It requires adequate places at accessible locations, a sufficient number of properly trained and equipped educators², responsible managers and staff, and related services (for example, transportation assistance and on-site affordable childcare³). Any of these factors can affect the quality of the language education. A study shows that the learning experiences of LINC⁴ vary across locations, even within one city⁵.

Language education also relies on consistent funding. And they are not cheap. In 2009, the average cost of each LINC student was more than C\$3000 per year.⁶ This number today would be only higher due to inflation. On the other hand, funding for such programs was cut⁷ due to recent policies and political changes, resulting in classes being terminated⁸. This change limits immigrants' access to this support. Taking Toronto as an example, the LINC and ESL⁹ programs consistently have long waitlists across the city in recent years, especially at locations with on-

¹ Evaluation Division, *Evaluation of the Language Instruction for Newcomers to Canada (LINC) Program*, 32–36.

² Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 24.

³ Toronto District School Board, 'LINC - Language Instruction for Newcomers to Canada'.

⁴ Language Instruction for Newcomers to Canada

⁵ Toronto North Local Immigration Partnership (TNLIP), 'Toronto North Local Immigration Partnership: Newcomer Settlement Strategy 2021-2025'.

⁶ Evaluation Division, *Evaluation of the Language Instruction for Newcomers to Canada (LINC) Program*, 40.

⁷ Toronto District School Board, 'Transitional Funding Support for Newcomer Language Programs - Letter to Canada's Minister of Immigration, Refugees and Citizenship'.

⁸ For example, the level 7-8 LINC class I used to attend was terminated in 2024.

⁹ English as a Second Language. Funded by the Government of Ontario.

site childcare.¹ This is because having their children cared for is essential for newcomer parents to attend language education.²

Multilingual materials are a great method to offer instant access to information for immigrants who lack fluency in the official languages. It is a practical solution applied by different levels of government in Canada. For example, Elections Canada provides a detailed *Media Guide* in the five most-spoken languages in Canada³, while the City of Toronto provides multilingual websites using Google Translate⁴. Accessing information in their mother tongue is welcomed by newcomers as one key to equity.⁵ However, this solution has three flaws.

First, translation qualities vary across different services, and the inconsistent terms can cause confusion. Machine translation, such as Google Translate, is hard to provide consistent and context-aware results. In the case of human translators, different contractors may have different styles and preferences. Some translations, speaking from my own experience, are grammatically correct but do not respect the native speakers' cultural mindset (they are understandable but are not common expressions). Taking election information as an example, the English term "ID" is

¹ NETLIP (North East Toronto Local Immigration Partnership), *NETLIP Focus Group Analysis Report 2025: Insights on Newcomer Needs and Service Gaps Across Neighbourhood Clusters in North York and Scarborough*, 31–32.

² Toronto North Local Immigration Partnership (TNLIP), 'Toronto North Local Immigration Partnership: Newcomer Settlement Strategy 2021-2025'.

³ Elections Canada, 'Elections Canada'.

⁴ City of Toronto, 'Translate'.

⁵ NETLIP (North East Toronto Local Immigration Partnership), *NETLIP Focus Group Analysis Report 2025: Insights on Newcomer Needs and Service Gaps Across Neighbourhood Clusters in North York and Scarborough*, 33.

sometimes translated into “身份证明文件” (Elections Canada’s *Election Day* in Simplified Chinese¹) and sometimes into “身份证件” (Elections Alberta’s *Voting in Alberta Provincial Guide* in Simplified Chinese²), and sometimes into both (Elections Canada’s *Media Guide* in Simplified Chinese³). Although, technically, 身份证件 is a short version of 身份证明文件, they tend to refer to different types of documents in Simplified Chinese: 身份证件 is usually a small card or tiny book issued by the government that you can carry daily, and 身份证明文件 are more likely A4-sized documents with seals of authorities. As tiny as they can be, these nuances can also overwhelm immigrants when they are added up.

Second, translations are hard to consider the cultural diversity of the immigrants’ original countries. People whose mother tongues are categorised as the same language may use very different grammars and dialects. Translations may feel perfect for people from one city but quite odd for people from another one. Languages also evolve rapidly over time. One immigrant’s mother tongue reflects the language development at the time they left their original country. The translations that work for immigrants who landed in a particular period of time may not work for those who come later.

Third, multilingual materials do not help newcomers to learn the languages that are required for taking actions, for example, filling out an application.

¹ Elections Canada, ‘星期一联邦大选日’.

² Elections Alberta, ‘艾伯塔省投票指南’, 5.

³ Elections Canada, ‘Elections Canada’, 11, 17.

Multilingual materials have to work together with interpreters or service providers who speak their mother tongue to fully address the language barrier to access services.

Interpretation services and **multilingual service providers** help immigrants *during* the service process. They provide immediate and efficient assistance for those who need guidance in their mother tongue. **Interpretation services** require an extra budget that most service providers do not have.¹ While **multilingual service providers** can be achieved by hiring employees from diverse cultural backgrounds without extra budget. Both methods provide an additional benefit to immigrant communities by creating jobs. However, they also share the same issue: The immigrants may face uncertain waiting time to be matched with the suitable service providers or interpreters, depending on how common their mother tongues are in Canada.

Among all the settlement services funded by the federal government of Canada, information and orientation, referred to as **settlement guidance** in this paper, were accessed most². Settlement guidance itself does not directly address the language barrier. It helps newcomers to assess their situation, tailor settlement plans, and recommend services/programs. In other words, it eases newcomers' cognitive burdens by "revealing the map" and "showing the path". To address the language barrier, the settlement guidance service needs to work with multilingual

¹ Wayland, 'Unsettled: Legal and Policy Barriers for Newcomers to Canada', 20, 24.

² Statistics Canada, *Settlement Services Provided to Immigrants to Canada, 2020*, 1.

service providers or interpreters, both within settlement service organizations (e.g., community centres) and with target service providers (e.g., Service Ontario).

Current solutions are analyzed using two **two-by-two matrix** charts as shown below. Due to a lack of exact numbers, the positions on the axis are rather qualitative than quantitative, representing the solutions' relations (A is likely more costly than B), not scales (A costs twice as much as B).

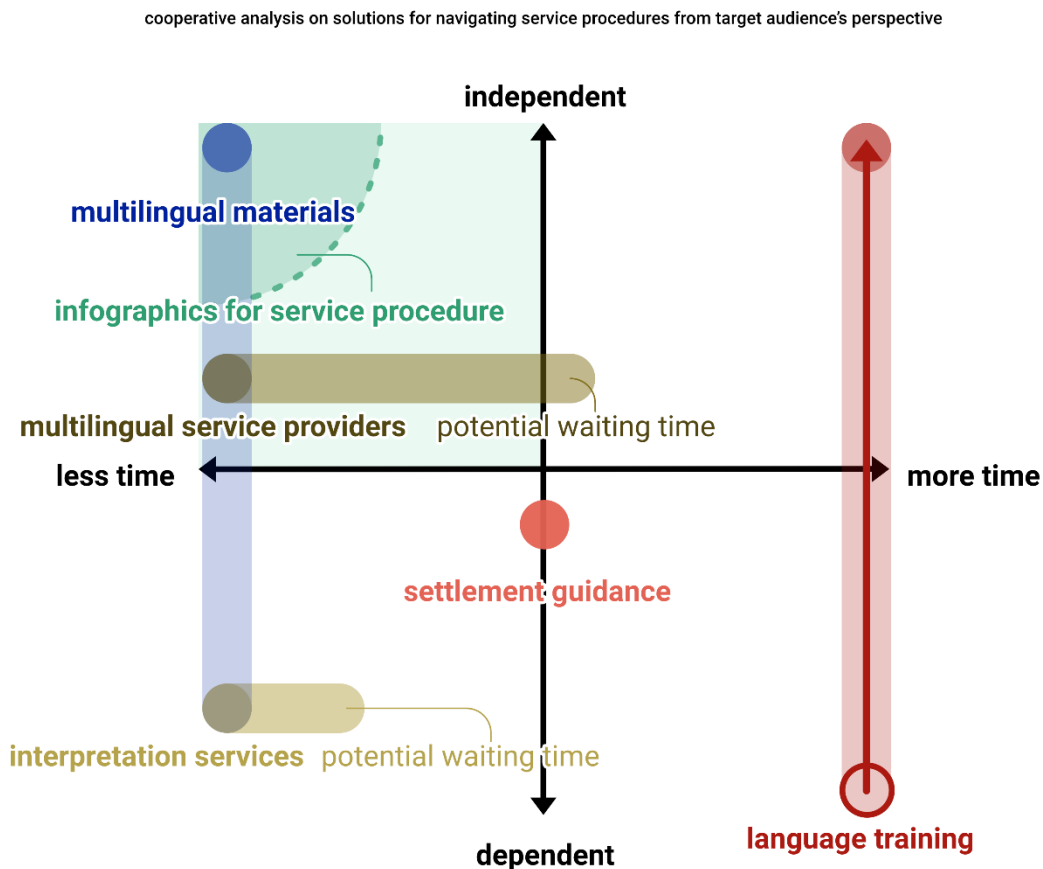


Figure 5 cooperative analysis on solutions for navigating service procedures from target audience's perspective, created by the author of this paper.

From the target audience's perspective, the vertical axis represents how likely they can accomplish the tasks independently: the more independently, the

better. The horizontal axis represents how much time they need to spend on this solution to finish this task: the less time, the better. The ideal solution should be located in the top-left area.

Language training consumes the longest time. It cannot immediately address the language barrier to accessing the service. But it is the only solution that solves the root of the language barrier. **Multilingual materials** address the information barrier instantly without others' assistance, but these materials cannot help the immigrants overcome the language barrier to access the service.

Interpreters and **multilingual service providers** allow immigrants to navigate services using their mother tongue, thereby solving the service barrier instantly. But they also make the immigrants heavily dependent on other people and can have long waiting times. Last, **service guidance** itself does not affect the immigrant's ability to achieve a single task but saves their overall time. It makes the immigrants lightly dependent on the settlement experts.

Given the above analysis, this research aims to provide a solution that assists the target audience in navigating the services **independently** and requires **minimal time** to do so.

cooperative analysis on solutions for navigating service procedures from service providers' perspective

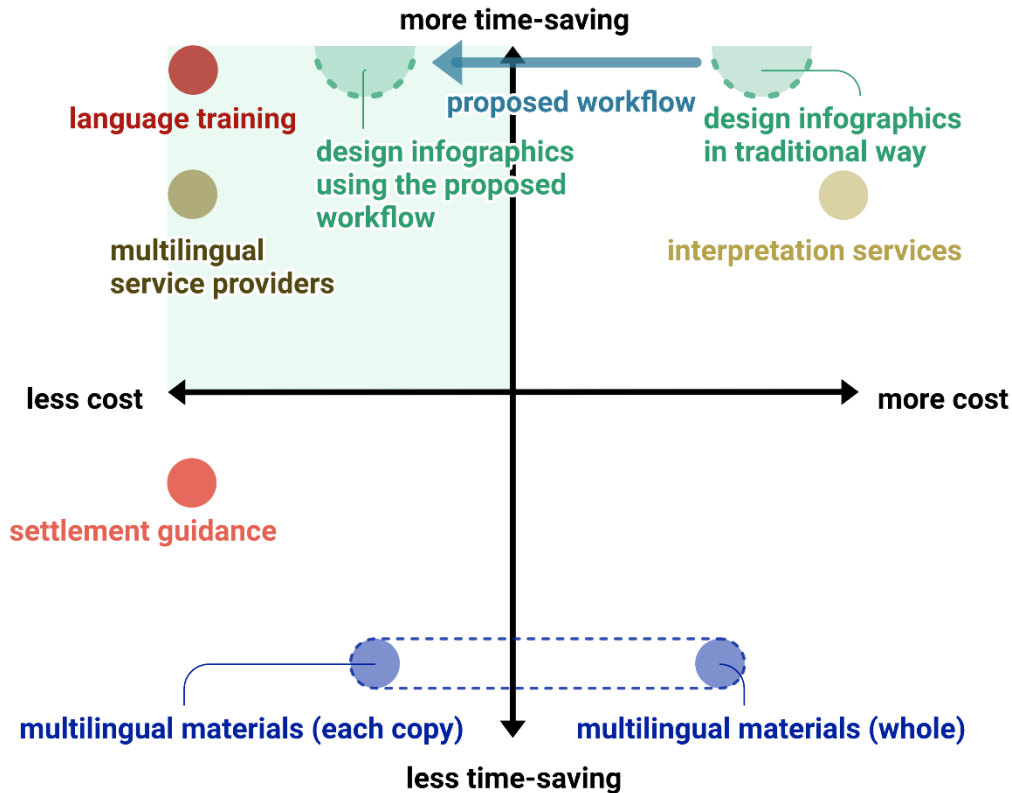


Figure 6 Cooperative analysis on solutions for navigating service procedures from service providers' perspective, created by the author of this paper.

From a service providers' perspective, the vertical axis represents how much time they can save for processing an applicant by applying a method: the more, the better. The horizontal axis represents how much budget they can spend on this method: the less, the better. The ideal solution should be located in the left-top area.

Successful **language training** addresses the language barrier entirely and does not cost service providers directly. **Multilingual materials** are usually the responsibility of the service providers, and they themselves cannot save service process time. It only saves time when working with interpreters and multilingual

employees. **Interpreters** and **multilingual service providers** both save significant time (compared to the scenario where the applicant and providers communicate in English). **Interpreters** require extra budget while employees require none.

Settlement guidance saves some time by familiarizing newcomers with the service and providing extra support without extra cost from service providers.

This research aims to provide a solution within a **reasonable budget** and **save time** for service providers. It **reduces the costs** of the traditional way by introducing new technologies into the workflow.

2.4. Summary

Canada has a great population of immigrants who need assistance to navigate services, especially when they are newcomers. The language barrier blocks newcomers from accessing essential services, increases the settlement burden and creates long-term inequity situations for immigrants. The current solutions, including language education, multilingual materials, interpreters, multilingual service providers, and settlement guidance, are addressing this issue, but **we can do more.**

3. *designing*: Infographics, AI, and Co-Design

“...given the designed is prefigurative and shapes and conditions human beings as much as it is shaped ...rethink how we could redesign technologies to promote the transition of everyday practices and the behaviors and beliefs that accompany them ...”¹

- Ahmed Ansari, Industry Associate Professor at New York University, Decolonizing Design through the Perspectives of Cosmological Others’

¹ Ansari, ‘Decolonizing Design through the Perspectives of Cosmological Others’, 19.

If you shout, “I’m a visual thinker!” at OCAD, you will receive a lot of nodding. Some people nod even harder than others. Me, for example.

Of course, visual thinkers are not limited to the artistic area. A study on school-age children in London, England, indicates that about 1/3 of the population are strongly visual-spatial learners, while 1/4 are strongly auditory-sequential ones, and the rest use both.¹ These numbers mean that 3/4 of the population can benefit from visualizing information. In fact, visualized information is essential for contemporary life. It is everywhere along your way, whether you are driving or taking public transportation, guiding you to your destination.

In the design stage, this research explores information visualization as an additional solution to those discussed in Chapter 2: the infographics that can address the language barrier to access essential services, the technologies that can accelerate the infographic designing process, and the workflow that can maximize the usability, accessibility and inclusion of the output infographics.

¹ Silverman, ‘The Visual-Spatial Learner’, 8.

3.1. Design Principles

To deliver information to the public, especially people facing information barriers, the output infographics must meet specific principles. Through research, I identified the most essential ones as **accuracy**, **understandability**, and **affordability**. These characteristics lead to the requirements for the technology and the workflow. In addition, I also want this project to be socially ethical and responsible.

Accuracy

Accuracy means there is no tolerance for errors in the output infographics. Accuracy is essential for the output to be *usable*. Many newcomers are already facing information barriers, meaning they lack the knowledge or experience to identify anomalies in the output infographics. If the outputs contain any misinformation, they will lead the audience to make wrong decisions and waste their time and money. This will not help newcomers with their settlements; even worse, these consequences will also harm immigrants' future lives. It can cost them trust in the organizations or governments and further affect their mental health.¹

To achieve accuracy, several considerations are required. First, the creation process must involve the people who hold the **expertise** in the policies and procedures. These experts should play a key role in the creation process and take

¹ Bajwa et al., 'Refugees, Higher Education, and Informational Barriers', 61.

responsibility for the final deliverables. Second, the published infographics need to be continuously **iterated and updated** to keep up with changing policies and procedures. Last, to correct the errors and update the design, the infographic files must be in **an easy-to-edit format**.

Understandability

Understandability means that the output infographics have to be designed in an easy-to-understand way for the target audience. Understandability is the key to turning a usable infographic into a *useful* one. The output infographics are meant to help newcomers navigate through their overwhelming settlement tasks in a timely manner. Therefore, understanding these infographics should require as little time as possible (at least less time than understanding the original documents does). Otherwise, they are the opposite of the core value of information design and are useless to the target audience. Understandability requires three key factors: visual consistency, inclusiveness, and feedback-driven iterations.

In his 1980 paper *Mapping Experience*, Marc Treib pointed out that “All communication depends upon accepted conventions. If there is no agreement, there is no mutual understanding”.¹ Just like written languages, to achieve agreement, visual languages need **consistent** vocabulary, grammar, and structure, at least within one image². To help newcomers, this consistency should also be maintained across a series of infographics served to one individual. After this

¹ Treib, ‘Mapping Experience’, 6.

² Treib, ‘Mapping Experience’, 6.

person learned this visual language, they can understand the next one more quickly.

To create a series of consistent infographics while also being able to update them when needed, we need a measure to strictly **separate their visual styles from content**.

Understandability also means that the design should be understandable for as many people as possible. Information designers deliver information through visualized conceptual models or metaphors, in other words, visual representations. People's conceptual models or mental models of things are built based on their experience and on-site clues available around them.¹ Therefore, to be understandable, these visual representations should align with the target audience's experiences as closely as possible. But how do we speculate about the universal knowledge and experiences of the target audience when they are from different cultural backgrounds from all over the world? We cannot. We have to tailor visual guidelines for different communities whenever needed. We do so by including them in the design process, empowering them to design for themselves, and then amplifying their preferences. We should also inform the target audience how we conclude the visual design guidelines so that they can tell the design teams how to improve the design process. This is the **inclusiveness** of the output infographics.

Lastly, the workflow should not only aim to design with the representatives of the target audience before and during the design process, but also include a

¹ Norman, *The Design of Everyday Things*, ch. 1.

mechanism to receive **feedback** from a wider population after the infographics are published. This is the only way for the design teams to know whether the deliverables are *truly* understandable enough to modify the design (or not) accordingly. This mechanism also makes the proposed workflow future-proof, as people's mental models can change over time.

Affordability

Affordability means overall low cost *and* cost-efficiency. Affordability makes a solution *applicable* in the real world. At the time this research was ongoing, the federal government of Canada, the main sponsor of the services for immigrants and refugees, was cutting funding and shrinking programs and staff.¹ To support immigrants through particularly vulnerable times like now, this solution should be affordable for its survival.

Several measures can be taken for this principle. First, we shall use **mature**, robust, and feasible technology wherever possible for both the output and the software. This can ensure we have enough capable software developers to develop and maintain this solution. Second, the technology should be **compatible** with the current mainstream hardware, so the organizations do not need to purchase extra devices. Third, the technology solution should be in an **open format** and not coupled with a single platform, service, or company (even if they appear affordable now), if at all. This is to make sure that the solution will not be locked in or hijacked

¹ Yogendra Shakya et al., *When the Ground Shifts*, 10.

by subscriptions, or become dysfunctional just because its dependency is discontinued.

Responsibility

Responsibility means being mindful of the consequences and making ethical choices. Responsibility makes a solution *future-ready*. Since I started to explore the possibility of incorporating AI into this project, I paid extra attention to the debate over it. Through the news and studies I read, I increasingly believe that AI is not just another new tool. It holds the power to alter the way humans live, work, and study. While businesses are swarming to this new gold mine without safety protocols, thinkers and researchers urge **caution and ethical considerations**. I believe that applying these considerations to products is where the designers' role lies. Therefore, I decided to expand, or should I say, constrain my exploration with responsibility in mind. I want to make my design decisions as responsible as possible, not only to the target audience or the users of the workflow, but also to any parties that may be impacted.

3.2. an *additional* solution: Infographic

3.2.1. Infographics improve understanding of information.

As outputs of information design, infographics are a kind of graphic that “inform” rather than “advertise”¹. Individuals and organizations have widely used infographics to improve people’s understanding of communication.² Infographics can enhance our mental abilities by conveying meaning, increasing working memory, and improving detection and recognition through visualization.³ A theory overview suggests that incorporating more visuals with written language can enhance comprehension.⁴ Furthermore, infographics can unlock “wordless” communication. From *How to draw a cat* to *How to plant a tree*, Nigel Holmes demonstrated how to accomplish a variety of tasks by using just illustrations and symbols, not words.⁵ All the benefits above are exactly what newcomers need when navigating services in an unfamiliar language.

3.2.2. Infographics have been used for assistance in public communication in Canada.

Since 2015, Statistics Canada has published more than 1000 research-based infographics on its website.⁶ These infographics turned pages-long data and

¹ Meirelles, *Design for Information*, 8.

² Smiciklas, *The Power of Infographics*, 6–7.

³ Meirelles, *Design for Information*, 13.

⁴ Aanstoos, ‘Visual Literacy’, 3.

⁵ Holmes, *Wordless Diagrams*.

⁶ Statistics Canada Government of Canada, ‘Statistics Canada - Infographics’.

analysis into straightforward and appealing images that the public can easily understand and will be interested in.

Another example I found during this research was created by Elections Alberta.¹ In this guide, the conceptual images (icons or photos) occupy almost half the page to provide visual cues for key concepts or steps. My favourite part is the diagram demonstrating the voter eligibility (see Figure 7). It translates the words “Canada”, “at least 18 years old”, and “Alberta” to 3 icons, and the logical operator “AND”² to the plus symbol. This “translation” makes a long sentence (sometimes a list) easy to understand and remember.



Figure 7 The diagram showing the voter eligibility in the Voting in Alberta Provincial Guide, by Elections Alberta. Non-commercial reproduction permitted by Government of Alberta.³

¹ Elections Alberta, 'Voting in Alberta Provincial Guide'.

² This word may be simple yet crucial in legal language.

³ <https://www.alberta.ca/disclaimer>

3.2.3. Infographics for service procedures shall be maps.

To visualize service procedures, we desire a type of infographic that clearly presents processes or flows AND the key actions service users should take. The kind of infographics that I know best suits this job are **user journey maps**.¹ A User Journey Map is a kind of diagram that is designed to reveal the user experience for service providers (usually businesses) in the field of User Experience (UX) design or research.² Though the User Journey Map is not initially designed for users, it is a mature medium to describe service processes in an easy-to-understand way. Therefore, I borrow the design elements from the user journey map as a starting point to create a **service navigation map**. Below are the similarities and differences between these two.

Both a User Journey Map and a Service Navigating Map care about the information below:

- Flows/processes/timelines.
- User actions.
- Expectations (outcomes).

However, a Service Navigating Map differs from a User Journey Map in the following ways.

¹ User Journey Map is also called customer journey map. I use the term user to emphasize its non-commercial purpose.

² Kalbach, *Mapping Experiences*.

- A Service Navigating Map instructs the service users instead of convincing service providers to improve services.
- A Service Navigating Map focuses on actions and their conditions (e.g., requirements, documents) instead of users' feelings or thoughts.

An extra benefit of borrowing User Journey Maps is its design process. To calibrate the maps, workshops with members of service providers are recommended. The participants of these workshops are encouraged to engage with and contribute to the map drafts to form a shared understanding.¹ The agenda and techniques for these workshops, which have been proven useful, can be incorporated into the proposed workflow.

3.2.4. Design Principles and Elements of Output Infographics

Referring to the design principles and elements² and combining the discussion above, the *Service Navigating Map* should be designed as follows.

Design principles

- Be simple, clear, and consistent.

Content

- Focus on user actions and how these actions can lead to an outcome.
- Organize information around each user action step by step.
- Connect actions with a clear timeline.

¹ Kalbach, *Mapping Experiences*, ch. 8.

² Kalbach, *Mapping Experiences*, chs 7, 11.

- Add a bit of fun to keep up morale.

Visual elements

- Use visual representations to replace text as much as possible (unless the target audience requires otherwise).
- Use lines and arrows to indicate the relationships and flows.
- Use colours to distinguish information and use one consistent colour to present one kind of information.
- Use icons or small illustrations to represent concepts (unless the target audience requires otherwise) and use one visual to represent one concept consistently.
- Organize layout using a grid system¹ (columns and rows) for clarity.

Text

- Pair visual representations with the texts to avoid ambiguity.
- Provide text instructions on the side of the visual instructions for clarity and accessibility.

These principles and elements are demonstrated below (see Figure 8).

¹ Armstrong, *Graphic Design Theory*, 63, 146.

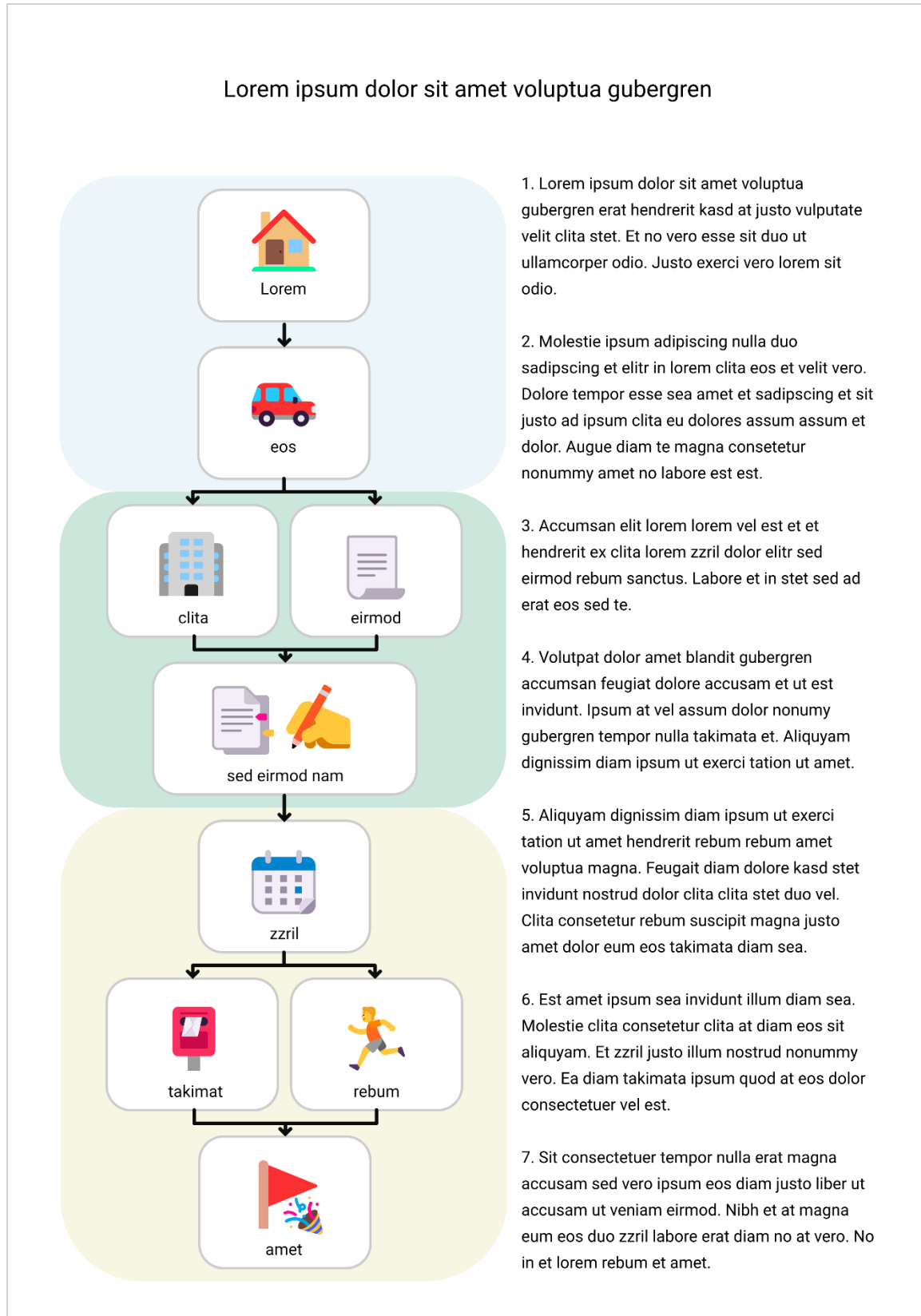


Figure 8 Low-fidelity layout of the service navigating map, created by the author of this paper.

3.2.5. Infographics are not friendly to everyone.

People who have vision impairments cannot access infographics.

With "graphic" embedded in its name, an infographic relies on visual symbols to deliver information. This feature excludes people who cannot access the visuals temporarily or permanently. As Barter and Coppin pointed out in their paper “A Diagram Must Never Be Ten Thousand Words”, diagrams have properties that alternative text cannot replace.¹ Therefore, for the sake of accessibility, the digital deliverables out of the workflow should include accessible text and should not be in the format of images (for example, PNG², JPG³, or GIF⁴).

Audiences may find the visuals in infographics not inclusive.

Infographics designed following traditional Western design patterns can be confusing or even offensive to audiences from other backgrounds. Taking colours as an example, the semantics of colour can differ across cultures.⁵ Meanings also shift over time. Using the colour themes of pink and blue to distinguish genders may have been common in the past. But today, as we have broadened our understanding about genders and sexes, it is seen as reinforcing stereotypes and exclude non-binary people.⁶

¹ Barter and Coppin, ‘A Diagram Must Never Be Ten Thousand Words’, 7.

² Portable Network Graphics

³ Joint Photographic Experts Group

⁴ Graphics Interchange Format

⁵ Ware, *Visual Thinking for Information Design*, 84.

⁶ D’Ignazio and Klein, *Data Feminism*, 111–13.

Research also found that immigrants from other cultural backgrounds have different preferences than traditional information design principles.¹ They preferred more colourful and detailed illustrations instead of a restricted colour theme or simple shapes, as well as the elements that reflect their age and cultural backgrounds instead of using generic human figures.²

Canada is a multicultural country³. When we design for Canadians, we should keep multiculturalism in mind and not make assumptions based on our own experiences. Therefore, to be truly inclusive, the design process needs to engage with the target audience and reflect their requirements.

Service providers may find infographics too time-consuming and expensive.

Creating infographics is time-consuming, making them less affordable for public service or individual use in the traditional ways.⁴ In my past days designing infographics, I spent at least 20 hours on each first draft, mainly on collecting information and looking for proper visual representations. In the early 2010s, the hourly rates for designing infographics were US \$75-\$250 (about US\$110-\$370

¹ Escobedo et al., “Infographing” Dementia Prevention’.

² Escobedo et al., “Infographing” Dementia Prevention’, 519.

³ Heritage, ‘Multiculturalism’.

⁴ It is hard to say exactly how much an infographic can cost. There are many factors contributing, but infographic design is usually at the high end of graphic design due to the complexity of the work. I estimated the budget based on my experience designing infographics and an hourly rate from Smiciklas’ 2012 book about infographics.

today¹) or US \$950 (more than US \$1400 today) for a flat fee.² These numbers mean one infographic can cost nearly CA \$2000 for a flat fee, or about CA \$3100 – \$10500 as of the time this paper was written.³ These numbers may be reasonable for businesses if the design can bring them much more profit than the cost. However, they are often too high for non-profit organizations.

According to Job Bank by the Government of Canada, the median hourly wage of a settlement counsellor in the Toronto region is C\$43.27.⁴ This calculation means that each infographic costs (much) more than one week's income of a settlement expert (C\$1,730.8). For service providers, whether they are government departments or provide settlement guidance, it is unrealistic to spend this much on visualizing service procedures.

Living in the age of generative AI, I wanted to explore whether it can help us address the cost issue for this solution.

¹ These numbers and below are converted using *CPI Inflation Calculator* by U.S. Bureau of Labor Statistics (https://www.bls.gov/data/inflation_calculator.htm)

² Smiciklas, *The Power of Infographics*, 117–18.

³ The numbers are converted using *Currency Converter* by Bank of Canada (<https://www.bankofcanada.ca/rates/exchange/currency-converter/>)

⁴ Employment and Social Development Canada, 'Settlement Counsellor in the Toronto Region | Wages - Job Bank'.

3.3. an *available* technology: Generative AI

3.3.1. AI is a big umbrella: a (very) brief overview

Since the recognizable work of AI started in the 1940s¹, AI has had three mainstream raises and two “winters”². The AI systems of the first trend were designed to solve problems following logic and protocols. Their success ended in the 1970s due to multiple limitations. The second trend was expert systems, an approach that powers AI with relevant knowledge to solve specific problems. This flourished until the mid-1980s, after many studies failed to deliver the expected results.³ We are currently in the middle of the third trend. Connecting with other fields, such as statistics, reunifying with its subfields, such as natural language processing, and being powered by the explosion of data, which is attributed to the World Wide Web, AI is having its highlight moment in the 2020s.⁴

The technology applied in this research uses *generative AI* models that are based on machine learning, a subset of the whole field. The paper uses the term “AI” instead of its precise name because of the recent popularity of “AI”. As it was pointed out by Meredith Whittaker, the founder of the Open Research Group at Google, this popularity was caused by marketing strategy, not academic or scientific effort.⁵ This paper follows this trend so people can better find this paper at this point

¹ Russell and Norvig, *Artificial Intelligence*, 17.

² “AI Winter” means “the gap between AI expectations and the technology’s shortcomings” and the shortage of funding and attention in this field. (Coursera Staff, ‘The History of AI’.)

³ Russell and Norvig, *Artificial Intelligence*, 17–24.

⁴ Russell and Norvig, *Artificial Intelligence*, 24–27.

⁵ Meredith Whittaker on AI, *Tech Power and Surveillance* | *THE NEW INSTITUTE*, at 15: 29.

in time. This decision also reserves and reveals the social and historical context of this paper for future readers.

3.3.2. Image-generative Models do not meet the characteristics of output infographics.

At the time I initiated this research (Jan 2024), image-generating AI models were struggling to generate meaningful infographics (see Figure 9). None of them accurately presented concepts or generated readable text. Furthermore, the images are not editable in a way (see Figure 12) that suits our purpose. In the past three years, the performance of text-to-image generative AI models has improved dramatically. By August 2025, Dall-E-4o by OpenAI had been able to embed clearly readable text; and Adobe Firefly started to get a sense of what an infographic is. (see Figure 10)



Figure 9 The text-to-image models' performance in infographic generation (tested in Jan 2024), tested and assembled by the author of this paper.

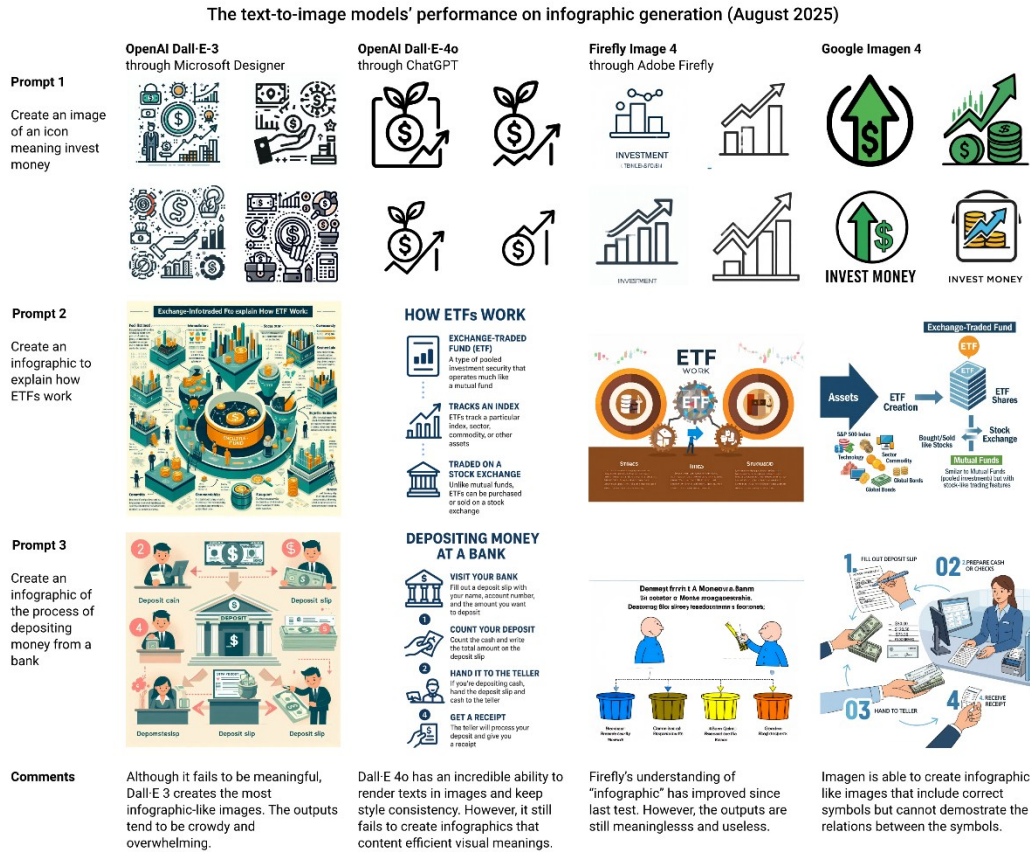


Figure 10 The text-to-image models' performance in infographic generation (tested in Aug 2025), tested and assembled by the author of this paper.

At the time this paper was written, in July 2026, there are AI-powered functions that **can generate (kind of) meaningful infographics** for service procedures, yet with flaws. (see Figure 11) **ChatGPT Image 2.0** retains its incredible ability to render text into images. However, the style consistency is not as good as the early version. Most importantly, the infographics generated by this model rely on text for understanding, which does not help address the language barrier. **Firefly's** understanding of "infographic" has further improved since the last test. However, the outputs are still meaningless and useless. **Nano Banana** performs best among these three models. It creates meaningful, style-consistent illustrations (though some are not meaningful without the text) that illustrate the service procedures. The

details are not ideal (e.g., the guiding lines are wrong). The infographics partially rely on text to be understandable.

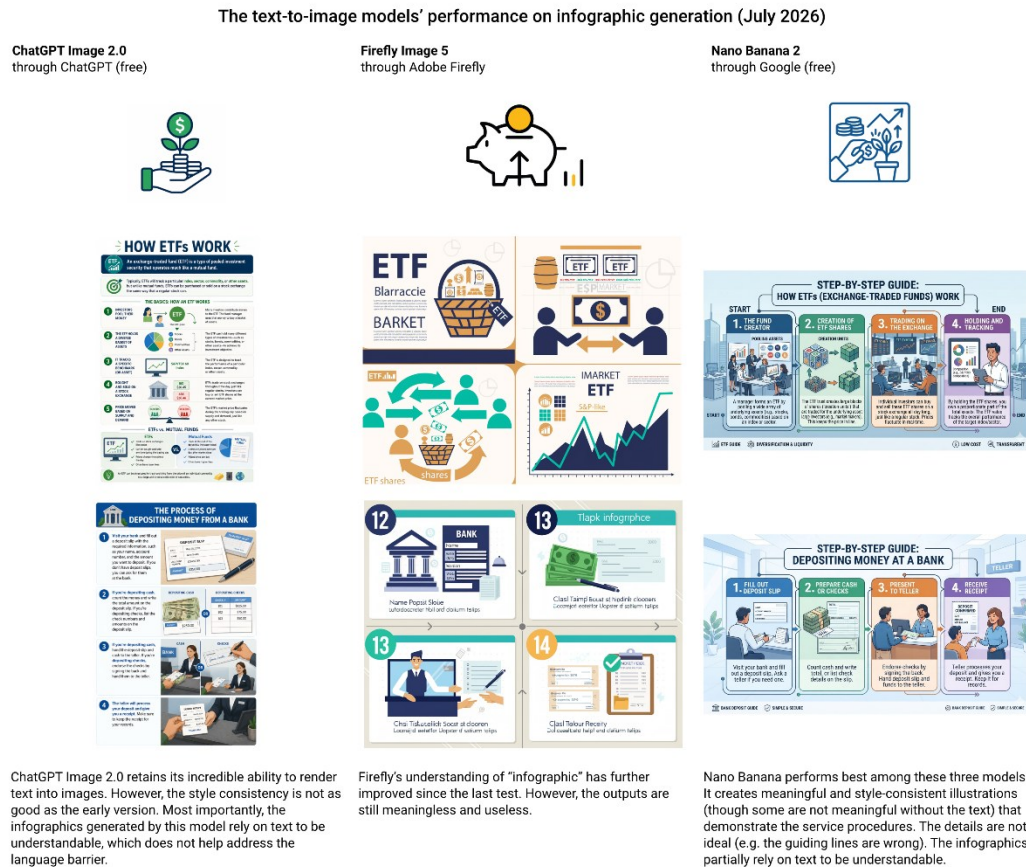


Figure 11 The text-to-image models' performance in infographic generation (tested in July 2026), tested and assembled by the author of this paper.

One can argue that, even though the current image-generative models' performance is not yet ideal, they can gain the ability to generate proper infographics soon enough, considering the current evolution speed in the AI field. This argument might be true, but it comes at a **high cost**.

Hugging Face¹, a community-based platform for machine learning, hosts a leaderboard of AI models' energy scores², measured by the AI Energy Score project.³ Although the data do not cover all the models in the market, we can see the pattern. Among text-generative models with under 20B parameters, the most power-hungry is Granite 4.0 (tiny) by IBM. It used an average of 81.82 Wh of GPU⁴ energy for 1k queries, while the average number in this category was 15.4. In contrast, the number for the least power-consuming image-generative models is 186.81, more than doubling Granite 4.0 and more than 10 times the average power that text-generative models consume.

Lastly, the images generated by current image-generative models are raster and **cannot be easily edited** in graphic design software such as Illustrator. Adobe claims its Firefly can create vector files.⁵ After testing it, I speculated that it applies tracing, a common function that has existed for decades, to the generated raster images and presents them in a vector format. This process does not solve the editing issue. Sure, you can change colour themes in a snap and twist a few nodes. And it does enable lossless scale-up. But it does not save you time if you want to edit the files in a meaningful way, for example, replacing the icons or editing the text.

¹ <https://huggingface.co/>

² Luccioni et al., 'AI Energy Score Leaderboard - December 2025'.

³ Luccioni et al., 'AI Energy Score'.

⁴ Graphics Processing Unit.

⁵ Lardinois, 'Adobe Firefly's Generative AI Models Can Now Create Vector Graphics in Illustrator'.

The “editable” image generator products performance (January 2024)

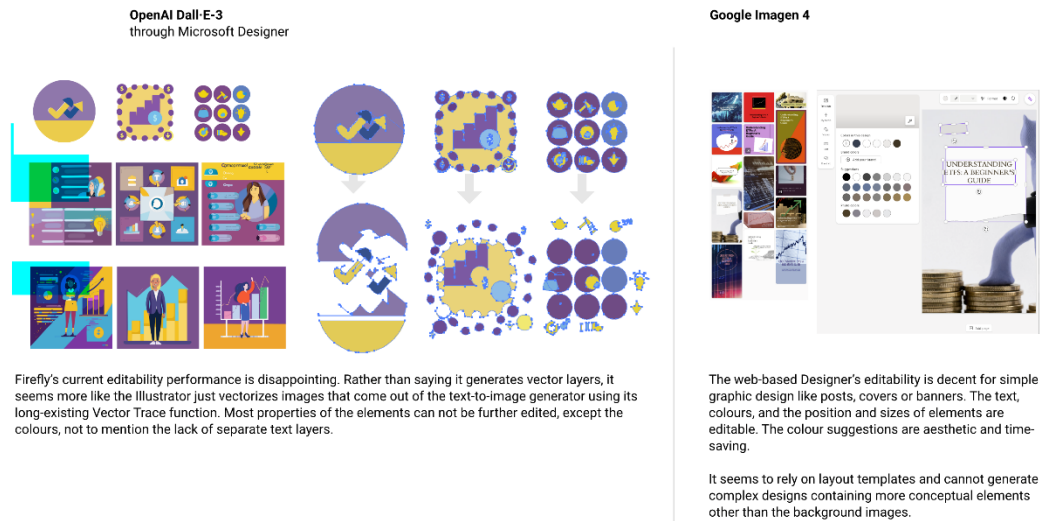


Figure 12 The “editable” image generator product's performance (tested in Jan 2024), tested and assembled by the author of this paper.

In summary, as demonstrated above, current text-to-image generative AI models are not well-suited to creating infographics for service procedures. They cannot ensure accuracy or affordability, and their outputs are not editable.

There may be another way.

3.3.3. Text-generative models can also draft graphics.

It is not an innovative idea to render computer languages into graphics. Markup languages, such as HTML, have proven that rendering text into visual symbols is a successful approach. The best example is front-end web development, where one can mark up any text and replace it with any image using CSS or JavaScript. This technology underpins the whole World Wide Web that we know today. Each webpage is an interactive diagram built with HTML and CSS. Research

also shows that it is approachable to use generative AI to create flowcharts.¹ In the meantime, with Markdown language extensions like Mermaid² and Markmap³, generating the code for diagrams or designs from prompts has been proven workable by AI-based applications in the market.

3.3.4. Diagram generation functions have existed.

Furthermore, all leading players of **online whiteboard applications** have offered AI-powered diagram generation functions, such as Miro⁴, FigJam⁵, and Lucid⁶. (see Figure 13)

¹ Mhatre et al., 'A Novel Approach for Creating Flowcharts Using Generative AI'.

² <https://mermaid.js.org>

³ <https://markmap.js.org>

⁴ Miro, 'The Online Mapping and Diagramming Tool | Miro'.

⁵ Figma, 'FigJam'.

⁶ Lucid Software, 'Interactive Whiteboards'.

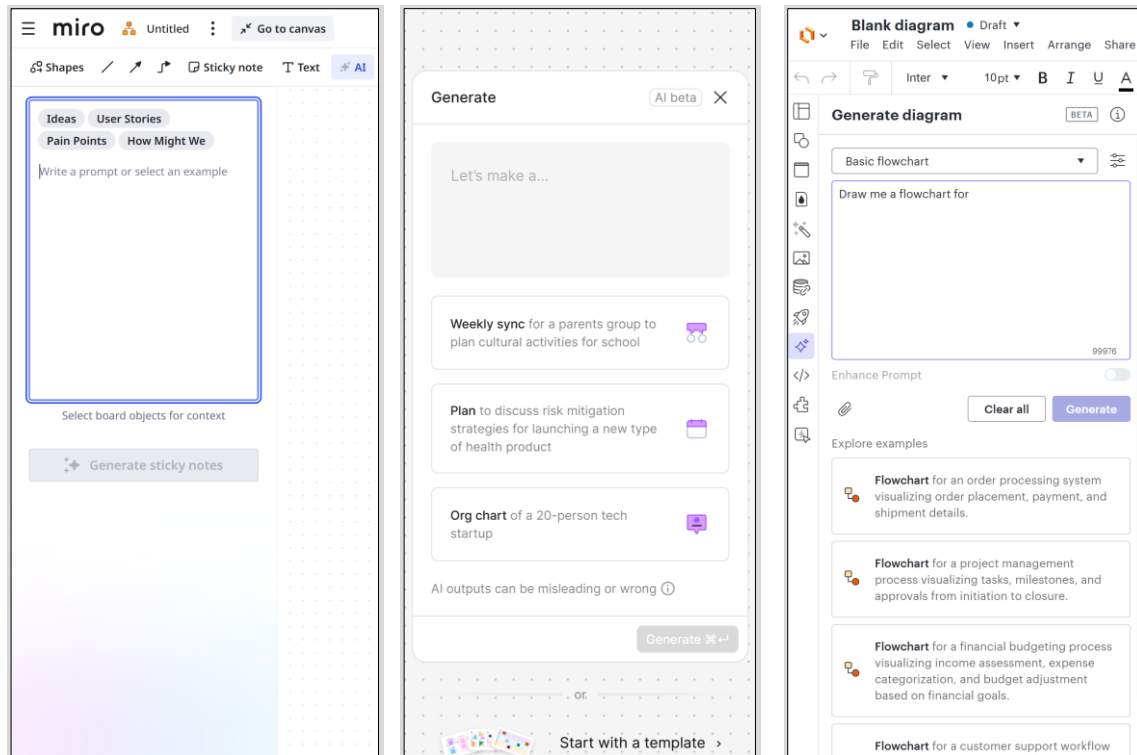


Figure 13 The AI-powered generating diagram functions of Miro(left), FigJam(middle), and Lucid(right), assembled by the author of this paper.

I tested Lucidchart using the third prompt for testing image-generative models (how to deposit money). The result is shown below (see Figure 14). It successfully generated a logically current flowchart. However, there are issues in the details. For example, some steps have order numbers (e.g., “3”) yet some do not. Additionally, a form of flowchart without visual representations cannot address the language barrier. I asked it to add icons after the flowchart was created. After spending a few minutes “thinking”, it responded that it added icons. I found only one, despite there being many concepts that can be visualized. Moreover, because they are not designed for graphic design, these online whiteboard Apps do not provide functions for style control, for example, customizing colour themes.

In summary, the current applications of AI to generate code for infographics are promising if they could include semantic visuals and provide better styling functions.

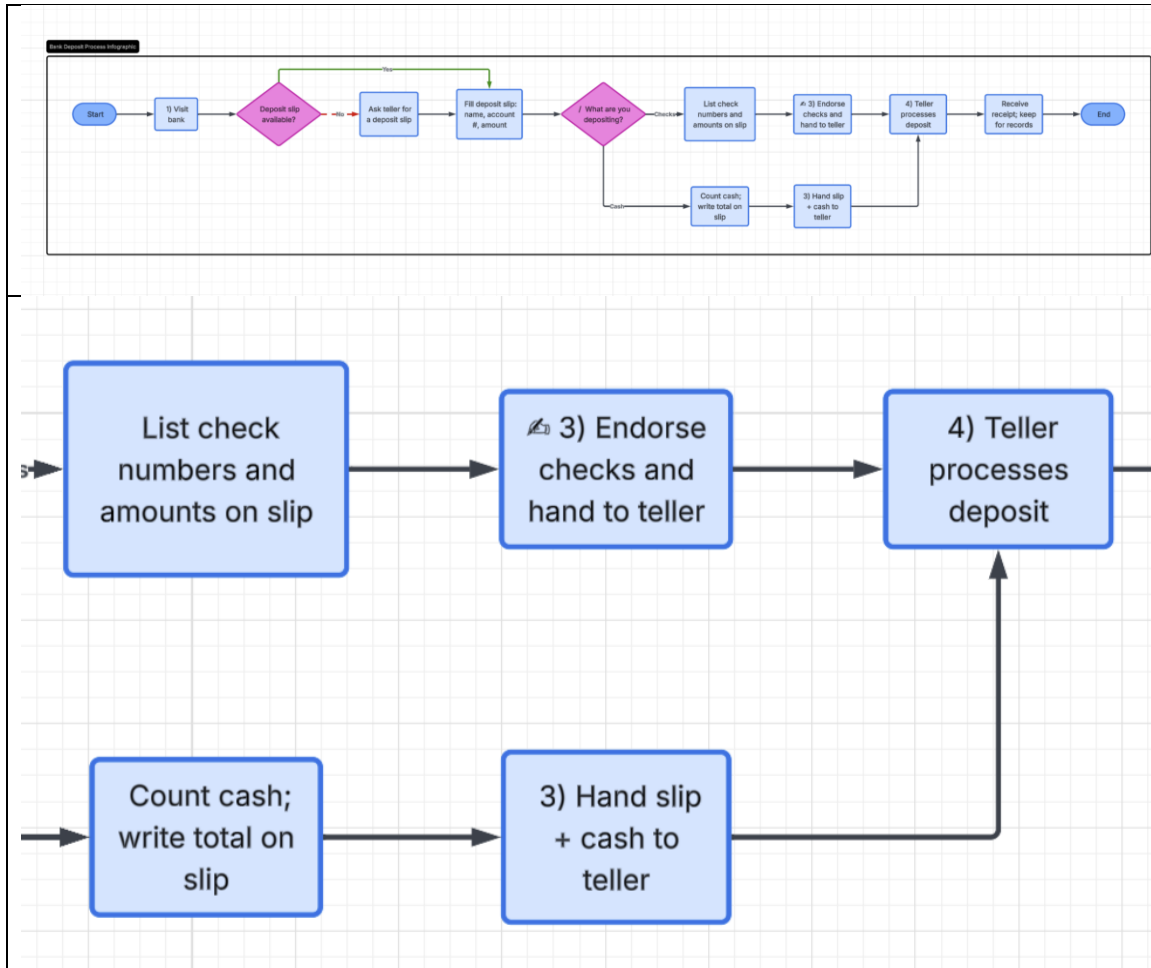


Figure 14 The infographic generated by Lucidchart (<https://lucid.app/lucidchart>). Above is the overview, and below is the detail. (2026 July). Tested and assembled by the author of this paper.

3.3.5. Text-generative models are a great choice for this project.

Text-generative models are well-suited to creating editable infographics due to their low energy consumption and the availability of a variety of open-source options.

One benefit of using text-generative models, as mentioned above, is that they are **more cost-efficient**. They cost less energy and time to generate the result. Even if the result is not ideal, the manual modifications are easy to do. While image-generative models not only require much more energy on a single task, they also modify an image by running a new task with more inputs, which further increases the energy use, making them more expensive.

Besides being less energy-consuming, text-generative models have **more open-source options**. At the time of this paper being written, there are nearly 200 thousand text-generative base models available on Hugging Face. These models can be used under open-source licenses and work without their creators' control, which provides abundant options for this task.

Now that the code-generating approach has been chosen for infographic creation, the next step is to decide which computer language(s) suit this task best.

3.3.6. HTML + CSS (+ JS)

Choosing languages was not a hard decision for me. After shortly comparing a few languages/formats that can be used to create the infographics, I chose HTML and CSS, with SVG¹ as embedded image format (see Figure 15).

The comparison of the potential languages

	UML/PlantUML	SVG	HTML+CSS	JavaScript
Vector format	 Yes	 Yes	 Yes	 Yes
Separated text	 Need to study	 N/A	 Yes	 N/A
Separated style	 Yes	 Yes	 Yes	 N/A
Common format	 Need to study	 Yes	 Yes	 Yes
Programmable	 Need to study	 Yes	 Yes	 Yes

Figure 15 The comparison of potential languages, created by the author of this paper.

HTML and CSS are the essential parts of the Web. They are **highly standardized and widely supported**. Everyone who can access the internet can view the output infographics. Working with SVG, this couple is also **scalable and responsive**, which means that it can, by design, be shown in different sizes and printed out. So, no matter which distribution channels the service providers or the target audience prefer, it can provide proper outputs that fit in. As part of the

¹ Scalable Vector Graphics.

modern web development approach, the **content (text) and style (visual) can be strictly divided** into HTML and CSS files without coupling with each other. This approach enables easy content editing and strong style control, and more importantly, collaboration between people with different expertise. Benefiting from **Web Content Accessibility Guidelines (WCAG)**¹, modern browsers with integrated screen readers can voice out the text for people with visual impairments. HTML and CSS are easy-to-learn languages and therefore have **a huge developer community** that provides fantastic frameworks and libraries. Additionally, due to their open-source nature, there is massive training data² for AI models to learn the design patterns and perfect their web coding skills, which makes the models **good at generating front-end code**. Last but not least, combining with JavaScript, another standardized web language, the output infographics can be **interactive and adaptive**, which unlocks more possibilities to improve the experience for more audience.

3.3.7.A Proof of Concept

Before I started developing, I used a commercial AI Web App to test the concept.

¹ <https://www.w3.org/WAI/standards-guidelines/wcag/>

² Pointing this out as a fact does not mean that I support AI companies to train their models using unauthorized data.

In ChatGPT (July 2025), I prompt the AI to fetch 100 icons' data from Google's Material Symbols¹, process and create a JSON file (see Figure 16).² Then I gave it a sentence and asked it to replace the matching words with icons (see Figure 17). The result is shown below (see Figure 18). You can see the words were replaced with Unicode and rendered as emojis in my operating system. I then asked ChatGPT to generate the HTML code embedding Material Symbols. The HTML file was rendered in the browser (Chrome) as below (see Figure 19).

```
"home": {
  "unicode": "\\e88a",
  "class": "noun",
  "category": "icon",
  "tags": ["building", "house"],
  "vector": []
},
```

Figure 16 One item in the "icon dictionary", tested and screen shot by the author of this paper.

use the symbols above to replace the words in this sentence with icons, matching the key, tags and their synonyms to decide which words to replace: A person is searching a place to live. They add options into a list, then edit the list by sorting the options, until they choose the first one as their favourite.

Figure 17 The prompt to replace words with icons, tested and screen shot by the author of this paper.

💬 Transformed Sentence (with icons):

A 🧑 is 🔍 a 🏠. They ➕ options into a list, then ✎ the list by sorting the options, until they choose the first one as their ❤️.

Figure 18 The test result rendered by ChatGPT, tested and screen shot by the author of this paper.

¹ <https://fonts.google.com/icons>

² In later process, I learned that it made it up instead of fetching the real data.

A 🧑 is 🔍 a 🏠. They + options into a list, then ✎ the list by sorting the options, until they choose the first one as their ❤️.

A 🧑 person is 🔍 searching a 🏠 place to live. They + add options into a list, then ✎ edit the list by sorting the options, until they choose the first one as their ❤️ favourite.

Figure 19 Two tests on generating HTML code, tested and screen shot by the author of this paper.

The test above shows the possibility to “rewrite” written languages with visual representations, settling down the direction of the technology solution. However, before diving into prototyping, there are several factors to be considered.

3.3.8. Current AI technology is prone to hallucination, dependence, and model collapse issues.

There are many limitations of the current AI technology. To be used in creating infographics for service procedures, I identified three limitations that affect the prototype design. They are hallucinations, dependence, and model collapse.

Hallucinations

AI *hallucinations* are “false statements generated by language models”.¹ All state-of-the-art language models have hallucination issues because they are designed to predict the most likely next word without understanding it.² AI companies and researchers are trying to decrease hallucinations by tweaking the model training³ or scaling up⁴. However, **hallucinations are inevitable**. And, for this

¹ Kalai et al., ‘Why Language Models Hallucinate’.

² Kalai et al., ‘Why Language Models Hallucinate’; Dwivedi, ‘A Neuroscientist Explains Why It’s Impossible for AI to “Understand” Language’; Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 24–27.

³ Kalai et al., ‘Why Language Models Hallucinate’.

⁴ Samborska, ‘Scaling Up’.

research, due to the accuracy required by the output infographics (the information), any hallucination is unacceptable.

As a result, I concluded that there should be **strong and meaningful human control** in the workflow. This strong control means that, besides including human experts, the workflow should also **limit the use of AI to necessary tasks** only.

Dependence

GitHub, the most widely used code storage and management platform, released Copilot in 2022¹, after being acquired by Microsoft in 2018. GitHub's Copilot², at the moment of its release, was powered by a language model called Codex, a language model that was fine-tuned by OpenAI based on GPT-3 for coding tasks.³ In March 2023, OpenAI announced the deprecation of Codex with three days' notice. This action did not just impact the developers who use Copilot, but also many researchers.⁴ The **deprecation** of Codex reminds developers of the risk of using API⁵ services. They can be discontinued overnight by their companies for unpredictable reasons,⁶ which will cost service providers extra money to update and migrate software, or even worse, lead to the termination of the product.

¹ Friedman, 'Introducing GitHub Copilot'.

² Microsoft has another product called Copilot, which works as a web chat App and is integrated into Windows. To be concise, in this paper, Copilot refers to GitHub's Copilot unless stating as "Microsoft's Copilot".

³ Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 16.

⁴ Narayanan and Kapoor, *AI Snake Oil*, The Reproducibility Crisis in AI Research.

⁵ Application Programming Interface.

⁶ Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 17.

Even without the worries over deprecation, the business model of **subscription** makes the AI services more unreliable for non-profit operations. The subscription fee can increase dramatically. Within three years, from free-for-all, ChatGPT added three tiers of pricing from CA\$11 to CA\$136 per month, not including business and enterprise use. In the meantime, OpenAI increasingly limits the use of the free tier by providing fewer conversations, less memory, and less powerful models.¹ Just as this paper was being written, GitHub changed Copilot's charging mode from request-based to usage-based billing.² There are complaints all over the internet stating how fast people's credits run out and they cannot continue to work as before.³

These are not single cases nor an invention of AI companies/services. Cory Doctorow, a Canadian author, coined the term “**enshittification**” to describe the process by which companies lure users with great free products at the beginning and squeeze the most profit out of them in the end.⁴ Price jumps are inevitable because this is the default business model of contemporary tech companies. Predictably, with the current hardware and energy shortage, the prices will only climb higher.

¹ OpenAI, 'ChatGPT Plans | Free, Go, Plus, Pro, Business, and Enterprise'; SaaS Price Pulse Team, 'ChatGPT Pricing History'.

² Rodriguez, 'GitHub Copilot Is Moving to Usage-Based Billing'.

³ KarimWajihKMW (User Name), 'GitHub Copilot AI Credits Are Unfair, Expensive, and Killing Real Development Workflows · Community · Discussion #198015'; Orland, 'AI Costs How Much?'; Vladutu, 'End of an Era — GitHub Copilot Models and Prices Change'.

⁴ Doctorow, 'Twiddler – Pluralistic'.

Given these issues, the best strategy to avoid dependence on tech companies is to avoid using API services and deploy **local AI models** that can function on the users' own devices.

Model collapse

Model collapse refers to a problem where AI models are trained by polluted data generated by other models.¹ This is not a future problem. It is happening now.² Model collapse, in this research, may cause the models to **over-repeat similar design patterns**, which means the code will follow the patterns that are used most in their data and stop adapting to new approaches. Given that the current data are dominated by approaches that reflect Western values (or the values of a few countries/communities advancing in AI and web technology), this could limit AI models' ability to apply the visual styles the target audience requires.

The impact of this issue is not severe, but it should be considered. The prototype should not only rely on the training data of the model it uses. It should have the ability to accept new data to **adjust the AI models**, reflecting the target audience's requirements.

¹ Shumailov et al., 'AI Models Collapse When Trained on Recursively Generated Data', 755.

² Wilkins, *AI Companies Are Learning an Ironic Lesson as the People They Pay to Improve Their Chatbots Are Just Feeding AI Slop Into Them*.

3.3.9. We need to consider lives other than the target

audience.

After comparing the performance and addressing the limitations, I want to discuss the cost. Because the question of “should we use it” is wider than “whether it is good enough”. It is about weighing the gains and costs, even if the costs are on others.

Jobs and Joys: I do not want to promote technology at the cost of people.

Although some voices are skeptical that the trend of replacing humans with AI is just a marketing strategy¹, and some reports suggest that AI has no impact on job losses², it is a fact that hundreds of thousands of people have been laid off *in the name of AI*.³ And more people will be.⁴ The people who are vulnerable in front of AI “labour” are the ones who have already been disadvantaged: women⁵, entry-level⁶, and less educated workers⁷. This trend of replacing humans with AI will further centralize power in the hands of a few tech oligarchs.⁸ That is not a future I want to see. And I am not alone. There are a growing number of people who simply reject

¹ Doctorow, ‘Pluralistic’.

² Wilkins, ‘You’ll Snort-Laugh When You Learn How Much AI Actually Added to the US Economy Last Year’; Statistics Canada, ‘Canadian Employment Trends in the Era of Generative Artificial Intelligence’.

³ Falk and Tsoukalas, ‘The AI Layoff Trap’.

⁴ Wilkins, *99 Percent of CEOs Are Preparing to Lay Off Workers and Replace Them With AI Within Two Years, Survey Finds*.

⁵ Lev, ‘For Women, the Increase of AI Use in the Workplace May Affect Their Careers’; Otis et al., ‘Global Evidence on Gender Gaps and Generative AI’.

⁶ Brynjolfsson et al., *Canaries in the Coal Mine? Six Facts about the Recent Employment Effects of Artificial Intelligence*.

⁷ Hartley et al., ‘The Labor Market Effects of Generative Artificial Intelligence’.

⁸ Narayanan and Kapoor, *AI Snake Oil*, Public Figures Spread AI Hype.

using AI for multiple reasons.¹ While some tech billionaire claims that job replacement by AI is inevitable², I argue that this technology should be used to assist professionals³ and benefit underserved populations.

As for my research, let me make it very clear: the outcome prototype is not aiming to replace graphic designers. Instead, it aims to empower designers and provide them more work opportunities. I worked as a graphic designer for many years. I still design graphics from time to time. I do not want my work to replace designers because, for sure, I do not want to lose my income, but also because I love my work. I enjoy the moments when I figure out a perfect visual metaphor, match a beautiful colour theme, or convince the client to take a solution that promotes accessibility. But my choice is not just for my own interest. I believe in the importance of this job over the years. Designing is not just moving pictures around, making things prettier. Designers build the bridges and close the gaps in communication. They bring in other considerations to balance the power of the businesses and users, governments and the public, one person to another person. If you have ever had the moment of “aha, I get it” while viewing a visual work, you have felt the joy of connecting with another human. And this beautiful moment should not be lost in the name of technological innovation.

¹ Rogers, ‘The AI Backlash Keeps Growing Stronger’.

² Wilkins, *Google CEO Says We’re All Going to Have to Suffer Through It as AI Puts Society Through the Woodchipper*.

³ Singh, *Ex-Google’s Yoodli Triples Valuation to \$300M+ with AI Built to Assist, Not Replace, People*.

Having presented my standpoint above, in this research, I want to make sure that designers play crucial roles in the proposed workflow, and they are credited for their work. I also want to respect others' standpoints by giving people the choice of not using AI in this workflow.

Cognition and Collaboration: I do not want to promote productivity at the cost of humanity.

Research shows that, despite the hype, AI cannot really *think* like a human.^{1 2} Working with AI only creates an illusion of expertise³ and spoils our brains⁴, literally⁵. It causes us to bypass the learning process⁶ and learn less⁷, costing our ability to think critically⁸. And let's not forget that the AI-powered digital products (including APIs) are not innocent tools; they are controlled by the companies behind them. They are not for you. They are for profit. They are, by design, to make you *feel* good, that you are productive, that you can save the world⁹, and that you can solve any problems by just paying for the AI products.

Singh, *Ex-Google's Yoodli Triples Valuation to \$300M+ with AI Built to Assist, Not Replace, People*.

and Limitations of Reasoning Models via the Lens of Problem Complexity'.

² And I would question the paradox here: If it really can or does think like a human, why would it think *for* a human instead of itself? After all, thinking for oneself is how a human think.

³ Spirllet, 'AI Is Giving Workers the Illusion of Expertise — and Quietly Making Them Worse at Their Jobs, Researchers Say'.

⁴ Conway, *Is AI Making Our Brains Lazy?*; McCarron, *Outsourced Thinking?*

⁵ Kosmyna et al., 'Your Brain on ChatGPT'.

⁶ Gill-Simmen, 'AI Doesn't Just Help Us Think, It Thinks Instead of Us'.

⁷ KPMG, 'Students Using Generative AI Confess They're Not Learning as Much - KPMG Canada'.

⁸ Gerlich, 'AI Tools in Society: Impacts on Cognitive Offloading and the Future of Critical Thinking'.

⁹ Karamali, "A World-Saving Mission".

Solving problems is not just about getting the job done. It is about getting the job done in the *right* way. The “right way” means that everyone involved should have their space to make expert decisions based on their best judgment and following their conscience. It means we have to listen to, support, accommodate, or compromise with each other, even if we disagree. It also means that sometimes (or most of the time) we get a result that does not entirely reflect our wish but is a *collaborative decision*. This is how our society works, how humanity works. We cannot solve a human social problem without collaboration, which sometimes entails frustration or disappointment.

Following these discussions, I want to promote and centralize human collaboration in the infographic-creation workflow.

Energy, Economy, and Environments: I do not want to promote power at the cost of our planet.

Due to the current international tension, increasing numbers of countries started to value digital sovereignty¹, which led to more countries wanting to build (more) digital infrastructure of their own. This action may promote digital security and preserve diversity; however, the race to build data centres brings high costs to all species.

¹ Fleming, ‘What Is Digital Sovereignty and How Are Countries Approaching It?’

At the time I was writing this paper, Hamilton, ON, had been in controversy over a data centre proposal¹ for almost two months.² The *Digital Research Alliance of Canada (DRAC)*³ proposed transforming a former steel mill into a data centre under the federal government's *AI Sovereign Compute Infrastructure Program*⁴.⁵ The developers behind this project promise innovation, jobs and public space.⁶ The residents are concerned about the use of power and water, as well as noise and heat emissions, and are demanding more transparency.⁷ In the meantime, a data centre proposal in Armour Township, another Ontario town, was withdrawn due to public opposition.⁸

The residents' concerns are not baseless. People do not want data centres in their neighbourhood⁹ for several reasons.¹⁰ As we have learned in the section above, AI is energy hungry. Both training and deploying large language models consume massive amounts of energy.¹¹ Even the CEO of OpenAI admitted how energy-

¹ Slate Asset Management, 'The Newest Standard-Bearer for Modern Industry in Hamilton, Canada.'

² Chandler, 'Hamilton's Data Centre Moratorium Could Be a Canadian First, Researcher Says, and More Could Follow'.

³ <https://www.alliancecan.ca/en>

⁴ <https://ised-isde.canada.ca/site/ised/en/ai-sovereign-compute-infrastructure-program>

⁵ Chandler, 'As Companies Explore Building Data Centres in Hamilton, Councillor Wants Your Feedback on a City Framework'; Chandler, 'Hamilton AI Data Centre Proposal Unaffected by Planning Tribunal Decision, Group Involved Says'.

⁶ Slate Asset Management, 'The Newest Standard-Bearer for Modern Industry in Hamilton, Canada.'

⁷ Chandler, 'Hamilton's Data Centre Moratorium Could Be a Canadian First, Researcher Says, and More Could Follow'.

⁸ Migneault, 'Developer Withdraws Plans to Build Northern Ontario AI Data Centre over Public Opposition'.

⁹ Ibrahimpoor, "Reflexive and Honest".

¹⁰ Maibach et al., '5 Ways Data Centers Endanger Their Local Communities and the Country as a Whole'.

¹¹ Sun, 'Why Do AI Chatbots Use so Much Energy?'

intensive AI is.¹ A simple “thank you” to ChatGPT at the end of the conversation can cost several MWh in sum.² Data centres are either driving up energy prices in surrounding neighbourhoods³ or increasing climate-change-related emissions because they have to build their own power plants.⁴ Data centres are also thirsty⁵, noisy⁶, and extremely hot⁷, which arguably harms the health of local residents and the surrounding ecosystem.

Building data centres also drives a shortage of hardware, which drives up the prices of graphics cards⁸ and memory chips globally. This cost has been transferred to consumers. As a result, hardware companies, such as NVIDIA, Apple, Microsoft and hardware companies have raised the prices of their devices.⁹

This wave of pushback against infrastructure does not just happen in Canada. In the US, growing numbers of neighbourhoods are challenging the local impacts of data centres.¹⁰ And more than 75 data centres have been blocked in the

¹ Altman, ‘The Gentle Singularity’.

² Delavande et al., ‘Saying Thank You to a LLM Isn’t Free — Measuring the Energy Cost of Politeness’.

³ Collins, ‘US Datacenters Use Enough Electricity to Power Upwards of 16 Million Homes for a Year – the Statistics on Why Opposition Groups Are Pushing for People Over Profit’.

⁴ Down and Milmo, ‘Datacentres Drive up Big Tech’s Carbon Emissions to a Third of Those of France’; Volcovici, ‘Gas Plants for US Data Centers to Be Major Source of Climate Change-Linked Emissions, Report Says’.

⁵ Li et al., ‘Making AI Less “Thirsty”’.

⁶ Graziosi, ‘Wisconsin Residents Sue Microsoft over Noise Caused by New Data Center | The Independent’.

⁷ Tangermann, *Massive Data Center Cooks Nearby Residents Alive Amidst Deadly Heatwave*.

⁸ Liu, ‘Nvidia Raises RTX Pro 6000 Blackwell GPU Pricing to \$13,250 — 55% Increase over MSRP in a Year’s Time’.

⁹ Ali and Heydari, ‘Apple and Microsoft Hike Prices as AI Crunches Global Memory Chip Supply’.

¹⁰ Mural, ‘How Local Communities Are Challenging Big Tech Data Centers’ Noise, Pollution and Rising Electricity Bills’.

first quarter of 2026.¹ In Ireland, the “Silicon Valley of Europe”, there are growing protests against the expansion of data centres.² And Australia is being increasingly cautious about the gains and risks of the data centres.³

This research will not go further into the debate, as the evidence has convinced me to be mindful of the environmental and ecosystem impacts. For this workflow, to limit the impact, I choose to use AI conscientiously: as little as possible and only as necessary.

¹ Morales, ‘More than 75 Data Center Build-Outs Worth \$130 Billion Have Been Successfully Blocked in the First Three Months of 2026 — Bipartisan Opposition Mounts Nationwide over Fears of Soaring Power and Water Costs’.

² Burgess, ‘Ireland Is a Data Centre “Cautionary Tale”. This Is the Impact on Locals’.

³ Commins, ‘Thirsty and Power Hungry’.

3.4. a *crucial* approach: Human-Centred Design and Co-Creation

I apply HCD to the proposed workflow for its agility and broad acceptance, and Co-Creation to improve the understandability of the output infographics and to foster potential empowerment.

3.4.1. Human-Centred Design and Design Thinking

HCD is chosen to increase the workflow's compatibility. As of the time of writing, HCD is the mainstream design methodology in Canada and other destination countries for migration. Applying HCD increases the chance that the service providers in these countries apply the proposed workflow.

Influenced by Don Norman's book *The Design of Everyday Things*, Human-Centred Design¹ has arisen and become the mainstream design methodology since the 1990s². When Norman introduced HCD in the revised *The Design of Everyday Things*, he defined HCD as "a philosophy and a set of procedures"³. Its main advocate, IDEO, a design and innovation company, in its 2011 book *Human Centered Design: Toolkit*, defines HCD as "a process and a set of techniques used to create new solutions for the world."⁴ HCD is sometimes used interchangeably

¹ Human-Centered Design

² Norman, *The Design of Everyday Things*, Preface; IDEO U, 'What Is Human-Centered Design?', sect. 3.

³ Norman, *The Design of Everyday Things*, 1.2.

⁴ IDEO, *Human Centered Design*, 6.

with Design Thinking and User-Centred Design.¹ The latest introduction by IDEO clarified the distinction. It defines HCD as a philosophy or mindset, Design Thinking as the process, and User-Centred Design as the practice.²

As mentioned in Chapter 1, Design Thinking (DT) process is flexible. Different design organizations practice DT through different phases or stages. In its 2021 publication, *Human Centered Design Toolkit*³, IDEO expressed the HCD process as “Hear, Create, and Deliver”⁴. Interaction Design Foundation (IxDF), a leading design education organization, teaches DT as a process of five phases: “empathize, define, ideate, prototype, test”.⁵ The Hasso Plattner Institute of Design at Stanford shares this practice.⁶ Founded by Nielsen and Norman, NNGroup (NN/G) added one phase, implement, to IxDF’s process. Additionally, NN/G further divided the process into three groups, “understand, explore, and materialize”, each containing two phases.⁷ The latest online version by IDEO includes more detailed seven phases: “frame the question, gather inspiration, synthesize for action, generate ideas, make ideas tangible, test to learn, and share the story”.⁸ Though these leading voices in design industry have different practices, the core values of DT are consistent. DT emphasizes the essentialness of building empathy with the end users. Designers or

¹ Herrera Batista, *The Ontology of Design Research*, 62.

² IDEO U, ‘What Is Human-Centered Design?’, sect. 2.

³ Spelled as it is.

⁴ IDEO, *Human Centered Design*, 8.

⁵ Dam, ‘The 5 Stages in the Design Thinking Process’.

⁶ Hasso Plattner Institute of Design at Stanford, ‘An Introduction to Design Thinking PROCESS GUIDE’.

⁷ Gibbons, ‘Design Thinking 101’.

⁸ IDEO, ‘The Design Thinking Process’.

researchers alter divergence and convergence to locate the solutions. All DT processes are non-linear, stressing the importance of testing and keeping iterating on the solutions. I implement the phases of DT and its core values in the proposed workflow as follows.

As a process to create infographics visualizing service procedures for immigrants to address language barriers, this workflow, focusing on one community at one time, initially asks this question: “**How might we create the understandability and inclusion of the infographics for *this* community?**” To begin, designers/researchers should start with secondary research and expert interviews to understand this community and its common service-related challenges. With a few service examples learned via previous research, the designers/researchers would then facilitate at least two co-design workshops. Each workshop goes through one cycle of *empathizing, defining and refining, ideating* and *prototyping* with the participants. In the first one, designers/researchers work with experienced immigrants, who have gone through certain service procedures, to design the infographic examples. These examples will be *tested* in the second workshop, in which the newcomers, who do not have experience with the examples, are invited to provide feedback and improve the design.¹ Through the workshops, designers/researchers would collect qualitative data and analyze it into design guidelines that work for this community. The next phase is to *implement* the design

¹ See **Error! Reference source not found.** for the detailed workshop plan.

guidelines in the infographic design and *test* it again during the creation process. Lastly, after the infographic deliverables are published, feedback from the target audience would be continually collected to inform iterations. (see Figure 20)

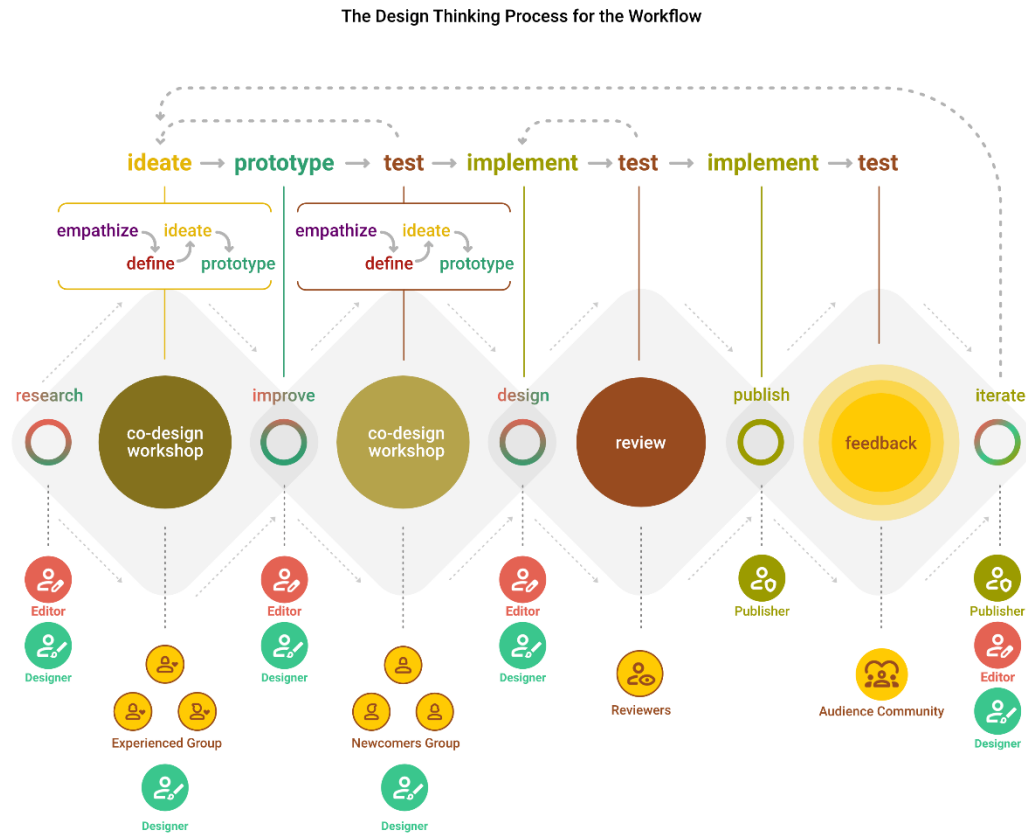


Figure 20 The Design Thinking Process for the Workflow, created by the author of this paper.

It is important to note that, though widely adapted, HCD and Design Thinking are also under harsh criticism. Ovetta Sampson, principal design director at Microsoft, a former IDEOer, wrote a blog post pointing out that “Design Thinking actually doesn’t work” without a true understanding of HCD philosophy and ends up with false empathy¹. Some opinions also linked Design Thinking to colonization and

¹ Sampson, ‘Stop Bastardizing Design with False Empathy’.

White Supremacy, resulting in monotonic white-male-default “universal” design¹.

These criticisms may have resulted in an important shift in the HCD design process: a shift in the human/user role. In the early years, IDEO proudly stated that HCD is a process that “...starts with the people we are designing for.” Norman’s comments echoed this statement. He pointed out that the understanding of people should be “primarily through observation” in HCD², which emphasized the importance of experts. Over years of reflections and evolution, in IDEO’s latest webpage, HCD has become “a creative approach to problem-solving that puts people...at the **heart** of the process...It means designing **with** people, not just *for* them”³.

3.4.2. Participatory Design, Co-Design, and Co-Creation

A HCD researcher and social scientist, Liz Sanders, noticed this shift of the “human” role. In her co-authored paper *Co-Creation and the New Landscapes of Design*, and later article *An Evolving Map of Design Practice and Design Research*, she mapped different design research practices in the HCD field by their approach, design-led or research-led, and mindset, expert mindset or participatory mindset.⁴ In this map, Participatory Design (PD) is a big bubble on the right side, the side of the participatory mindset, across both approaches. PD started in computer systems design following the User-Centred Design approach in Scandinavia.⁵ It stressed the

¹ Buzon, ‘Design Thinking Is a Rebrand for White Supremacy’.

² Norman, *The Design of Everyday Things*, 1.2.

³ IDEO U, ‘What Is Human-Centered Design?’

⁴ Sanders, ‘An Evolving Map of Design Practice and Design Research’, 13.

⁵ Schuler and Namioka, *Participatory Design*, xi, 31.

active involvement with the end users to ensure the output meets their needs. This approach not only improves the quality of the design output but also contributes to democracy building.¹ PD was adapted in North America in the 1990s under the name of Cooperative Design.²

Today, co-design is widely applied in fields outside computer systems, including product, experience, and service design. It has been concentrated into one simple definition: **design with people**.³ Meanwhile, co-creation, or collective creation, expanded the activity out of the design process, including various collective creativity.⁴ Though “collective creativity” or “collaboration” can occur between designers and any type of non-designer,⁵ today, we use these two terms more often to refer to co-activities with the end users, who are called the target audience in this research.

In this research, **co-design** specifically refers to the co-design activities to create the infographic examples with the target audience, in which case it *practices* the **participatory design** approach. In the meantime, **co-creation** refers to collaboration among service procedure experts, graphic designers, and communities.

¹ Schuler and Namioka, *Participatory Design*, 35.

² Schuler and Namioka, *Participatory Design*, 31.

³ McKercher, *Beyond Sticky Notes*, 14.

⁴ Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’, 6.

⁵ Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’, 6.

This research promotes the co-design and co-creation approaches not only for their ability to answer the workflow's questions but also for their "impact with positive, long-range consequences".¹ They are not just a process to generate design outputs. They are also part of the mindset in the proposed workflow. In this workflow, the professional experts, including settlement experts and designers, should see the design process itself as a way to empower the communities. They are encouraged to prioritize relationships with the immigrant communities², recognize and share their power as experts in these relationships³, and respect plural means and worldviews.⁴

3.4.3. Co-Design Framework

The study "*Infographing*" *Dementia Prevention: A Co-Design Approach* by Escobedo et al explores the co-creation approach to infographic design⁵. This team facilitated two rounds of online workshops to gather feedback from participants on the input prototypes. They iterated the design twice based on the feedback (see Figure 21) and evaluated the design via a survey. This study demonstrated that a co-design workshop framework can be applied to graphic design.

¹ Sanders and Stappers, 'Co-Creation and the New Landscapes of Design', 9.

² McKercher, *Beyond Sticky Notes*, 14; Moll et al., 'Are You Really Doing "Codesign"?'

³ McKercher, *Beyond Sticky Notes*, 14; Sanders and Stappers, 'Co-Creation and the New Landscapes of Design', 9.

⁴ Moll et al., 'Are You Really Doing "Codesign"?' 2; McKercher, *Beyond Sticky Notes*, 15.

⁵ Escobedo et al., "*Infographing*" *Dementia Prevention*'.

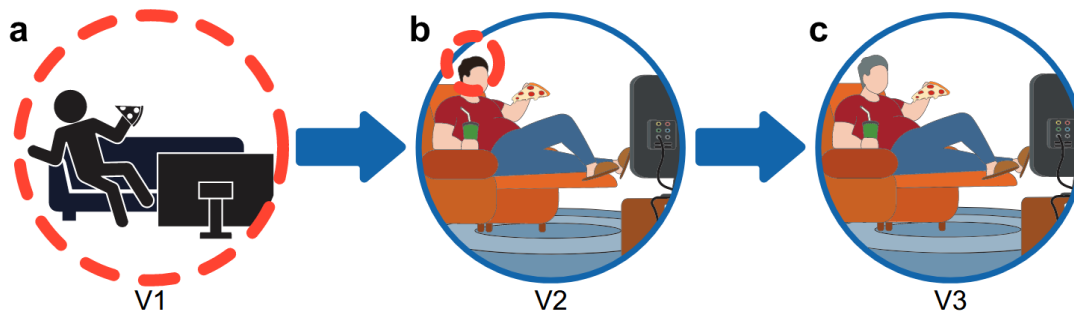


Figure 21 An example of the iterations through co-design in “Infographing” “Dementia Prevention”¹ by Escobedo et al.

The framework that the above study applied was originally developed by Trischler et al² for public service design, then modified and adapted to online sessions by Kennedy et al during the COVID-19 pandemic³ (see Figure 22).

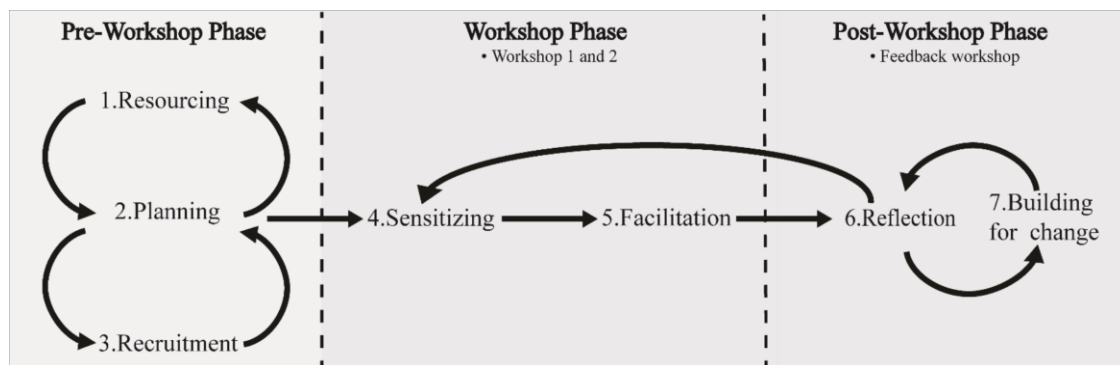


Figure 22 An extended model of Trischler and colleagues' co-design framework by Kennedy et al.⁴

This framework has seven steps:⁵

- The **resourcing** stage is to gather information and understand the problem.
- The **planning** stage is to plan the workshop and prepare recruitment.
- The **recruiting** stage is to invite participants.

¹ Escobedo et al., “Infographing” Dementia Prevention’.

² Trischler et al., ‘Co-Design’.

³ Kennedy et al., ‘Translating Co-Design from Face-to-Face to Online’.

⁴ Kennedy et al., ‘Translating Co-Design from Face-to-Face to Online’, 10.

⁵ Kennedy et al., ‘Translating Co-Design from Face-to-Face to Online’, 3–4.

- The **sensitizing** stage is to provide context to prepare participants.
- The **facilitating** stage is to organize the workshop.
- The **reflecting** stage is to test ideas.
- The **building for change** stage is to implement the solution.

3.4.4. Adapting the Framework

The co-design workshops in my proposed research follows the same framework as “*Infographing*” *Dementia Prevention*. The *resourcing* stage has been completed in this research. When the designers/researchers work with a new community, they start with the *planning* phase. In this stage, they will collaborate with settlement experts, who work closely with this community, to prepare for the workshops. In the meantime, the participants can be recruited with the help of the settlement experts in the *recruiting* phase. In the *sensitizing* stage, the participants will be contacted to provide information about the workshops, including the purpose and the schedule. To benefit the participants, a brief survey will be sent out to find out the service procedures that are most useful for them. These service procedures will be used as examples in the workshops. In the *facilitating* phase, there should be at least two rounds of design activities to create the infographics for the service procedure examples. In the first one, designers/researchers work with experienced immigrants, who have gone through these service procedures, to design the infographics. In the second round, the newcomers, who lack experience with the examples, are invited to provide feedback and improve the infographics. Through the workshops, designers/researchers collect qualitative data and then

analyze it to design guidelines in the *reflection* phase. In the meantime, the infographics will be finalized and sent to the participants so they can share with their community. In the last phase, the designers apply the design guidelines to create more infographics. The co-design workshop process was demonstrated below. (see Figure 23) ¹

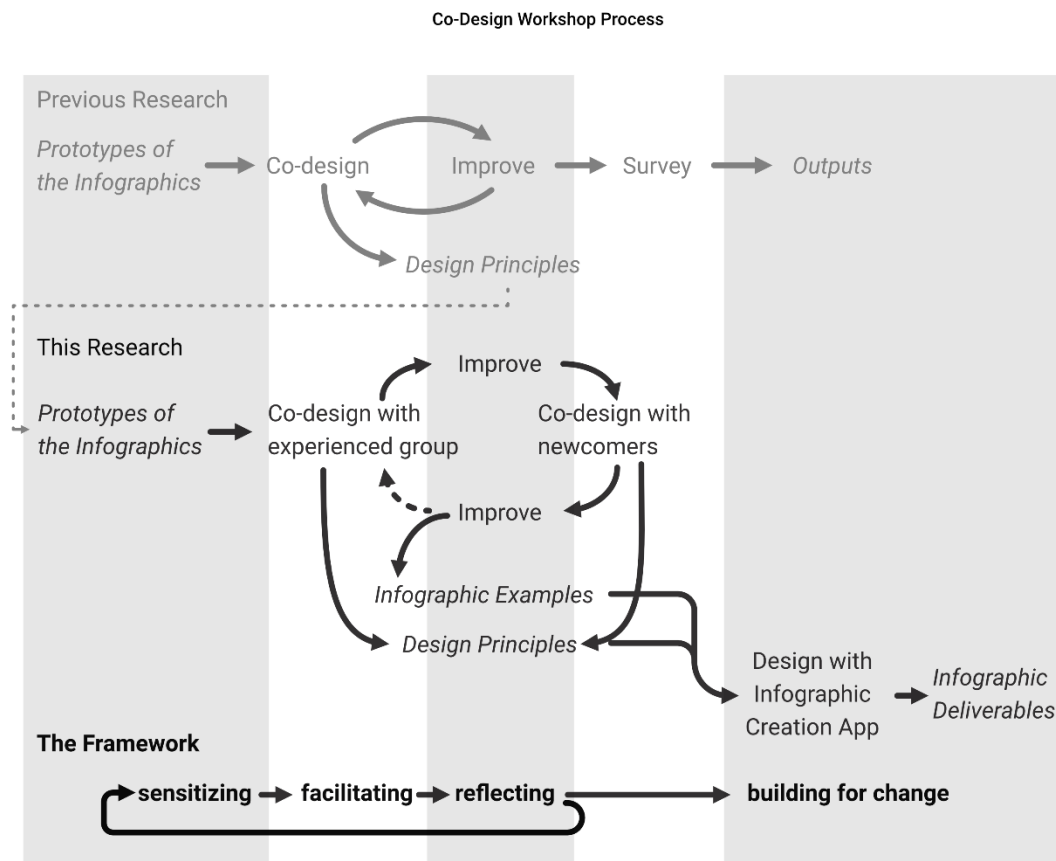


Figure 23 The Co-Design Workshop Process, created by the author of this paper.

For the proposed workflow, I planned a few adaptations to this framework. They are highlighted as follows.

¹ See [Appendix E](#) for the detailed workshop plan.

Planning with Empowerment in Mind

The co-design workshops aim to empower the community not just with the results but also through participation.

When working with the settlement experts, the designers/researchers should identify a few service procedure examples that are most useful for this community. This action is to make sure that the participants can benefit from designing the infographics. After the workshops, the participants will receive the outputs and be encouraged to share them with their social circles. This action addresses the most urgent challenge in the community as well as helps strengthen their ownership of the outputs.

Recruiting with Survey for Better Analysis

The participants should be recruited and grouped mindfully based on their experiences and backgrounds. Their English proficiency, educational background and life experience are considered during the recruitment phase and documented through a pre-workshop survey. This can help researchers better understand and analyze the participants' insights.

Smaller Sizing Borrowed from HCD for Feasibility

The co-design workshops for system design may be too big for this workflow. For example, Jones and Ael recommended a size of 10-25 for small groups in co-creation workshops¹. The recommended size of a mapping experience workshop is

¹ Jones and Ael, *Design Journeys through Complex Systems*, 21.

6-12.¹ This number can be harder to reach when recruiting from loosely structured communities than from structured organizations. Therefore, this research employs the Human-Centred Design methodology and aims to recruit 3-5 participants per workshop. Three is a feasible number recommended by Steve Krug in his book *Rocket Surgery Made Easy*². Five is the maximum number recommended by Nielsen based on his research³. This size makes the organizing the workshops more feasible while still providing enough insights.

In-person Workshops for Better Communications

The co-design workshops should be hosted in-person. Though online meetings have been proven to work and provide some benefits⁴, in-person workshops bring the participants a “significant advantage in their engagement and learning”⁵. Given the English proficiency of the participants, in-person workshops allow them to use multiple methods to express themselves other than language. Additionally, considering language barriers and cultural differences, designers' and researchers' observations, rather than participants' self-reports, will provide valuable insights. This kind of observation is nearly impossible to conduct during online meetings under the current technology.

¹ Kalbach, *Mapping Experiences*, ch. 8.

² Krug, *Rocket Surgery Made Easy*, ch. 3.

³ Nielsen, 'Why You Only Need to Test with 5 Users'.

⁴ Kennedy et al., 'Translating Co-Design from Face-to-Face to Online', 12.

⁵ Jones and Ael, *Design Journeys through Complex Systems*, 29.

Flexibility

Lastly, it is worth noting the difference between the framework's original purpose and the proposed workflow's goal. The framework was originally developed for service design¹, not graphic design. Therefore, it should be applied as a reference with flexibility.

¹ Trischler et al., 'Co-Design', 1595.

3.5. Summary of the Design Stage

The design stage was to respond to the first secondary research question:

What design process might maximize the degree of understandability and inclusivity of infographics optimized for immigrant communities?

To answer it, I defined the type and requirements of the output infographics, explored and selected a suitable type of AI model, and developed the participatory design workshop plan using a co-design framework.

The infographics should be designed and iterated collaboratively, following the design principles defined through co-design workshops with the target audience. The outputs should be in formats used in front-end web development. Optionally, the design process can be moderately assisted by text-generative AI models that run on users' devices. All stakeholders' knowledge and experience should be recognized and valued during this process, including settlement experts, graphic designers, and the target audience.

4. *prototyping*: An AI-assisted Infographic Creator

“Given that AI is a powerful technology, we have a moral obligation to use it well, to promote the positive aspects and avoid or mitigate the negative ones.”¹

- Stuart J. Russell, professor of computer science at the University of California, Berkeley, and Peter Norvig, Distinguished Education Fellow at Stanford HAI, Research Director at Google, *Artificial Intelligence: A Modern Approach*

¹ Russell and Norvig, *Artificial Intelligence*, 986.

4.1. Defining the Scope

To clarify the expectations, I define the prototype as follows.

This prototype is:

- A **proof of concept** to test creating editable infographics using front-end web technology with AI's assistance.
- A **low-fidelity** interactive user flow to present the workflow and gather feedback.

This prototype is NOT:

- An interface prototype for user experience (UX) design, as UX design is not this research's focus.
- A fully functional product as it does not have a full backend and omits some basic functions.

For clarity, the prototype is referred to as the all-uppercase *APP* to distinguish it from other software applications.

4.2. Preparing the Development Environment

I built a fully local environment to develop the prototype. This environment includes Windows Subsystem for Linux (WSL)¹, Ubuntu on WSL² (24.04), Docker Desktop³, and Ollama Docker Image⁴. I used Visual Studio Code (VS Code)⁵ as my code editor⁶ and Git⁷ for version control.

To avoid “dependency hell”⁸, I set up a development container and launched VS Code from it. To be AI-friendly, the backend container is Python-based. Ollama runs in a separate container for easier maintenance and migration.

The development environment structure is shown below (see Figure 24):

¹ Microsoft, *Microsoft/WSL*.

² Ubuntu, ‘Ubuntu on WSL’.

³ *Docker Desktop*.

⁴ ‘Ollama’; ‘Ollama/Ollama - Docker Image’.

⁵ ‘Visual Studio Code - The Open Source AI Code Editor | Your Home for Multi-Agent Development’.

⁶ Sometimes VS Code was referred as an Integrated Development Environment (IDE) due to its extended abilities by the extensions. However, Microsoft brands VS Code as a code editor and, recently, an AI code editor. I prefer this definition as I started to use VS Code because of its simplicity and flexibility in its early years.

⁷ Git, ‘Git’.

⁸ Snider, ‘Python Dependency Hell’.

Development Environment

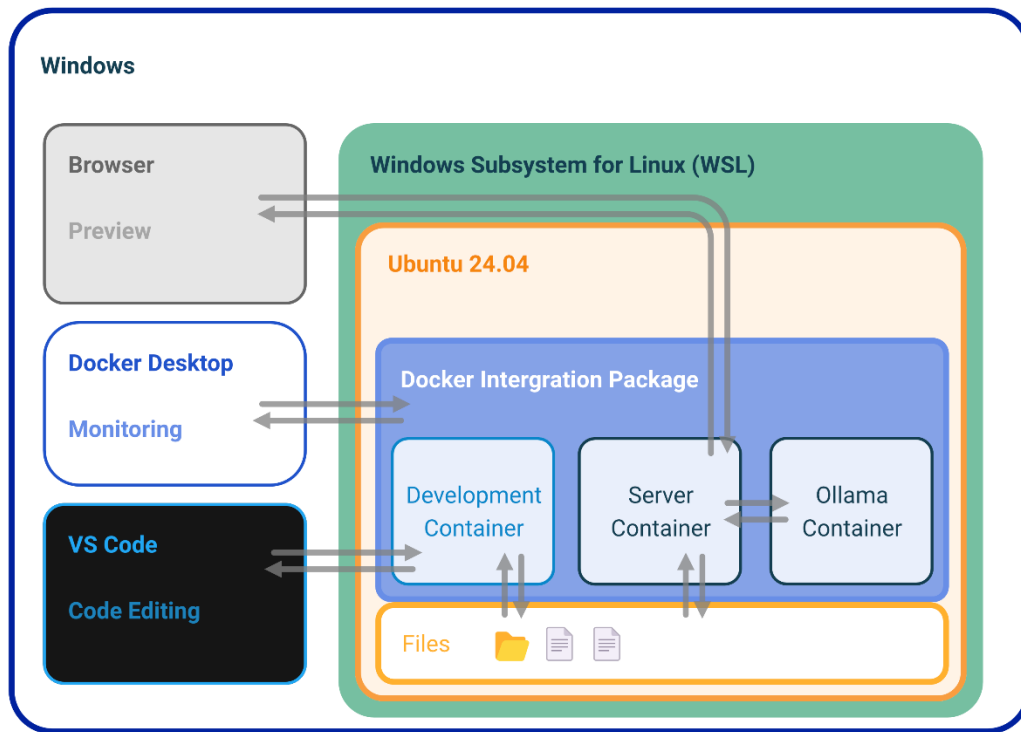


Figure 24 The Development Environment, created by the author of this paper.

4.3. Working with AI Models

In this prototype, I use AI to assist with three tasks: 1) to create a dictionary of visuals and text, 2) to rewrite and structure the text instructions, and 3) to generate infographic drafts based on the text instructions. Based on these purposes, I need a) one image-to-text model and one text-generative model, or b) one multimodal model.

I first filtered out models that cannot run on a personal-use computer, since the APP must run locally without cloud services or expensive hardware. In this research, I chose from open-source¹ models that can run with Ollama. I then compared the models based on their sizes, energy consumption, and reviews, using information from Hugging Face, news, and blogs. After narrowing down to a few models, I tested them in the order of small to large. For the demonstration, I settled on Gemma3-4b by Google because it was then the smallest multimodal model that meets the criteria, with both decent image-to-text and text-generation abilities. I also provided other models for users to choose from.

There are various strategies for working with AI models, including prompt engineering, fine-tuning, and retrieval-augmented generation (RAG).² As discussed in the Design Stage, unmodified mainstream language models are competent for the tasks in this prototype. Therefore, I chose working with **prompt engineering**.

¹ Open Source Initiative, *The Open Source AI Definition – 1.0*.

² Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, ch. 4.

Prompt engineering is a strategy to optimize the outputs of the AI models by focusing on their inputs.¹ After several rounds of testing, I settled on the strategies as follows:

For task 1, to create a dictionary of visuals and text, I used zero-shot learning², giving a prompt without any examples.

For task 2, to rewrite and structure the text instructions, I used few-shot learning, prompting with examples.

For task 3, to generate infographic drafts based on the text instructions, I believe that the best strategy is also few-shot learning; however, due to a lack of infographic examples within the timeframe, I could not test this approach in this prototyping stage.

See Appendix J and I for the prompts.

¹ Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 136.

² Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 142.

4.4. Prototyping and SPARK

The initial prototype had basic functions, including project management, document handling, summarizing the original document in simple language, inserting icons, and drafting infographics by assembling the icons. These basic functions are provided by HTML, CSS, and JavaScript (JS) on the frontend and by Python on the backend. At this stage, no framework or library was introduced to the frontend, while the backend is FastAPI, a lightweight Python-based web framework chosen for its high performance.¹

The initial prototype was presented² at the SPARK event in the Digital Futures program (October 7th, 2025). Viewers generally liked using AI to improve accessibility while sharing their concerns. Most critiques are for the infographic drafts. Viewers mentioned that they needed more meaningful visual symbols, including the images from the original document, and a clear flow of the service process. I found that the rewritten text did not directly improve viewers' experiences of reading. However, the format and inline visual symbols might. This finding "sparked" the exploration of generating more structured text, which also led to a better infographic drafting function. The UI also created confusion and did not represent the workflow as it should. These comments were incorporated into the next version of the prototype.

¹ Jeremiah, 'Python Backend Development'.

² It is worth noting that I did not follow the usability test procedure; therefore, my observation may not be accurate enough.

4.5. Iterating

The sections below show the prototype's current stage with design considerations explained. It is worth pointing out that, although users can switch freely between roles in the prototype demonstration, in the real situation, they can only access the workspace of their assigned role. One person can play different roles in different projects. However, to form meaningful collaborations and ensure the quality of the outputs, one should take accountability for only one role on one project.

4.5.1.Account

The *Account* page is for a user to set up their account (see Figure 25). Every user, no matter which role they play, can access this page. The key components on this page are shown and explained as follows.

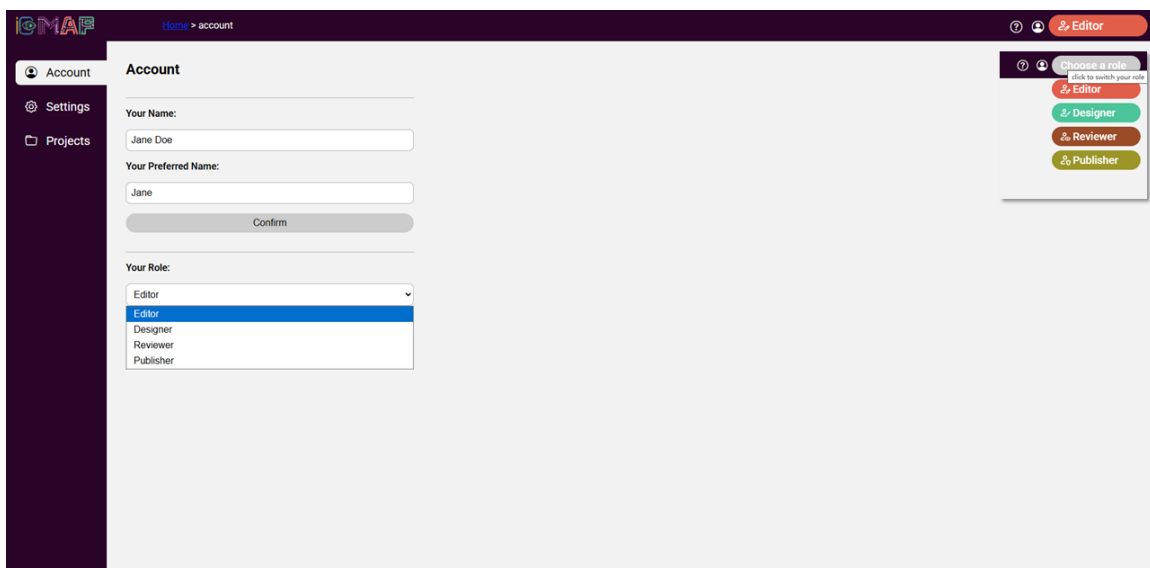


Figure 25 Composed screenshots of the Account page and the opened role switching dropdown, screen shot by the author of this paper.

Your Name is for the user's name. This APP documents the user's name to encourage the user to be responsible for the final result, which helps ensure meaningful human control.

Your Preferred Name is for the user's preferred name, which will be displayed on the infographics that they work on. This approach balances transparency to target audiences, crediting and appreciating the people behind the scenes, while respecting their privacy and identity.

Your Role is to set up the user's role, assuming one user will play one role in one project. The APP will use this setting to generate the credit on the infographic. The role switching dropdown menu at the top-right corner works as the same way as *Your Role*. It exists to indicate the user's current role and allows them to switch roles conveniently. In a real use case, switching roles will send the user back to the project management page to choose another project to work on as they cannot play different roles in one project. In the prototype, the user will stay in the same project for demonstration purpose. I will explain each role's responsibilities when introducing their workspace below.

In a real use case, there also should be security settings (e.g., user's email and password). This prototype does not include them for they are not the core functions.

4.5.2. Settings

The *Settings* page is to set up default settings for new projects (see Figure 26). An *expert* user (an editor, designer, or publisher) who acts as the *project manager* can access this page. The key components on this page are shown and explained as follows.

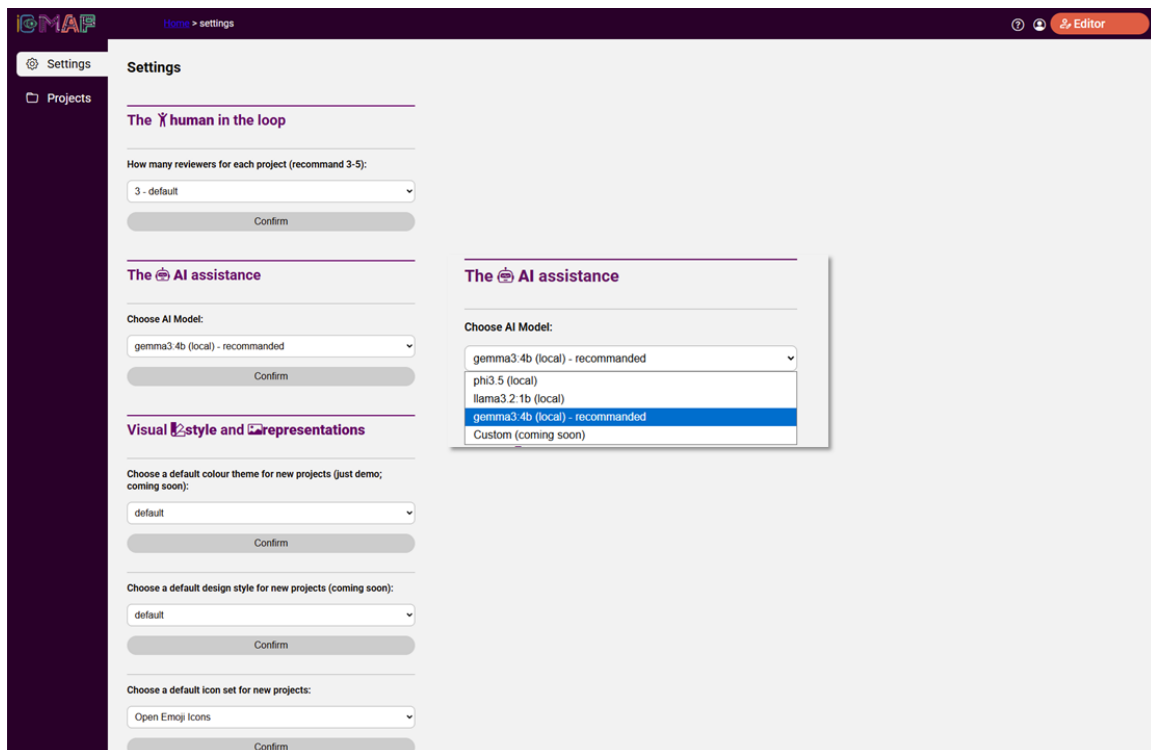


Figure 26 Composed screenshots of the project Settings page and the Choose AI Model dropdown, screen shot by the author of this paper.

How many reviewers for each project (recommend 3-5) is to set the size of the review team. This size follows the same rules as HCI design testing that was discussed in the Design Stage. Providing this flexibility is to make sure that the project manager can balance between performance and feasibility.

Choose AI Models is to set the AI model. Providing the settlement experts or service providers with this freedom is to make sure they have the right to choose AI

based on each organization's policies and prevent them from being locked into one tech company.

Choose a default colour theme for new projects, ***Choose a default design style for new projects***, and ***Choose a default icon set for new projects*** are to set up the design guidelines for new projects. Colour themes and design styles are stored in CSS files and will be loaded based on these settings. Icon sets are a set of JSON files and a folder of image files. The JSON files work as dictionaries that connect the visual and text. When the user switches icon sets, the APP will check if the set has its dictionary and ask the user to initialize the set if not.

Currently, the APP only provides the user interface (UI) for global settings, assuming that each deployment of this APP serves one group of a target audience. In a real use case, there will be UI for settings for different levels (for example, project-level settings) as well.

4.5.3. Project Management

The *Projects* page is for a user to view all the projects that they are working on or have access to. Each user has their unique content. The projects are ranked in decreasing order by their last update time (newest at top). The key components of each project are shown and explained as follows.

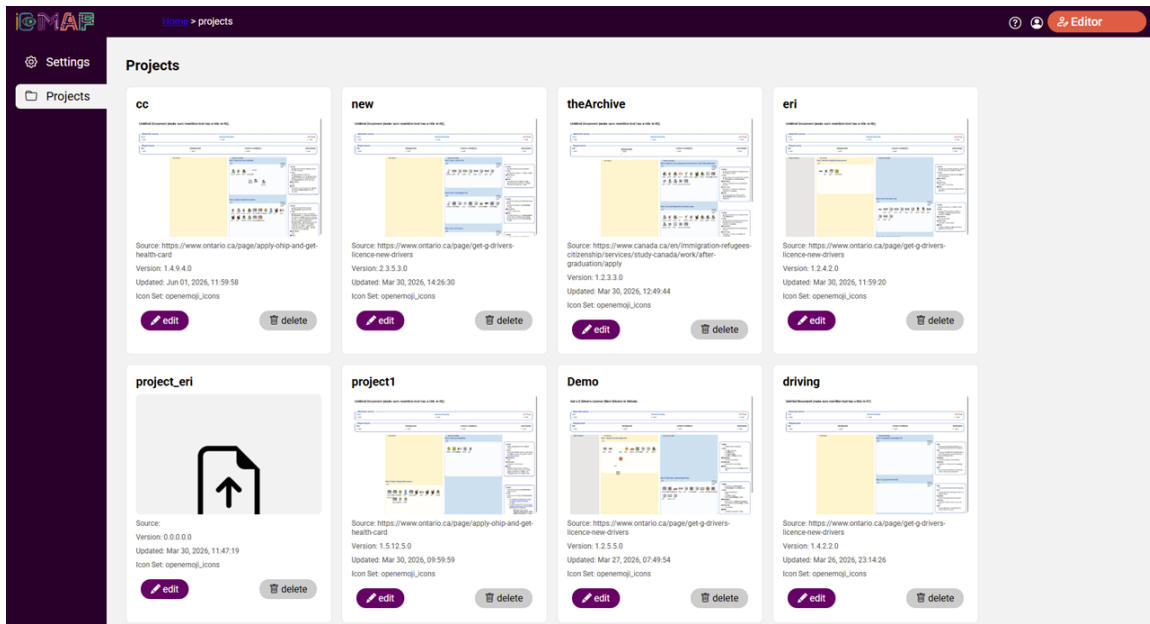


Figure 27 Screenshot of the Projects page, screen shot by the author of this paper.

At the top of each project is the **project name**. It can be different from the source document's name. The reason for this design is to give the organization the freedom to set their own namespace according to their particular situations. The image in the centre is a **screenshot** to show the current status. The screenshots were taken when one user saves the file. Below is some information (metadata) about the project: **Source** shows the original document's file name or URL. This information helps users to identify the topic of this project. **Version** and **Update** provide information about version control. **Icon set** is shown here but not other design guidelines because it decides the visual vocabulary. At the bottom are action buttons: **edit** will bring the user to the workspaces of their current role. And **delete** moves the project to the recycle bin once the user confirms their decision.

4.5.4. Workspaces

The workspaces share a similar layout. The common components show as follows. The top shows project information, including the **project name** and **metadata**, which reminds the user of their current work. The **work area** is the biggest part(s) in the middle with white backgrounds. This is where users work on text editing, designing, or reviewing. Each user has their unique work area in their workspace. The **small buttons** at the bottom of each work area (e.g., *save*) are the functions to interact with the content above. The **big buttons** below the work areas (e.g., *send to designer*) are functions for handing the user's work to their collaborators. Each work area also has its own context menu, which can be triggered by clicking or selecting the element (e.g., text, icons, comment marks).

4.5.5. Import Source Document

If there is no source document in the project, a pop-up will prompt the user to import one. (see Figure 28) This is usually the Editor's job. The prototype can process webpages or text files (.txt, .pdf, .doc, or .docx) but works better on the former. To demonstrate, the prototype provides some examples of URLs on the right side, which will not be part of the final product.

After being imported, the source document will show above the Editor's work area. The Editor can update the source document when the service procedure is updated by clicking the "replace the source file" button. (see Figure 29)

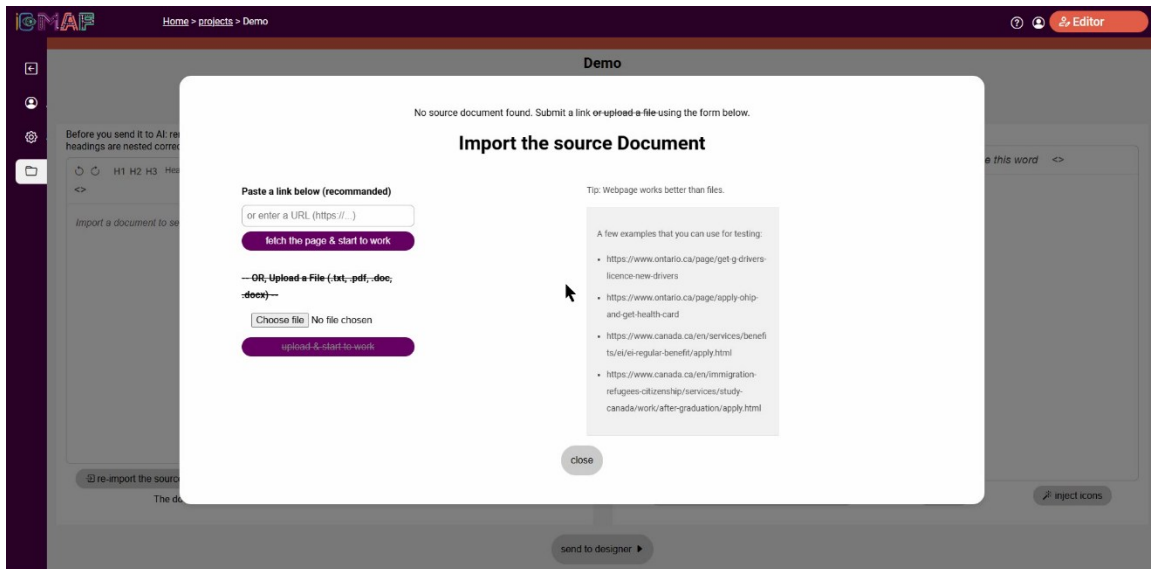


Figure 28 The screenshot of the Import Source Document pop-up, screen shot by the author of this paper.

4.5.6. Editor's Workspace

Editors are those who have expertise in service procedures and, ideally, experience licence working with the target community. They are responsible for the accuracy of the text content and the visual representations.

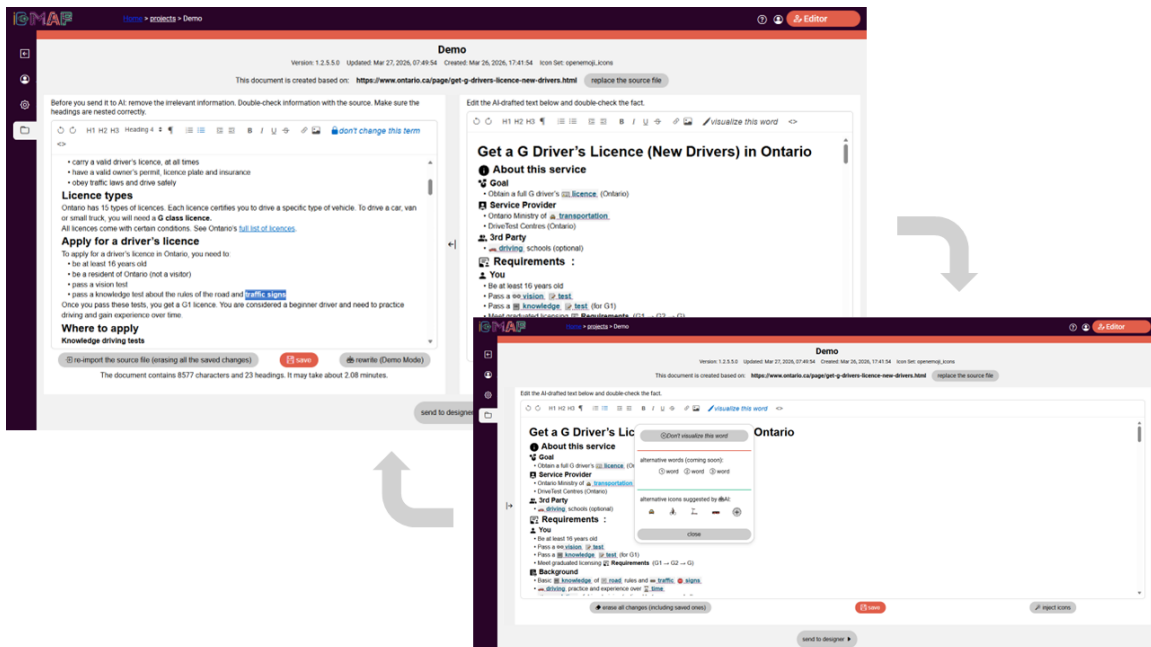


Figure 29 Composed screenshots of the two phases of the Editor's Workspace: normal and focus, screen shot by the author of this paper.

The main work area in the Editor's workspace has two parts. The right part can be enlarged to focus mode by clicking the expand button in the middle. (see Figure 29)

The left side is a ***text editor for the original instruction***, customized from Quill¹. This file is created from the source document. When the Editor uploads a file or provides a URL² to the official webpage of the service procedure, the APP will clean the styles, but the remaining content will be untouched as the original file. The Editor can remove irrelevant information (for example, a temporary notice on a Canada Post strike) and mark the terms that should not be rewritten (for example, treat "Employment Insurance" as one term) using the customized function "*don't change this term*".

The right side is the ***text editor for editing the rewritten instruction***, also based on Quill. After cleaning and marking the original instruction, the Editor presses the "rewrite" button, and the language model will restructure the information into a step-by-step instruction. Each step includes key points such as who, where, when, how long, how much, and the expected outcomes. The Editor is required to fact-check this instruction and ensure the headings are nested correctly.

The visual representations are also injected into this text editor. After being satisfied with the restricted instruction, the Editor will introduce the visuals (currently testing as icons) by pressing the "inject icons" button. The APP will go

¹ Chen, *Slab/Quill*.

² Uniform Resource Locator.

through the text, match terms to a dictionary created during the project settings step, and compile a new file with visuals attached to the concepts. It is the Editor's responsibility to examine the accuracy and appropriateness of the visuals. They can replace the visuals or choose not to visualize a word using a customized function in the **context menu** by clicking one of the highlighted words.

When the Editor confirms the instruction and visuals, they can send the work to the Designer by clicking the “send to designer” button.

4.5.7. Designer's Workspace

Designers are graphic designers who are ideally good at infographic design. Their responsibility is to provide suggestions for visual representation choices, solve the correct visual relations between the components, and make sure the deliverables follow the design guidelines developed with the target community.

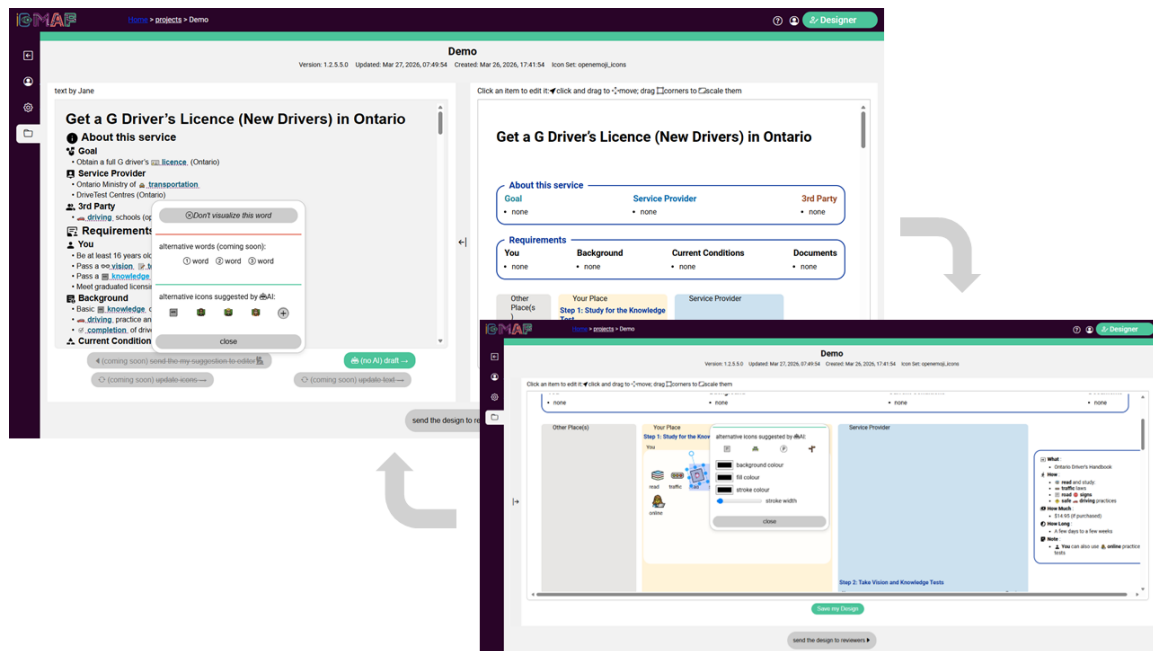


Figure 30 Composed screenshots of the two phases of the Designer's Workspace: normal and focus, screen shot by the author of this paper.

Similar to the Editor's workspace, the main work area in the Designer's workspace also has two parts, with focus mode available. The left side is a text area for the rewritten instruction by the Editor. The Designer can view the text and make suggestions to visual representations but not edit the text directly. This limitation is to ensure the accuracy of the information and to respect the Editor's expertise.

Using the button "draft", the Designer will receive an infographic draft that APP compiles from the instruction. Visual representations with their text are extracted from the instruction and grouped into each frame of a step. Steps are mapped into different columns based on where the action is taken. Lines with arrows (not shown in this screenshot) are also injected between steps to show their relations and guide the audience's attention. The text instructions are also divided into steps, shown as bubbles aside the visuals. This compiling process uses old-

school programming, not AI, to handle the files, to make sure all the text and visuals remain exactly the same. In future, with enough design examples, AI can assist in drafting the layout by modifying the CSS file without processing HTML.

The Designer can edit the infographic draft on the right side. They decide the visual relation between the visual representations and make sure the design aligns with the design guidelines. They can change the positions, size, and rotations by clicking the words and visuals.¹ They can change the colours of the visuals due to the SVG format. When the Designer is happy with the infographic design, they can send it to the Reviewer to comment by clicking the “send the design to reviewers” button.

4.5.8. Reviewer’s Workspace

Reviewers are representatives of the target community. Their responsibilities include providing honest feedback on the design, rating its understandability, and marking the parts that need improvement.

¹ 최연규, *Daybrush/Moveable*.

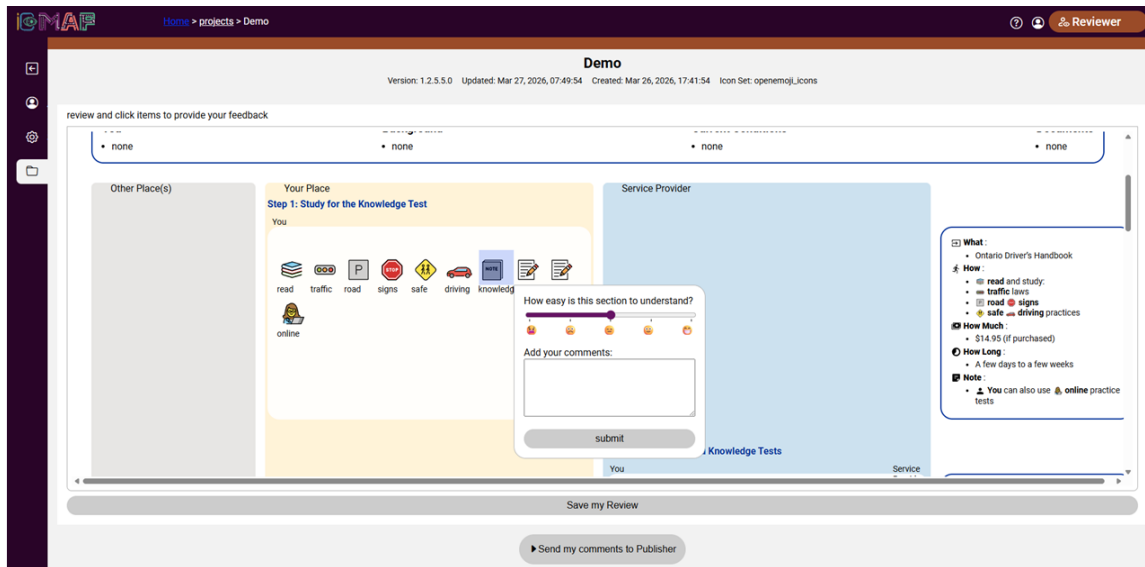


Figure 31 Screenshot of the Reviewer's Workspace, screen shot by the author of this paper.

The main work area in the Reviewer's workspace has only one area. The Reviewer can click text, visuals and frames to input their feedback in the pop-up context menu. The prototype currently enables two types of feedback. One is the rate of understandability. The numbers from all the reviewers will be averaged and reflected as a colour background on the infographics. The second is the free text comment. The Reviewer can input reasons and suggestions for improvements. When they finish reviewing the infographic design, they can send it to the Publisher by clicking "send my comments to publisher".

After publishing, the target audience will be invited to provide feedback on the infographic deliverables and sent to a page similar to the Reviewer's workspace and provided with the same functions.

4.5.9. Publisher's Workspace

Publishers are responsible for quality control. They examine the text, design, and comments, deciding whether the infographics are good enough to publish.

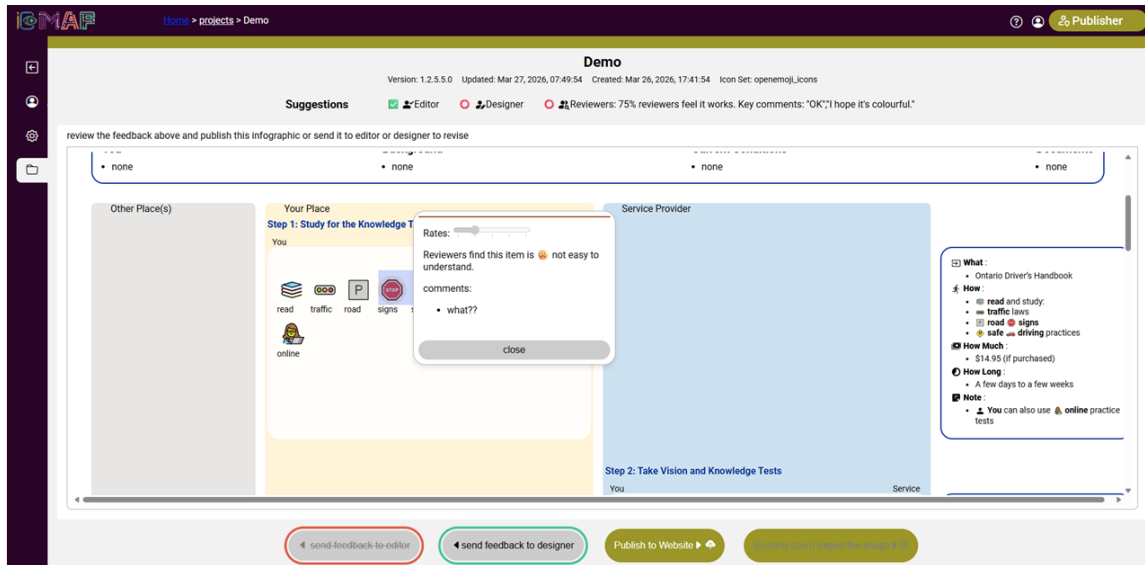


Figure 32 Screenshot of the Publisher's Workspace, screen shot by the author of this paper.

The main work area in the Publisher's workspace also has only one area. The elements with comments are highlighted in the Publisher's view. Additionally, a summary at the top of the work area helps the Publisher make decisions. They can choose to send the design back to the Editor, Designer, or both, with the comments attached, for modification. If they are confident about the design, they can publish it as a web page or as an image file for printing.

The Publisher will continually receive feedback after publishing and decide the time to trigger iterations.

4.6. Output Simulation

The prototype demonstrates the possibility of developing such a product to output editable infographics using credible information and collect feedback. A simulation of the output infographic is shown below. (see Figure 33)

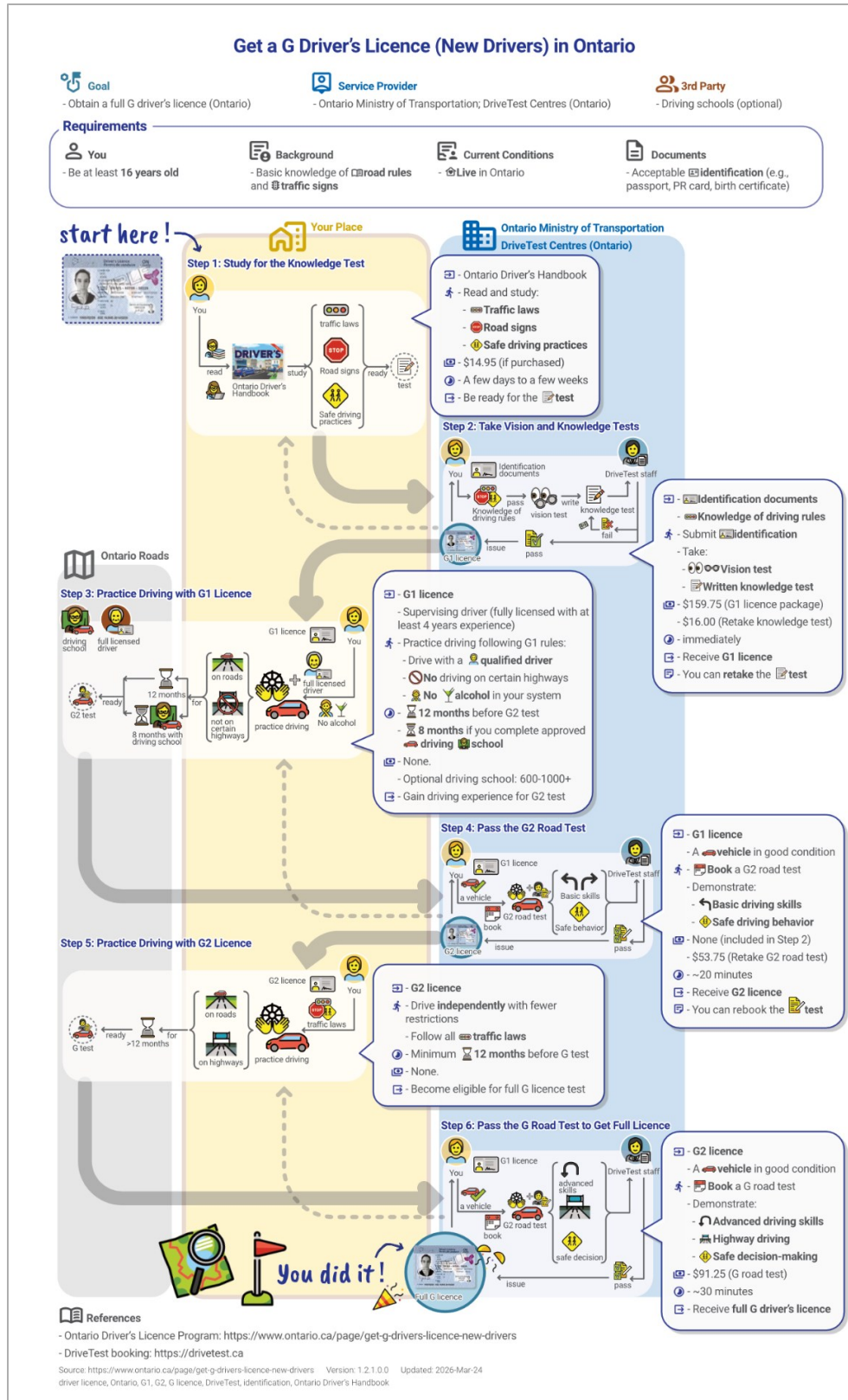


Figure 33 A simulation of the output infographic by the prototype, created by the author of this paper. The icons used in this simulation are from OpenMoji (<https://openmoji.org/>). CC BY-SA 4.0. Fonts (Caveat Brush and Roboto) licensed under the SIL Open Font License, Version 1.1.

4.7. Exhibition: DFX (Digital Futures Graduate Exhibition)

This prototype, along with the simulated output, was presented at DFX, the annual Digital Futures Graduate exhibition (March 26th-30th, 2026). Faculty and students at OCAD, as well as external visitors from various businesses, visited my spot and offered feedback.

Set up

My assigned spot was near the entrance and against the windows. With the help of faculty, staff, and my peers, I set up two tables with handouts, one monitor, and one TV. I also designed and set aside a pull-up poster. (see Figure 34) I prepared two types of handouts: an invoice-size (half-letter) card with the proposed workflow on the front and a brief introduction to my research on the back; and a tri-fold Legal-size flyer with the workflow and introduction on the outside and the simulated output infographic “Get a G Driver’s licence (New Drivers) in Ontario” on the inside. Both handouts attached my contact information and a QR code that is linked to my thesis webpage¹. (see Figure 35) The monitor in the middle of the setup was connected to a laptop. Viewers could interact with the prototype, which was hosted in Docker containers on my home computer and accessed via Remote Desktop by Google.² When there were no visitors, this monitor would play a screen recording of the prototype being operated. The TV on the right-hand side was connected to

¹ <https://thesis26.jczhang.net/>

² <https://remotedesktop.google.com/>

another laptop, which was playing an animated PowerPoint file that presented the workflow and prototype. (see Figure 36) A one-sentence introduction of the prototype, the proposed workflow, and their relations was shown on the poster beside the tables.



Figure 34 The exhibition setup at DFX, shot by the author of this paper.

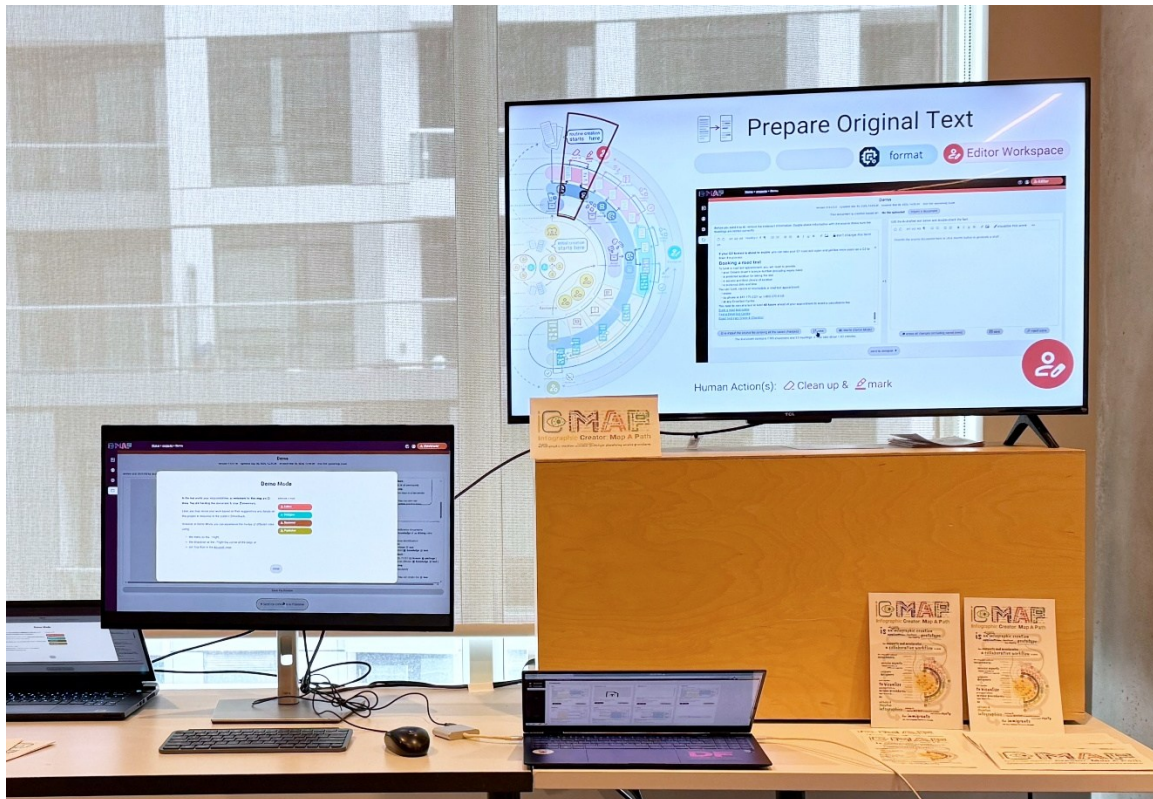


Figure 35 The prototype and presentation display at DFX, shot by the author of this paper.

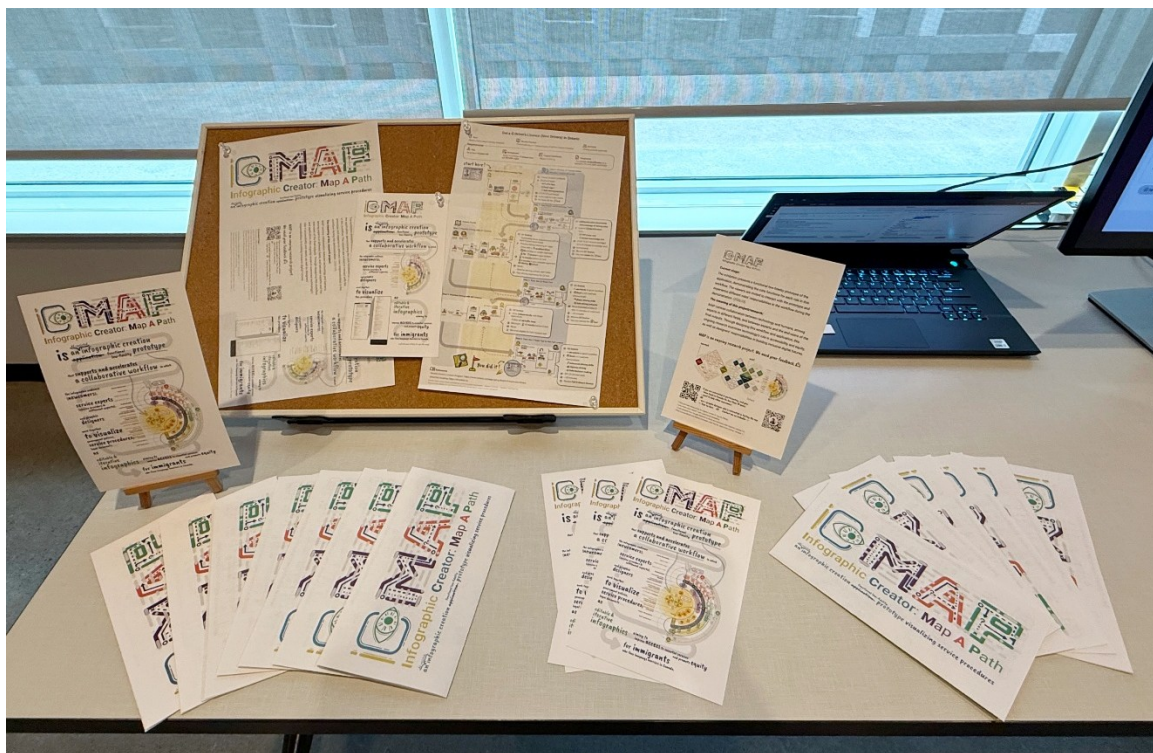


Figure 36 The handouts at DFX, shot by the author of this paper.

On-Site Feedback

Based on the number of handouts that were taken during the exhibition, I estimated that more than 70 people visited my spot, excluding my peers. I mostly received positive comments from the visitors. People liked the idea of using AI to visualize information and improve equity. They also appreciated that I put ethics and humans into the design considerations. Many visitors are also new to Canada (new immigrants and international students). They showed excitement about the visualized service procedures being implemented in real life. One visitor was disappointed to learn that the handout at DFX was only a design demonstration, not a real output, after they had cheerfully grabbed one. People who are children of immigrants or came to Canada as children also showed appreciation of this idea, recalling the difficulties their parents experienced. Perhaps the most interesting comments I received were from highly educated native English speakers, who shared that official instructions were hard to read and would appreciate them being visualized.

Some improvements I took away from the exhibition included more clarity on presentation and a better user interface design. Some people were confused and thought the APP users would be immigrants. The critiques on the UI and UX were expected as they were not the focus of this research. However, these two comments actually echoed my research topic, emphasizing the importance of communication and interaction interfaces.

4.8. Summary of the Prototyping Stage

The prototyping stage responded to the second secondary research question: ***How might we apply the available technology, such as AI, to support the creation of infographics?***

To answer it, I designed and developed a low-fidelity prototype of a **collaborative platform using web development and language model technologies to accelerate human collaboration**, taking into account the considerations discussed in the Design Stage. In conclusion, this prototype proves the possibility of this approach and provides a framework for future development.

5. *feedback*: Interviews

“Treat everyone you interview like they just won the Nobel Prize in their own life experience.”¹

- Quoted by Code for America, *Qualitative Research Practice Guide*

¹ Code for America, ‘Qualitative Research Practice Guide’, 25.

5.1. Process

To gather feedback on the drafted workflow and the APP prototype, I conducted interviews with settlement experts. I sent out four interview invitations and got three responses. I interviewed one of them in person and two online.

All the settlement experts are settlement program managers with years of direct experience working with newcomers. They work in two unrelated organizations that belong to different types and provide different types of settlement guidance: organization A covers all aspects, and organization B focuses on a specific area. Both organizations are funded by multiple levels of government. One of them also has private sponsors, and the other does not. All the experts are passionate about their work and want to help with meaningful improvements to immigrants' experience. The interviews were conducted in English as all the experts speak it fluently.

Two categories of questions were asked: The first was about the service-related challenges that newcomers were facing, which serves a double function. They were used to better understand the current status of the design challenge and to prepare the workshops for future research. The second category was about the workflow and the prototype. I presented them using a PowerPoint file with animations and screen recording, then asked a few related questions. The interviewees were also encouraged to share their related thoughts freely. I took notes by hand during the interviews. Additionally, I recorded our conversations using

my phone or the Snapping Tool on Windows¹. The files were stored on the device and not uploaded to the cloud. I then transcribed them using *aTrain*², an offline AI tool developed by the researchers at the University of Graz³ for academic purposes. I analyzed the interview transcript and my notes using the *thematic analysis* method and summarized the themes.

¹ <https://support.microsoft.com/en-us/windows/apps/use-snipping-tool-to-capture-screenshots>

² Haberl et al., 'Take the aTrain. Introducing an Interface for the Accessible Transcription of Interviews', v. 1.4.2".

³ Haberl et al., 'Take the aTrain. Introducing an Interface for the Accessible Transcription of Interviews'.

5.2. Analysis

Information

Regarding the goal of this workflow, **the accuracy of information was heavily stressed**. Accuracy means authoritative information through official channels, the availability of service procedures according to the audience's eligibility, and the timeliness of the information. Two experts listed the harms of providing incorrect information, including wasting immigrants' time and money and damaging their mental health, which match the conclusions of the literature review. These two also emphasized the importance of **customizing** information based on each client's¹ situation, as information about all the services is overwhelming for newcomers and makes it hard for them to navigate on their own. **Assessing** the client and customizing the information is the first step toward the settlement guidance in both organizations.

Communication

Both organizations use **multiple methods** to communicate with their clients. Communication can take different forms (e.g., online channels, physical printouts), in different locations (e.g., at the organization's space, at special events), or at different scales (e.g., one-to-multiple, one-on-one). But all the methods share one

¹ The term "client(s)" in this chapter means immigrant(s) or newcomer(s), who are the target audience in this paper. I follow the interviewees' vocabulary and use "client(s)" here to respect their perspective.

key element: they provide a direct connection to humans who can filter information for the client and answer questions. Regarding language barriers, the communication can happen in the official language (English in this case) or the client's mother tongue. No language issues were brought up during the interviews. In organization A, which provides general settlement guidance. The expert mentioned that, though its clients' official language levels vary, settlement experts can match clients with **volunteers** who share their mother tongue if needed. The experts in organization B, where the clients need to meet language requirements to be eligible, did not mention language issues either. However, one expert shared their thoughts on the way their clients use AI tools in communication: AI tools help polish messages to read professionally yet feel disconnected from the sender.

When asked to demonstrate how to introduce service procedures to their clients¹, two experts broke the procedures down into step-by-step instructions, using clear indicators such as “first...then...last...”. One expert started each step by clearly stating the expected outcomes or goals, while the other one emphasizes the importance of setting expectations. This observation suggests that knowing the outcomes helps with effective communication with the immigrants. During the in-person interview, the interviewee rotated their computer monitor and instructed me to switch seats so I could observe the interactions being operated on a website. This

¹ Due to time constraints, this question was not presented to the third interviewee.

action suggests the importance of “**showing**” rather than relying solely on language in communication.

Workflow

Regarding preparation for the workshops, the experts can list a few challenging aspects that newcomers face. Housing, childcare/school, and employment are mentioned most often. However, I collected **no data on specific service procedures**. Given the small number of interviewees, I could not identify a clear reason. Therefore, I asked the third interviewee for feedback on my interview questions. They suggested that it would be helpful if the researcher could provide the experts more time to prepare by sending them the list of questions and supporting information (e.g., the prototype and infographic examples) in advance of the interviews. This feedback will be implemented in future iterations.

Regarding the co-design workshop plan, the experts raised concerns about the information provided by experienced immigrants, given the importance of information accuracy and customization. Two experts reminded me that past experiences would be useless for newcomers, because procedures change over time and differ for each person depending on their situation.

For the second workshop, based on their experience working with newcomers, one expert expressed confidence that clients, whether or not they have experience with the services, can provide meaningful feedback on the outputs (e.g., whether they are user-friendly).

Two experts expressed that they felt clear and reasonable about their responsibilities in the workflow, while another one was not presented with this question.

One expert commented that they and their peer managers can fulfill the Editor's and Publisher's responsibilities within the workflow because they have **accurate, complete knowledge** of the services. Based on their experience, the internal designers can also serve as the Publisher to ensure the outputs align with the brand image. Another expert emphasized that the organization should designate one person as the Publisher, responsible for both content and style.

Prototype

Most comments on the prototype were about project management. Its importance emerged because this workflow values feedback, iteration, and staying up to date with procedures. Project management can become overwhelming quickly. Three types of improvements were suggested. First, users should be provided with customizable methods for organizing projects to suit their responsibilities or working styles. The methods could be folders, tags or other attributes. And the users should be able to sort and filter the projects according to their preferences. Most importantly, projects that are not the current user's responsibility should be archived and not shown on this page until a revision is needed. This measure can help users navigate projects more effectively. Second, different view modes (e.g., grid or list) should be provided for the users to switch

between. Third, a set of indicators should be presented for the project, showing its status and, most importantly, whether it requires the user's immediate attention.

One expert suggested an in-workflow communication tool that allows users to highlight a specific area and request information from their collaborators. A similar function currently exists for reviewers. The expert helped to see that it would also be valuable for designers and editors to communicate with each other.

These suggestions will be implemented in the future iteration of the prototype.

Output infographics

Concerning the complexity of the service procedures, two experts expressed interest in **customized infographics** for the audience. They suggested adding an interface (e.g., a questionnaire) for the target audience to input their circumstances and then providing infographics that match their eligibility. Another possible approach is to integrate with the organization's existing chatbot to filter and present suitable infographics to the clients.

Another issue that was raised was the **use of icons**. One expert questioned the number and understandability of the icons. This question can become a new research focus in the future iterations of this research.

Integration

The experts also provided insights on how to integrate the research outcomes into their organizations' current workflow, technology, and settlement guidance procedures.

The interviews suggested that the proposed workflow can integrate with the organizations that already have a **graphic design workflow**. Both organizations have internal graphic designers who can participate in this workflow instead of hiring externals. One expert found that the workflow can work with the current one in their organization. Another one stated otherwise, but speculated that it may work in organizations other than the ones they worked in. One particularly interesting factor that I had not considered before is the organization's influence on the output infographics. One expert mentioned that they also should match their **brand image**. Future research on this topic should include interviews with management-level and internal graphic designers.

As for technology integration, the experts I interviewed have no objection to AI, suggesting the potential real-world application of the outcome APP. In fact, one organization developed **training on safe and efficient AI use** for its staff and clients, which was praised as very helpful. One expert even mentioned they were "having fun" using AI tools as they help with productivity and communications following customized instructions. Both organizations deploy one brand productivity suite. I believe it is safe to assume most service providers do similarly. It is worth

considering how the outcome APP can integrate with the mainstream **productivity systems**.

Integrating the output infographics can be more complex. During the interviews, I realized that I did not have a clear image of **how to introduce the infographics** to the target audience. A few potential solutions include through settlement guidance service, or service providers themselves, or discovered by the target audience. Further research needs to address this question.

5.3. Inspired Future Improvements

Inspired by the settlement experts, I drafted a few improvements for future development.

Adaptive

One clearly implementable improvement is to make the output infographics interactive and adaptive. The target audience should be able to input their situation and access tailored information. I considered this possibility when I chose the output format. The interviews helped determine the high priority of this feature. This feature can address not only language issues but also the overwhelming situation that newcomers are facing.

Modularize

Related to the improvement above, one way to achieve adaptivity is to modularize the infographics. Each step or a few related steps should be bundled into one module. The Editor and Designer focus on the content of each module, and the overall picture can be compiled when the target audience requests the information. This feature can reduce workload (and therefore budget) and improve maintainability.

Fact-check between workshops

To address the concern about the outdated or unsuitable information yet still empower the target community, the first co-design workshops should focus

exclusively on the language and visual preferences, not the content. The examples should be drawn from long-term service procedures that have fewer variants. The services should not have changed long enough so that most participants went through the procedures under the same policies. The infographics from the first workshop should be reviewed by the experts before being introduced to the newcomer group.

Prototype Iteration

The immediate UI improvements should focus on the Project management page and an in-workflow communication tool. Both functions can initially be designed following current design patterns (for example, the project page in online whiteboard platforms and the comment system in Word) and then tested with the potential users of the APP.

6. *epilogue*: Outcomes, Scope, Conclusions, Reflections, and Beyond

6.1. Outcomes

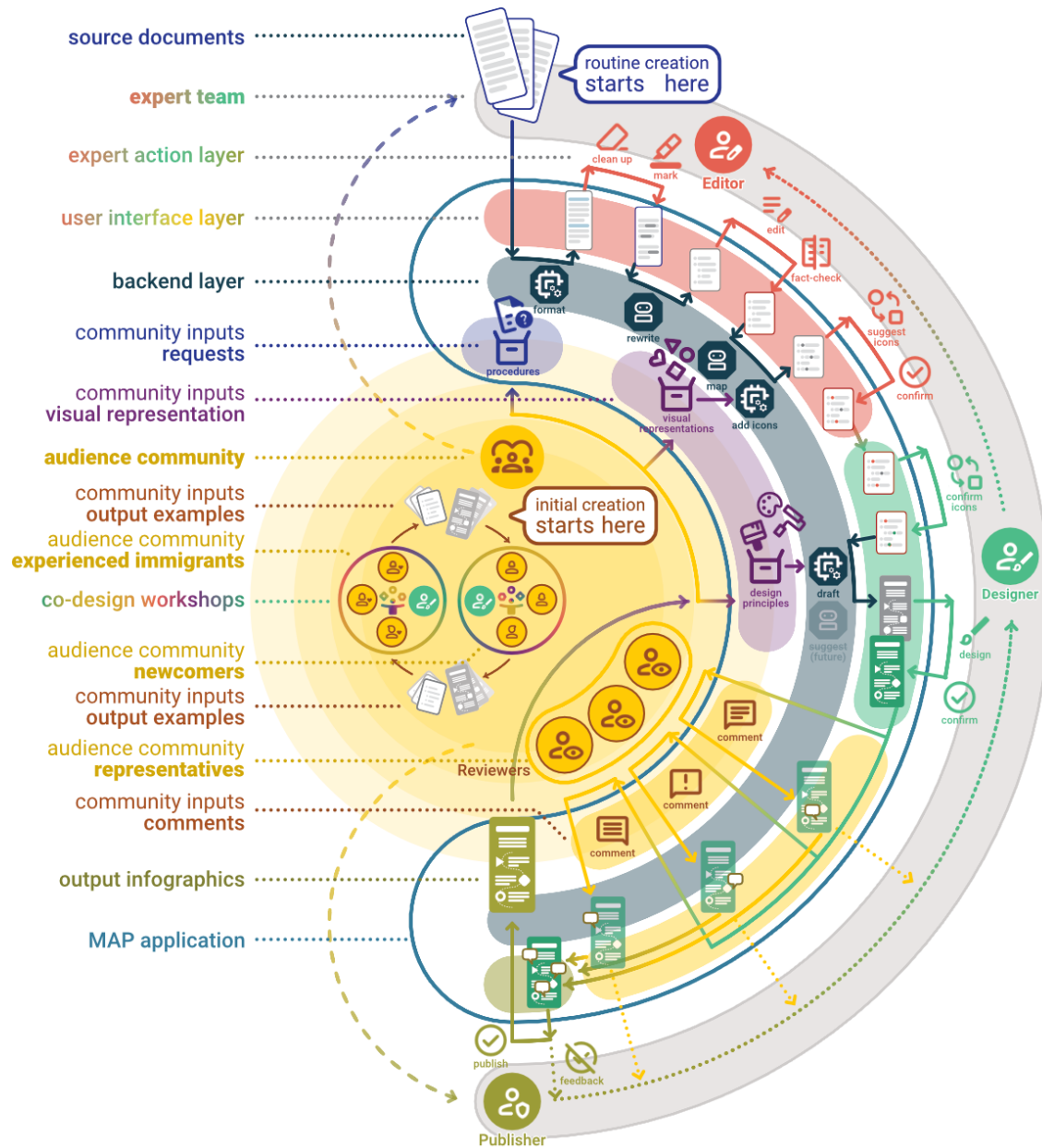


Figure 37 The proposed workflow, created by the author of this paper.

This research proposes a workflow to co-create infographics of service procedures. It starts with a series of co-design workshops with the target community. Through these workshops, the designers understand this community's

visual preferences, which inform the design guidelines for the next step. Via a collaboration platform, the settlement experts, graphic designers, and reviewers (representatives of the community) work together to visualize the service procedures as user-journey-map-like infographic deliverables. After being examined by the publisher, the infographics will be published and continually monitored. The iteration will be triggered by community feedback or by changes to the service procedures.

A low-fidelity prototype of this platform is another outcome. This prototype serves as a proof-of-concept. It demonstrates the possibilities of such a platform and its key functions. It also provides a framework for future development. The current prototype can assist experts in rewriting the original service documents into structured instructions, help designers create initial infographic drafts, collect feedback from reviewers, and export the infographic deliverables as webpages or pictures.

6.2. Scope

This research is the first step toward a functional workflow and platform for infographics of service procedures. It focuses on the theoretical discussions, the directive principles, and the technological possibilities. This research recognizes that the scope is limited. Some known issues are discussed below and planned to be addressed in future iterations of this research.

The literature review on language barriers can be updated in future. Much of the literature evidence on language barriers in this research is based on the 2021 census. This data could be outdated. It would be ideal if future research could incorporate the latest studies using 2026 census data, which would provide a clearer picture of the design challenge.

Primary research data on recent newcomers' experiences with language barriers can be collected in the future. My knowledge of newcomers' experiences was drawn from my life experience. This research recognizes that it is not necessarily considered valid in the traditional research paradigms. The research can be strengthened by collecting related primary research data via interviews or, for time efficiency, during the co-design workshops in the future.

AI's ability and performance in assisting infographic drafts can be experimented with and tested in future. The third task in the APP, generating infographic drafts based on the text instructions, was only partially achieved. At this stage, the APP is able to compile the instructions into drafts that contain visuals and

text. Developing and testing another part of this function, suggesting visual relations, requires sufficient infographic examples, ideally from the co-design workshops. Therefore, this function was postponed until more examples can be created.

The output infographics shall be tested with the target audience in the future. As a proof of concept, I initially planned to design and develop the APP around the features of the output infographics (or even diverge to other solutions if the target audience prefers) based on the feedback from the co-design workshops. However, this plan was altered several times due to multiple factors. Unfortunately, I had to start prototyping the APP before fully understanding its purpose. Therefore, the simulated infographic only reflected the capabilities of the APP, not the design guidelines preferred by the community. So, I decided that it was not necessary to involve my peer newcomers in testing it until the co-design workshops are conducted. This decision follows the principles of co-design, being respectful and prioritizing relationships over research outcomes.

More stakeholders will be invited to co-design this workflow in future. I believe that, not just the infographics, the proposed workflow should also be *co-designed by the people who will apply it*. Many activities in the proposed workflow were initially planned to serve double functions: testing the workflow AND designing the workflow. As this original plan shifted, the current outcomes should be considered as an initial point for a future *Research-through-Co-Design* project.

6.3. Conclusions

This research identified infographics as a solution to address language barriers to essential services and proposed a process and technology approach to create such infographics. Although, due to the scope and timeframe, this research only offers an initial point for future completion, it has discovered some findings. They are discussed below following the categories suggested by Findeli et al.¹

6.3.1. Design Knowledge

This research indicates that the infographics for service procedures may address more than language barriers.

This research is based on an unspoken hypothesis that immigrants' language barriers to service access are due to their unfamiliarity with the official languages. It led to the solution of using visuals to "translate" an unfamiliar language to a *maybe* more universal language. In this case, we are using the visuals' symbolic meanings² to solve a language problem. However, during the research, I found evidence that may suggest otherwise. First, experiments with AI suggested that the difficulties reading the original written language were not caused by the advanced vocabulary. When I prompted AI to rewrite the documents using a lower English level, I found that the outputs' vocabulary was not significantly different than the original one. Second, the fact that native English speakers also experience difficulties reading

¹ *Research Through Design and Transdisciplinarity*, 72.

² Coppin, 'Perceptual-Cognitive Properties of Pictures, Diagrams, and Sentences: Toward a Science of Visual Information Design', 101.

original documents indicates there may be other reasons than language unfamiliarity. Third, people commented that the restructured instructions (see Figure 29) are easy to read even without visuals. This feedback suggested that additional visual cues can help with understandability without “translation”. This evidence led to a new hypothesis: Besides language, **the lack of a conceptual model of the systems** may contribute to the difficulties in understanding the original instructions. In other words, the instructions are difficult to read because the audience cannot associate the languages with their previous experience. This theory needs further research. However, it is **interesting that infographics can still address understandability even with different causes**. Thanks to the pictorial information¹ visuals also carry, they can help audiences form conceptual models by building a bridge between the words and their experiences.

This research demonstrates the feasibility of an AI-assisted text-to-image approach for producing editable, meaningful infographics.

Current AI-based text-to-image approaches have two mainstreams. One purely relies on text-to-image AI to generate raster images from descriptions, which sometimes can be good at translating visual representations but bad at presenting relations. Another one generates special Markdown text from the input text, then compiles it to editable diagrams, which may be better at relations but has no

¹ Coppin, ‘Perceptual-Cognitive Properties of Pictures, Diagrams, and Sentences: Toward a Science of Visual Information Design’, 101.

visualization of concepts at all.¹ This research explored a different approach that is able to visualize both concepts and relations by separating the visualization process.

The process is described below.

1. The input text is rewritten by a text-generative AI model following **defined structures**. Through this process, the text was divided into components, each containing one tag and one piece of information (value), for example, “location (tag): Service Ontario (value)”.
2. Humans review the restructured text.
3. The **value** in each component is visualized following the given visual-text relations (or, though not promoted in this research yet, possibly, AI-generated visuals). In this research, these relations were provided by a pre-created “dictionary” that reveals them via JSON items. AI can be involved in creating these relations or retrieving the visuals.
4. The visual layouts or relations are decided by **tags** and the styling code (e.g., CSS), which can be defined by humans or drafted by AI, or both. The indicators of **relations** (e.g., lines with arrows) can also be created by programming code.
5. Humans edit visual representations and visual layouts.

¹ During this research, a new text-to-figure AI tool, PaperBanana, became available. It uses multiple agents to create “publication-ready” diagrams and charts. (Zhu et al., ‘PaperBanana’.) The results looked promising but did not solve the issue of editability.

Though in a very early stage, the prototype in this research has been able to create the drafted layout and lines that can be further edited by designers. Additionally, by introducing meaningful human control, this approach can eliminate AI hallucinations and model dependence. This experiment demonstrates that we can solve problems without reinventing the wheel (or over-engineering too many fancy wheels) by carefully analyzing the exact needs of the outputs and **combining feasible technologies and human power**.

6.3.2. Design Practice and User Satisfaction

Designing from the designer's personal experience can lead to user satisfaction, but reflexivity and co-design are crucial.

This research started with me trying to scratch my own back, or, in an experience design phrase, target my own pain point. It is personal, which can be a double-edged sword in this case. On one hand, **empathy is not an issue in the design process**. Having this experience made me sure this solution could work, at least for immigrants who share my thinking style and mindset. And the positive feedback that I received from other newcomers during the research can prove it. However, on the other hand, **it put a lens in front of my eyes and may have brought blind spots in my research journey**. Therefore, I believe there are two approaches that are crucial to this research: reflexivity and co-design. By revealing my experience, mindset, and considerations, I described the lens and **invited my peers to judge the validity** of this research. I was hoping that co-design with

settlement experts and newcomers could help address my blind spots. Though the design process did not go as planned, I discovered **invaluable insights and inspirations from my interviewees**, which expanded my comprehension of this research.

6.3.3. Design Education

The research process suggests that the process for obtaining research approval can be improved.

The importance of research ethics cannot be overstressed. We can improve the *application process* to better accommodate HCD or co-creation. At OCAD, for example, the current application process for Research Ethics Board (REB) approval requires a detailed plan that anticipates all activities. On the other hand, an HCD design process recognizes that designers cannot exhaust considerations without working with the end users. The designers need **research activities with human participants** to define the research question or design challenge before forming a plan. Additionally, the application process and form imply a linear research paradigm, while the HCD process is **non-linear**. The researcher may dramatically revise their research plan, even shift their research topics, based on the findings from the previous activity. Under the current REB application process, plan revisions increase the workload of both the researcher and the reviewer. Furthermore, the REB application form was designed for only one research activity, while the design

process under the pragmatic worldview involves **multiple types of activities**.

Applying via the current form makes the application hard to draft and read.

This paper suggests improvements below. First, the applications can be **organized by activity** instead of by research project. It can be done with minor modifications to the application form's UI and database structure, or by grouping or linking applications without any software updates. In this way, researchers and reviewers can focus on one activity at a time. Second, the REB support mechanism can shift from approval to **advising**. The reviewer of an application can follow up with one research project, approving or providing feedback as the research activities unfold. This mechanism does not affect the workload for research that involves only one activity, but it decreases the overall workload for multiple chained activities, especially co-design activities.

6.4. Reflections

During this research, I also had some unaddressed questions. I discuss some of them below.

cultural(?) backgrounds

I believe the output infographics should be community-targeted because design theories suggest that people would have different preferences for visual representations and relations based on their experiences. These experiences are often mentioned as cultural backgrounds. However, as visual designers, how can we categorize cultural backgrounds that determine people's visual understanding? No doubt it should not be based solely on people's countries of origin or mother tongues. We also do not want to create massive versions of a single service procedure with minor differences, which will cause more confusion. Then, how do we know when or under what conditions we should start a new cycle of the workflow? Or can we find out the timing or conditions at all?

To begin to answer these questions, the best way I can think of now is through co-design, testing, and feedback. We can start with one cycle of the workflow with people from different countries and speak different mother tongues. In this way, we see *if* the differences are really huge enough to create community-targeted versions.

pluralism vs accuracy

Related to the question above, I believe that one core value of co-design should be respecting pluralism. Not just respecting the way the target audience visualizes concepts, but also how they interpret the rules behind service procedures. However, pluralism can pose challenges when it works with legal language, which prefers a strictly singular understanding. Legal language is long and difficult to understand without legal training because it was formed through history to eliminate any plural explanations. So, how do we balance between respecting the target audience's perspectives and the clarity of legal language?

I believe the answer has already been created by the settlement experts. They use languages other than the original to explain and guide their clients through these services successfully. In other words, we already have the plural expressions of the service procedures without creating chaos. What makes these expressions clear and reliable is the communication context and follow-up questions, not complications. The infographics offer a way to map the meanings with the audience's experience through visuals. What decides the accuracy of the audience's understanding is their experience, not linguistic expressions. The infographic of service procedures was never meant to replace human experts but provide an additional channel to communicate.

a possible echo chamber

To be transparent, it is worth noting that much of the news and research about the downsides of AI and data centres was “recommended” by Google’s algorithm. One news article I read will cause the algorithm to push another one with the same keywords. This technology helped me with this research, but it also possibly put me in an echo chamber. Therefore, it is possible that I was overly concerned and overemphasized the negative impacts. This experience stressed the importance of exchanging opinions with peers and respecting feedback from other perspectives.

6.5. Next Steps and Beyond

6.5.1. Next Steps

My next priority is to test the co-design workshop plan. I am eager to gather feedback from my peer immigrants and learn their preferred solutions.

In the meantime, the prototype will be updated based on the feedback from the settlement experts. I also need to design and develop an interactive prototype to display the output infographics.

Following these two activities, I expect to test the whole workflow with a community partner, and, eventually, test the output infographics with immigrants.

The last step is to work with the potential users of the APP to design and develop its user experience and interface.

6.5.2. Beyond

By the time you reach this line, I hope I have presented who I am as a researcher. I am a visual thinker, designer, woman in technology, graduate student in Digital Futures at OCAD University. But most importantly to this research, I am an immigrant to Canada.

This years-long research started with my ambition to address language barriers with my professional experience, but it has become something more. It is a learning journey and a life adventure. **It reflected and shaped who I am as a designer.** Below are some of my extended thoughts during the research.

From immigrants to accessibility

This workflow can benefit more than immigrants. Native official language speakers can also face language barriers. According to the 2022 *Programme for the International Assessment of Adult Competencies* (PIAAC), which includes 32% first-generation immigrants, 19% of Canadian adults have literacy proficiency of Level 1 or below, which means they can *at most* “understand short texts and organized lists.”¹

One year earlier, CBC investigated the 2013 PIAAC and provided a deeper interpretation. They found that a considerable number of Indigenous people and native official language speakers are among those who gain the lowest scores in literacy assessment. One story in this report may provide a crucial insight: A truck driver named Piché never had the chance to receive a proper education due to his learning difficulties in his youth.²

He is not alone. In the 2022 Canadian Survey on Disability (CSD), among 8 million people who have one or more disabilities, about 20% are experiencing a learning disability, and 48% faced communication-related barriers within a year. (Statistics Canada, 2023, p. 1, 3, 5) In addition to learning disabilities, mental health issues, either permanent or temporary, can impact one’s cognitive performance. Lam et al. found that 94% of patients reported cognitive dysfunction during the

¹ OECD (Organisation for Economic Co-operation and Development), *Survey of Adults Skills* 2023, 1.

² Chin, ‘Nearly Half of Adult Canadians Struggle with Literacy — and That’s Bad for the Economy’.

depressive episode, making it difficult for them to concentrate and understand ¹.

Right when I was finishing up this paper, I read another study revealing that cancer survivors' reading ability is impaired by their treatment, suggesting the need for better accessibility of long text instructions with bullet points and icons.²

By creating an alternative path other than text to access information, the infographics can help anyone with reading difficulties, whether permanent or temporary, to manage their lives better.

From problem-solving to dynamic balancing

I came to OCAD to seek support for solving one problem. My studies at OCAD shifted my understanding of “*problem*”. I realized that a problem is not a water well, but a running river. It is a part of an ecosystem, and it changes its shape all the time.

Realizing the nature of *problem* changed my view of the designers' duty. It is not to block the water but to carve the riverbank a little to benefit one community while keeping the neighbours in mind. Not just the neighbours, but also the fish in the river, the trees on the banks, and the birds and the insects on the trees, the mountains where the river starts, the sea where the river ends, and the wind and the sky which we all are under. We are not simply designing a new application, a product, a tool, but a process to reach the goal. We shall not just design for the end

¹ 'Cognitive Dysfunction in Major Depressive Disorder', 649–50.

² Kletenik and Adler, 'Many Cancer Survivors Have Impairments That Make Using Mobile Devices and Websites Difficult'.

users but also the people who make that end goal happen. We shall care about their productivity AND well-being, contributions AND takeaways. With all these careabouts, while humbly acknowledging that we cannot create an ultimate one-for-all solution, we can design a dynamic system that is open to change and adaptation to balance the relationships.

From technology to (digital) futures

The design process in this research is also a discussion of how we implement powerful technologies in our society.

Technologies are not simply neutral tools. Companies, profits, people, and agendas are behind the technologies. Our design choices have consequences not only for the stakeholders involved, but also for society and everyone who lives within it. When a new power disturbs the current power dynamics in any established relationship (even an unbalanced and unfair one), we should consider the power shifts and rebalance. When we decide whether to use a certain type of technology, or to use it for what kinds of tasks and to what degree, we should be aware of the consequences of our design choices. We should not simply empower the powerful people, which will further worsen inequality, class consolidation, and oligarchy, resulting in democratic crisis. But we also should not hand out powerful tools without instructions to people who lack specific professional knowledge, which can lead to misunderstanding, delusion, and potentially societal upheaval.

In this workflow, I try to design the use of AI to do neither and both. It works as an amplifier for the target audience's preference and an acceleration for productivity. Through this experiment and effort, I hope this research may encourage my peer designers to think beyond the technology. After all, we are not just mapping a path for today; **we are also envisioning the plausibility of futures.**

(approximately 23015 words)

Appendixes

Appendix A: Research Map

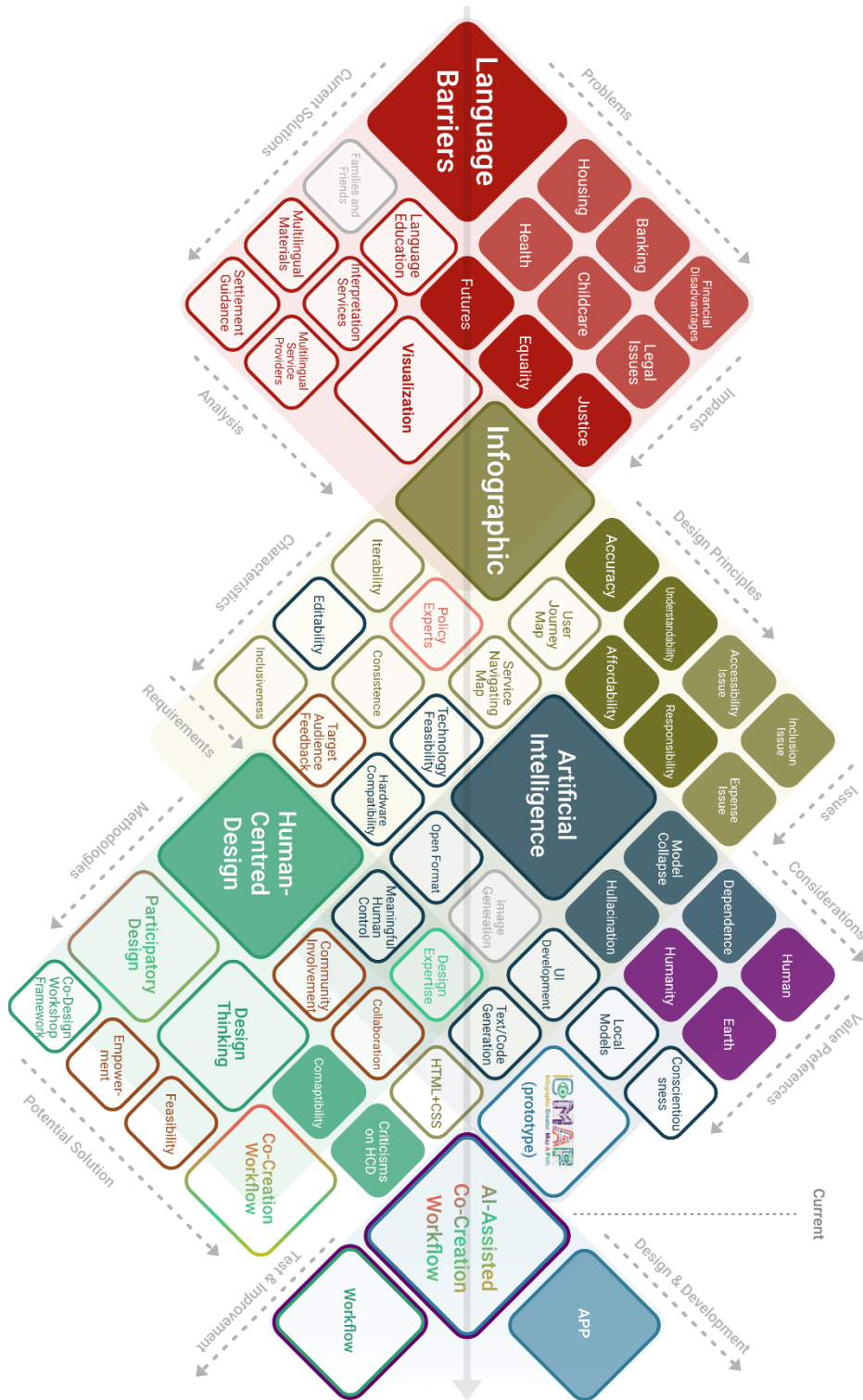


Figure 38 A map for this Thesis Research

Appendix B: CLB Language Ability Standard



STAGE II Profiles of Ability Across Stage II Reading

CLB 5 Initial Intermediate Ability	CLB 6 Developing Intermediate Ability	CLB 7 Adequate Intermediate Ability	CLB 8 Fluent Intermediate Ability
The reader can: Understand simple and some moderately complex texts in predictable, practical and relevant social, educational and work-related situations. When the text is: • Mostly concrete, factual and descriptive • With mostly common and some abstract or specialized vocabulary and occasional high-frequency idioms • Sometimes supported by visuals • Relatively short • In moderately demanding contexts Demonstrating these strengths and limitations: • Identifies purpose, main ideas, important details and links between paragraphs • Finds some information to make comparisons • Occasionally guesses the meaning of unknown terms, phrases and idioms from the context without a dictionary • Often rereads and needs clarification • Comprehension is based on knowledge of basic grammar and some developing understanding of complex sentences and structures • Identifies some different styles and registers • Uses a bilingual dictionary regularly; begins to use a concise unilingual ESL dictionary	The reader can: Understand an adequate range of moderately complex texts in predictable, practical and relevant social, educational and work-related situations. When the text is: • Mostly concrete, factual and descriptive • With mostly common and some abstract or specialized vocabulary and occasional idioms • Occasionally supported by visuals • Relatively short • In moderately demanding contexts Demonstrating these strengths and limitations: • Identifies purpose, main ideas, specific factual details and some implied meanings • Finds specific, detailed information for comparing and contrasting • Sometimes guesses the meaning of unknown terms, phrases or idioms from the context without a dictionary • May reread and ask for clarification • Comprehension is based on a developing understanding of complex sentences and structures • Identifies an expanding range of different styles and registers • Uses a concise unilingual ESL dictionary regularly	The reader can: Understand an expanding range of moderately complex texts in less predictable but relevant social, educational and work-related situations. When the text is: • Factual, descriptive or argumentative; with opinions, explicit and implied meanings • With concrete, abstract or specialized vocabulary, and some idioms • Moderate in length • In moderately demanding contexts Demonstrating these strengths and limitations: • Identifies purpose, main ideas, specific details and many implied meanings • Finds, integrates, compares and contrasts information • Often guesses the meaning of unknown terms, phrases and idioms from the context • Comprehension is based on a developing understanding of an increasing range of complex sentences and structures • Identifies a range of different styles and registers • Uses a unilingual dictionary to confirm and refine interpretation of unknown terms	The reader can: Understand most moderately complex texts in less predictable but relevant social, educational and work-related situations. When the text is: • Factual, descriptive or argumentative; with opinions, explicit and implied meanings • With a range of concrete, abstract and specialized vocabulary and idiomatic language • Moderate in length • In moderately demanding contexts Demonstrating these strengths and limitations: • Identifies purpose, main ideas, specific details and implied meanings, as well as mood, attitude and register • Finds, integrates, compares, contrasts and analyzes information • Usually guesses the meaning of unknown terms, phrases and idioms from the context, but often requires clarification of less common idioms, cultural references and figures of speech • Comprehension is based on an understanding of an adequate range of complex sentences and structures • Identifies a wide range of different styles and registers • Uses a unilingual dictionary to confirm and refine interpretation of unknown terms

Figure 39 Profiles of Ability Across Stage II Reading, Pawlikowska-Smith, Grazyna. *Canadian Language Benchmarks: English as a Second Language for Adults*. [Rev.]. Citizenship and Immigration Canada, 2012.

Appendix C: Prompts for Testing Image-Generative AI Models

Prompt 1

Create an image of an icon meaning invest money; Modern Line Icon, Icon Design, Bold Outline, Solid Colour, white background, Minimalistic.

Prompt2

Create an infographic to explain how ETFs work: An exchange-traded fund (ETF) is a type of pooled investment security that operates much like a mutual fund. Typically, ETFs will track a particular index, sector, commodity, or other assets, but unlike mutual funds, ETFs can be purchased or sold on a stock exchange the same way that a regular stock can. An ETF can be structured to track anything from the price of an individual commodity to a large and diverse collection of securities.

Prompt3

Create an infographic of the process of depositing money from a bank:

1. Visit your bank and fill out a deposit slip with the required information, such as your name, account number, and the amount you want to deposit. If you don't have deposit slips, you can ask for them at the bank.
2. If you're depositing cash, count the money and write the total amount on the deposit slip. If you're depositing checks, list the check numbers and amounts on the deposit slip.

3. If you're depositing cash, hand the deposit slip and cash to the teller. If you're depositing checks, endorse the checks by signing the back and hand them to the teller.

4. The teller will process your deposit and give you a receipt. Make sure to keep the receipt for your records.

Editing Prompt for Prompt 3

× Edit selection ↶ ↷ Cancel

THE PROCESS OF DEPOSITING MONEY FROM A BANK

1 Visit your bank and fill out a deposit slip with the required information, such as your name, account number, and the amount you want to deposit. If you don't have deposit slips, you can ask for them at the bank.

2 If you're depositing cash, count the money and write the total amount on the deposit slip. If you're depositing checks, list the check numbers and amounts on the deposit slip.

3 If you're depositing cash, hand the deposit slip and cash to the teller. If you're depositing checks, endorse the checks by signing the back and hand them to the teller.

4 The teller will process your deposit and give you a receipt. Make sure to keep the receipt for your records.

DEPOSIT SLIP

DATE	NAME	ACCOUNT NUMBER	AMOUNT
May 20, 2024	Jane Smith	123456789	\$250.00

DEPOSITING CASH

Amount: \$250.00

DEPOSITING CHECKS

CHECK #	AMOUNT
101	\$125.00
102	\$75.00
103	\$50.00

DEPOSIT RECEIPT

DATE	AMOUNT	ACCOUNT #
May 20, 2024	\$250.00	123456789

+ change them to Canadian dollar 🎤 ⬆

Appendix D: Initial Prototype

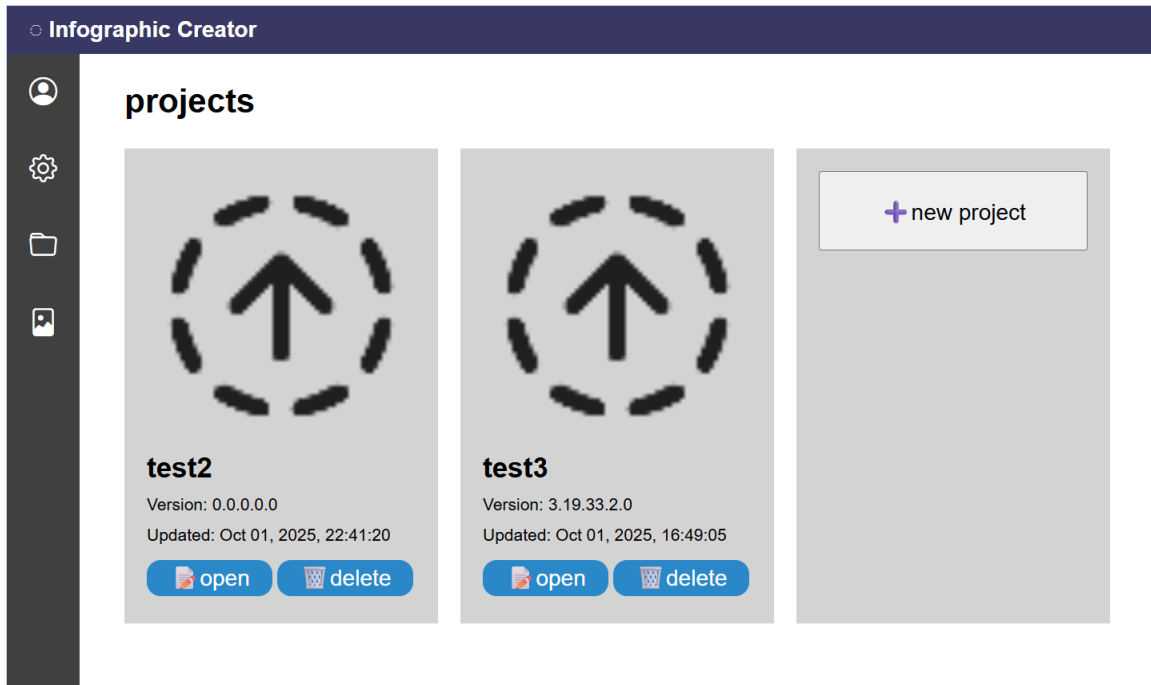


Figure 40 Screenshot of the project management page

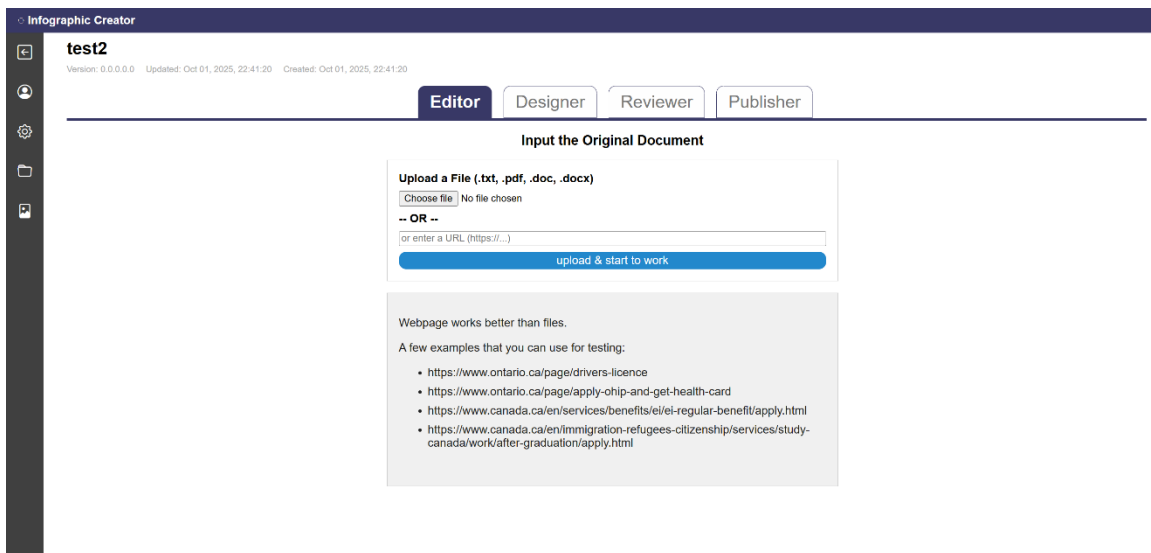


Figure 41 screenshot of the upload page

Infographic Creator

test3

Version: 3.19.33.11.0 Updated: Oct 02, 2025, 16:48:13 Created:

Editor Designer Reviewer Publisher

Edit and Summarize

licence.docx replace the original file re-markdown the original file ↓

Get a G driver's licence: new drivers

If you are at least 16 years old, you can apply for driver's licence in Ontario. As a new driver, you will need to practice driving and gain experience over time. For most people, the two-step process takes about 20 months to finish. Here's how you get a driver's licence.

The Ontario driver's licence is a blue, plastic card that displays your name, address, date of birth, photo and signature. The licence has an expiry date. You have to renew it before it expires.

Driving in Ontario

To drive on Ontario roads, you need to:

- carry a valid driver's licence, at all times
- have a valid owner's permit, licence plate and insurance
- obey traffic laws and drive safely

Licence types

Ontario has 15 types of licences. Each licence certifies you to drive a specific type of vehicle. To drive a car, van or small truck, you will need a **G class licence**.

All licences come with certain conditions. See Ontario's [full list of licences](#).

Apply for a driver's licence

To apply for a driver's licence in Ontario, you need to:

- be at least 16 years old
- be a resident of Ontario (not a visitor)
- pass a vision test
- pass a knowledge test about the rules of the road and traffic signs

save & summarize

re-summarize →

The text appears to be a guide on how to get a driver's **licence** in Ontario, Canada. It explains the different levels of driving licenses (G1, G2, and full G) and the requirements for each level.

Here are some **key** points from the text:

Getting a Driver's License:

- To start, you need to have a valid Ontario driver's licence.
- For G1, you must pass a vision test and a **road** test within 12 months of obtaining your G1 licence. You can take the **road** test at any DriveTest Centre.
- After 12 months with a G1 licence, you can drive without another experienced driver in the car on most roads, but not on highways or high-speed expressways.

G1 Road Test:

- The G1 **road** test covers basic driving skills such as turning left and right, stopping, parallel parking, one-way streets, lane changes, and **traffic** lights.

save

send to designer ▶

Figure 42 screenshot of the editing page

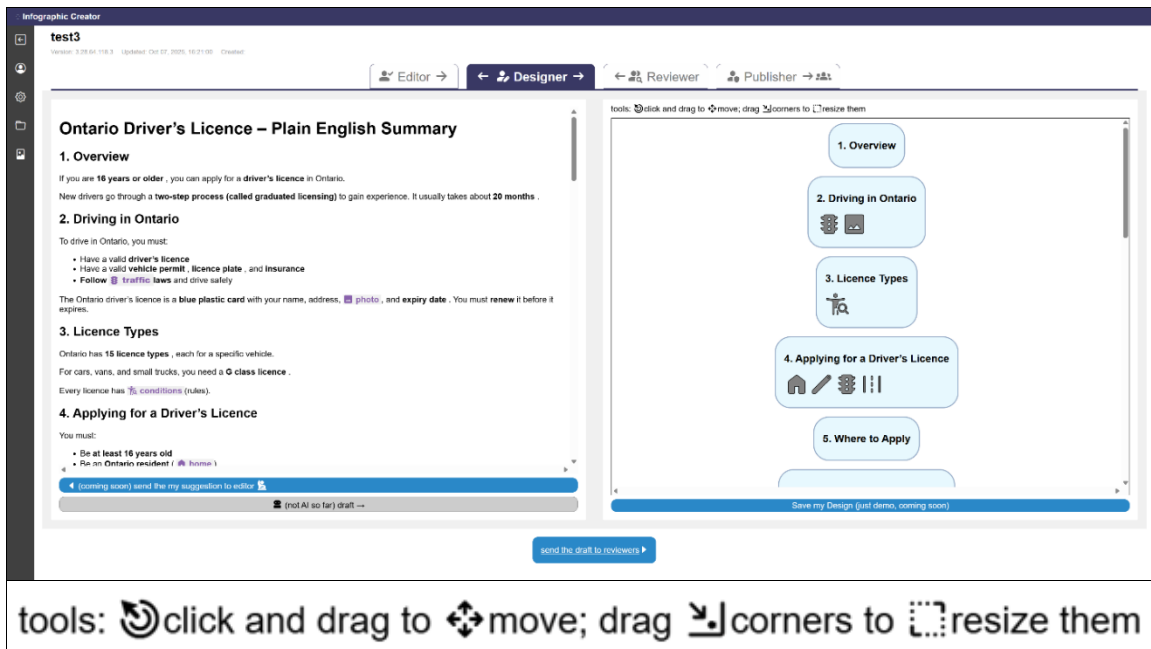


Figure 43 screenshot of the persona of Designer

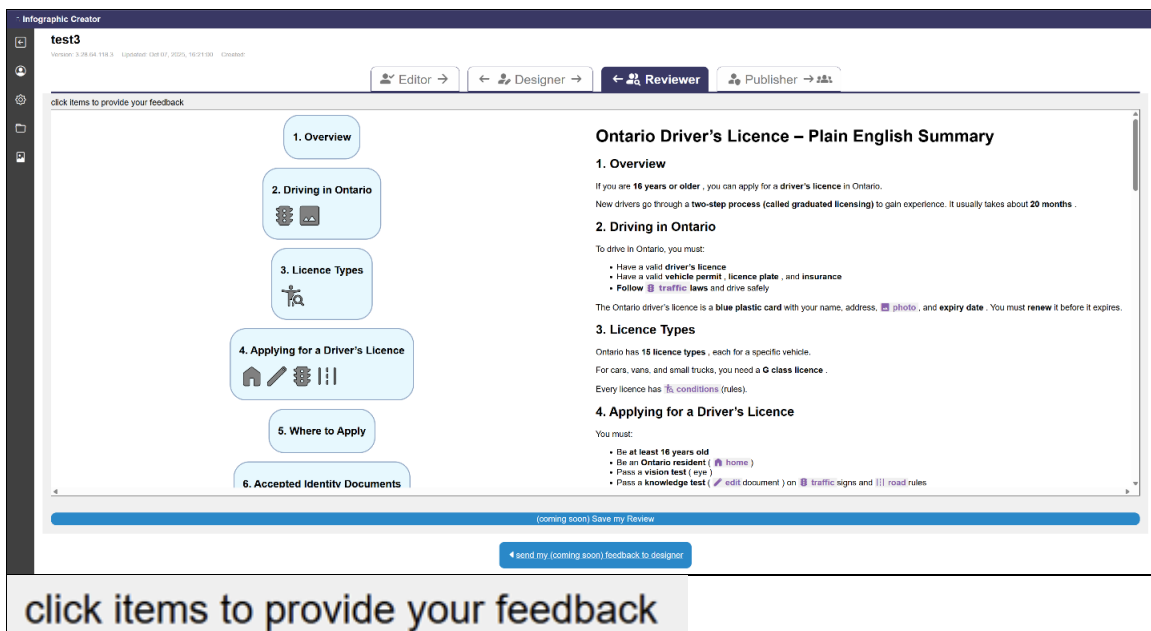


Figure 44 screenshot of the persona of Reviewer

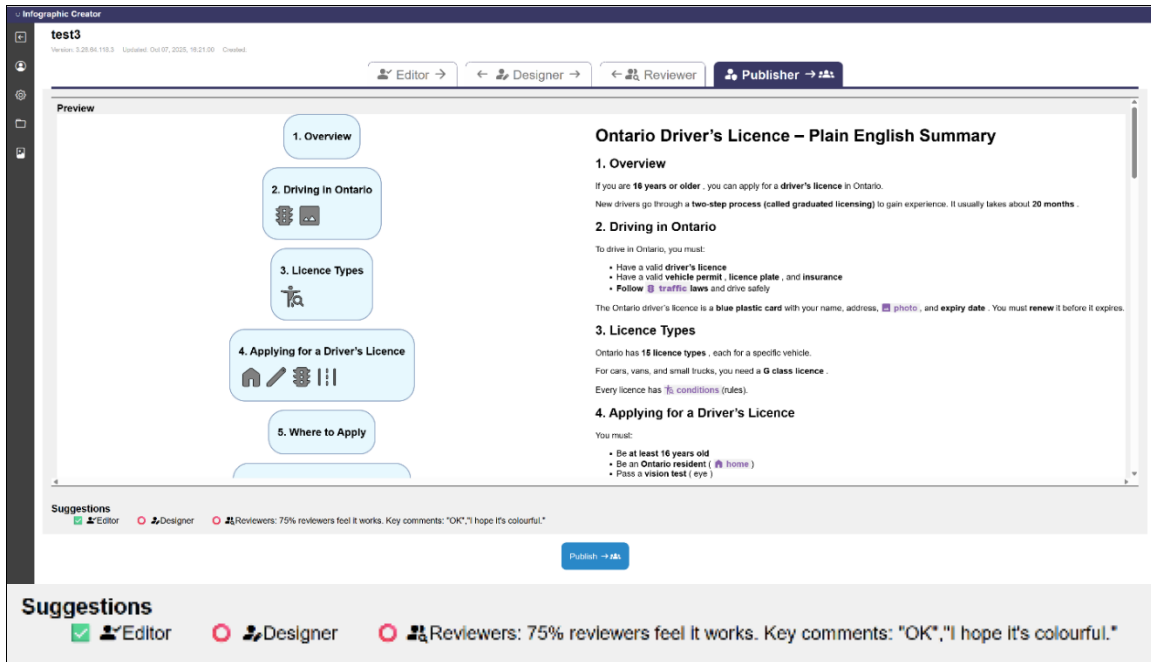


Figure 45 screenshot of the persona of Publisher

Appendix E: Co-design Workshop Plan

This plan was developed based on the co-design framework by Kennedy et al.¹ It provides a scaffold and a toolbox for the co-design workshops for infographics of service procedures. It should be discussed with the settlement experts when planning and applied with flexibility to suit different communities or under different circumstances.

Pre-Workshop Phase: Resourcing, Planning, Recruitment

This co-design process should work with two groups of participants from the community. One group are the participants with certain understanding and experiences on example policies/procedures (Experienced Group); the other group contains participants without such experiences (Newcomer Group).

Resourcing

During the *Resourcing* step, media scanning² or netnography³ should be conducted to identify the most challenging and recent policies or procedures that impact the target community. Designers/researchers should also collect or make assets of suitable design principles, visual styles and visual representations that can be used during the workshops, for example, design examples showing different

¹ Kennedy et al., 'Translating Co-Design from Face-to-Face to Online', 10.

² Kumar and Hackett, *101 Design Methods*, 25.

³ Butler, 'Netnography'.

visual styles, a set of cards of icons or photos. These assets can be reused for different communities.

Planning

During the *Planning* step, a detailed recruitment and facilitation plan will be finalized with the settlement experts and, if applicable, other stakeholders. The policy and procedure examples that were collected from the resourcing phase should be combined with the ones that experts provide. Alternative solutions for unexpected situations, for example, changing to online sessions, should be considered. If needed, the approval of the Research Ethics Board (REB) should also be obtained in this phase.

Recruiting

Participants can be recruited through settlement service providers via multiple channels. A few drafted standards for recruitment are below.

- Participants should have lived in Canada for no more than 10 years. The time length should be documented.
- Participants could communicate with the designers/researchers in at least one official language, or all the co-creators share one mother tongue and can communicate in it.

Workshop Phase

Sensitizing

Designers/Researchers should provide information about the workshops to the recruited participants, including the purpose and the schedule. Considering the language proficiency and culture differences, the consent form can be sent to provide the participants more time to read, but not required to be signed before they are explained in the workshops. If the workshops are conducted online or the co-design process is via an online platform, tutorials should be sent in advance of the workshops.

Importantly, to benefit the participants, a brief survey should be conducted. This survey should collect the following information.

- The participants' preferences for the policy/procedure examples, chosen from the examples collected in the previous steps.
- The time of their engagement with the examples.
- Relevant but limited demographic information, such as their English proficiency and educational background.

After the survey, the groups will be formed based on the participants' familiarity with example policies/procedures. Participants for the Experienced Group are experienced users. They should have successfully navigated the example policy/procedures and, ideally, recently. Participants for the Newcomer Group should not have engaged with the examples or have limited experience. Other than

having the experience or not, they should be recruited by the same standards. One participant can be in both groups for different examples.

Facilitation - Experienced Group

The Experienced Group workshop is ideally hosted by a team of three: one facilitator, one observer, and one documentation taker. The facilitator introduces and guides the participants through the activities. The observer pays close attention to the participants' actions and asks additional questions when needed. The documentation taker ensures the video-recording device is running properly and takes photos as needed.

Warm-up

The team introduce themselves and the workshop, explains the data collection and gathers consents. The facilitator then starts activities that help the participants to warm up. The potential techniques include Bingo¹ to know each other and 30 Circles² to support creativity.

Activity for Design Examples

The participants will be asked to:

Say: Recall their recent experiences involved with the example policy/procedure, and what they did

Make: Design the visuals

¹ Lewrick et al., *The Design Thinking Toolbox*, 42.

² Lewrick et al., *The Design Thinking Toolbox*, 44.

- Read the original documents for the policies/procedure examples
- Choose visual representations from the provided cards or hand-draw ones
(with the help of the team if needed)
- Arrange them on the whiteboard and draw the lines

Say: Explain their decisions – why they think this may represent the concept / improve the understanding

Potential techniques for this activity include Image Sorting¹ / (Reverse) Card-Sorting², Concept Metaphors and Analogies³ / Semiotic Analysis⁴, Flowchart⁵, Mind Mapping⁶ and Prototyping⁷ / Prototype to Test⁸.

Additionally, the creative techniques that use visuals as metaphors to understand or analyze user experience, though originally not meant to output the visual design, can be borrowed for this activity; for example, Customer Journey Map⁹, Service Blueprint¹⁰, and Solution Diagramming¹¹.

¹ Kumar and Hackett, *101 Design Methods*, 116.

² Suzanne Stein, 'Creative Techniques Handbook 2015', 15 presented by Chris Olsen, Hart Reed, Tarik El-Khateeb.

³ Kumar and Hackett, *101 Design Methods*, 218.

⁴ Suzanne Stein, 'Creative Techniques Handbook 2015', 100 presented by Leiane Cooke, Sachiko Murakami.

⁵ Suzanne Stein, 'Creative Techniques Handbook 2015', 45 presented by Tatiana Jennings, Monica Virtue, Laura Wright.

⁶ Suzanne Stein, 'Creative Techniques Handbook 2013', 50 by Dushan Milic and Umar Amanullah.

⁷ Suzanne Stein, 'Creative Techniques Handbook 2015', 100 presented by Rida Salman, Mehnaz Aydemir.

⁸ Lewrick et al., *The Design Thinking Toolbox*, 199.

⁹ Lewrick et al., *The Design Thinking Toolbox*, 103.

¹⁰ Lewrick et al., *The Design Thinking Toolbox*, 203.

¹¹ Kumar and Hackett, *101 Design Methods*, 266.

Activity for Design Principles

The participants will be asked to:

Make: Select the design principles and visual styles that work for them

Say: Explain the reasons

Potential techniques for this activity include Design Principles Generation¹ / Design Principles², Critical Items Diagram³ and Dot Voting⁴.

Data Collection

During the activities, observation will be conducted, and questions may be asked to understand the following issues.

- How do they interpret/describe the policy or procedure, in both visuals and language?
- What icons do they choose to represent certain concepts, and why?
- How do they draw or present the policy or procedure, and why?
- What design style do they choose/prefer and why?

Additionally, learning about the following issues can be helpful.

- What kind of information is needed mostly by the users?

¹ Kumar and Hackett, *101 Design Methods*, 188.

² Lewrick et al., *The Design Thinking Toolbox*, 53.

³ Lewrick et al., *The Design Thinking Toolbox*, 145.

⁴ Lewrick et al., *The Design Thinking Toolbox*, 159.

- How do they manage to understand the example policy or procedure? Or maybe they manage to get positive results through the procedure **without** fully understanding it; then how do they do it?
- What challenges did they have and how have they managed them (or not)?
- Other insights and inspirations.

Outputs

The outputs of this session are design examples created by the participants. Digital design files will be created and reviewed by the experts for clarity. The original design draft will also be saved for the Newcomer Group to work on.

Facilitation - Newcomer Group

The Newcomer Group workshop is ideally hosted by the same team of three.

Warm-up

Similar to the Experienced Group, the potential warm-up techniques include Bingo¹ to know each other and Stop & Go² to concentrate and bridge to the main activities.

Activity for Design Examples

The participants will be asked to:

Do: Perform as they are handling the example procedure based on their understanding of the infographics

¹ Lewrick et al., *The Design Thinking Toolbox*, 42.

² Lewrick et al., *The Design Thinking Toolbox*, 43.

Say:

- Read the policy
- Explain their understanding
- Feedback on the design
- Other feedback

Make: Improve the design

Potential techniques for this activity include Role-Playing¹, Think Aloud², Test Sheet³, Feedback Capture Grid⁴.

Activity for Design Principles

Same with Experienced Group.

Data Collection

During the activities, observation will be conducted, and questions may be asked to understand the following issues.

- How do the participants interpret the visualization of the policy/ procedure, in language and action?
- Are they able to understand and follow the infographics? How long for them to react?
- How many errors are involved? Why do the misunderstandings happen?

¹ Chow and Stein, 'GRAND Appendix Booklet', 19.

² Suzanne Stein, 'Creative Techniques Handbook 2015', 116 presented by Tegan, Elliot Fienberg, Jessica Kee.

³ Lewrick et al., *The Design Thinking Toolbox*, 213.

⁴ Lewrick et al., *The Design Thinking Toolbox*, 217.

- What would they like to improve?
- What design style do they choose/prefer and why?

Additional issues to study are the same as those of the Experienced Group.

Outputs

The outputs of this session are design examples iterated by the participants. Design files will be updated and confirmed by the experts as the final draft.

Post-Workshop Phase: Reflection and Building for Change

In the *Reflecting* phase, the infographics will be finalized by graphic designers and sent to all the participants. They will be encouraged to share the infographics with their social circles, benefiting their communities, who are also welcome to send feedback.

The *Building for Change* phase will occur in the rest of the workflow.

Appendix F: Invitation Letter for Interviews

Invitation

Date: _____

Dear _____

You are invited to participate in an **Expert Interview** for my research. The research title is *Light a Path: AI-assisted Participatory Creation Process for Infographics to Improve the Accessibility of the Government Services*.

What you will do

You will be asked questions about your opinions on recent government-related settlement challenges of the recent immigrants. You may also be asked about your experience in assisting immigrants to understand government policies/procedures and suggesting technology improvements for your work. You will be shown an App prototype and asked to provide your feedback. You will have a chance to share your thoughts related to this topic freely.

Later, you will also be asked for your feedback on the infographics output by an App prototype that was developed in this research. You are encouraged to share

your feedback on the research outcomes, the proposed workflow, the App prototype, and the infographics through these two sessions.

The interview will take approximately 2 hours of your time. The feedback will take no longer than 1 hour of your time, depending on your preference.

What this is about:

My research explores how to create infographics for more inclusive access to government services for immigrants. The interview is to help me prepare for participatory design workshops with recent immigrants. I will use your opinions on the recent settlement challenge to prepare the policy/procedure examples to ensure the participants of the workshops can benefit from these activities.

Possible benefits of participation include

Your participation may benefit recent immigrants and improve their experiences with government services. If you are interested, your name or the alias of your choice will be included in the research as a contributor.

Potential risks

There are no known or anticipated risks greater than those in everyday life associated with participation in this study.

If you are willing to participate, please let me know by replying to this message. Follow-up information about time and place will be provided soon.

Who I am:

I am a graduate student in the Digital Futures program at OCAD University. I have been struggling with language and information barriers since I came to this country. **I know I am not alone.** Through this research, I want to help people who share a similar experience. I believe that we can build a better future together.

If you have any questions about this study or require further information, please contact the Principal Investigator, **JC Zhang** or the Faculty Supervisor, **Simone Jones**, using the contact information provided below. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University #2025-78. If you have any comments or concerns, please contact the Research Ethics Office through research@ocadu.ca.

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Appendix G: Semi-Structured Interview Script for Experts

The researcher will introduce herself and the research, then explain the data collection process and clarify the participants' rights in plain English following the **Informed Consent Form**. The participants will be clearly informed that they can refuse to answer any questions and stop participating at any time.

With the participant's consent, a semi-structured interview will be conducted with the following questions.

- What is your job? How do you work with newcomers?
- Based on your experience, what are the **recent** common issues that newcomers bring to you that require accessing government services?
[Possible follow-up questions include:]
 - How do you introduce these policies, services, or procedures to your clients? Pretend that I am your client and show me how you help them.
- Similar to the previous question, based on your experience, what are the **most essential or challenging** issues for newcomers that require accessing government services?
[Possible follow-up questions include:]
 - How do you introduce these policies, services, or procedures to your clients? Pretend that I am your client and show me how you help them.
- What kind of technology (e.g., software, website, digital device, AI/LLMs) do you use at work? Are they helpful?
- What kind of assistance/improvement related to communication with your clients would help your work?
[Possible follow-up questions include:]

- This is the prototype I'm currently working on (present and introduce the App prototype page by page. Encourage the interviewees to interact with it). It aims to accelerate your work and your collaboration with designers and your clients (use interviewee's vocabulary to show respect to their expertise and build trust).
 - As the settlement expert, you will mainly use the Editor and Publisher workspace here. (Show these pages again if necessary, staying on the Editor workspace). I'm going to ask you how would you improve this prototype. It's an ongoing work. Please share your thoughts freely. (See the attachment)
 - Are the steps in the right sequence?
 - What do you think your responsibilities are here? Do they make sense to you?
 - What kind of functions/features would help you work better?
 - Moving to the workflow.
 - Does this workflow make sense to you? How would you improve it?
 - What/which functions/features (e.g., rewriting, drafting design, adding comments) are working/would help with the goal of better collaboration and better results?
 - What/which functions/features should be focused on?
- Can we get back to you for feedback on the workflow design and output infographics later?
- If you want to be attributed as a contributor to this research, what is the name or alias (and title) that we should use?

At the end of the interview:

- Thank the participants.
- Inform them that they may be contacted to clarify their response.
- Remind them of their rights and the deadline to withdraw the consent.

Appendix H: Semi-Structured Interview Script for Experts

Attachment: Prototype

Before we start

As settlement experts, you will use the editor and publisher workspaces mostly. However, for the purpose of demonstrating the whole workflow, I'm going to introduce the prototype and share my design considerations. Later, we will go through the prototype again page-by-page, focusing on the pages you will use most, and I'll ask for your feedback and how you would improve them. You are also more than welcome to share your thoughts on any part of this prototype and the workflow.

The prototype is still buggy. We may encounter problems, and I prepared a video just in case.

I may use some terms in my field that may not be clear to you. Feel free to interrupt me anytime and ask me to explain.

Introduction

[Account Setting]

Let's start with account settings:

- Your name
- Preferred name: this will be published with the document
- Your role: Editor (I'll explain each role later.)

[Project Setting]

Project settings are the default settings for future projects. (I'm also working on project-level settings, but they haven't had an interface yet.)

- How many reviewers: reviewers are the representatives of the targeted users, the people who will use the infographics.
- AI models: the App is designed to be able to connect with a range of AI models, so different organizations can choose based on their situations and requirements. It currently only supports local models, which means the ones run on your device and don't exchange data with big companies' services.
- Visual:
 - o Decided by the workshops (the targeted user decides what visual style, colour theme, icon set works for them) -> future research
 - o Currently, as a proof of concept, I use just a few open-source icon sets; later, I will add more image sets
 - o (don't click the red button)

[Project Management]

- A typical starting page when you open apps like whiteboard, Words. (tags, folders are on the roadmap.)
- The screenshots show you the most recent changes to a project
- Create a new one

[New Project]

- For a new project, you'll be asked to import a source file
- Recommend importing one from the official websites, like the examples here. For the demo, I prepared some examples here. (I'll change the examples to the examples you just gave to me.)

[Editor workspace - 1]

- After import, the backend will process it, keep the text and show it on the left side. The editor needs to clear out the irrelevant information, e.g., navigation menu, notice for Canada Post Strike.
- If there are any issues, we can try to fix them by re-importing the file. When we are done, we click save and then rewrite.

[Editor workspace - 2]

- Then the editor needs to edit the step-by-step instruction drafted by AI on the right side, making sure all the facts are correct, and the structure is right for the next step.
- Save, then add icons

[Editor workspace - 3]

- You will be the first gatekeeper of the visual representations. Change the icons or delete them. (In the future, the App will remember your preference)
- Save, send to designers
- Your work of this stage is done if this is a real project. You are going to wait for the designer or reviewers' feedback and work together to address the issues.
- For this demonstration, I'm going to show you other workspaces.

[Designer workspace - 1]

- The Designer will review the text and adjust the visual representations.
- If they want to change the icons that the editor set, the changes will be sent back to the editor to confirm. – This is to make sure the result is a combination of both your expertise.
- Click draft (no AI, just extract icons and restructure them)

[Designer workspace - 2]

- Currently, the designer can change the colours, size, and positions, but cannot edit the visual representation (icons here). It ensures consistency in the visual language.
- Save the design when they feel good. And send the design for review.
- On the roadmap:
 - o If you update the text or icons at the same time, they can just update them.
 - o After we have enough examples (not sure how many), we may be able add AI into this process to create better drafts. It is supposed to be able to predict the images' positions and sizes based on the examples and save the designer's time.

[Reviewer Workspace]

- Reviewers can click on the icons or select the text to add scores and comments.
- If they feel the design needs more work, they can send the review back to the editor or designer. Or if they feel good, they can recommend publishing it.
- The editor and designer can view the comments in their workspace
- Roadmap:
 - o Comment function that is similar to Word or collaborative whiteboard Apps – the team members can discuss, react to, resolve or delete the comments

[Publisher Workspace]

- The publisher examines the comments and outputs the design to a webpage or image (later: support print out)

Clarifying Questions?

- Any parts need more explanation?

Step-by-step***[Account Setting]***

As you have seen their workspace, these are the responsibilities for each role:

Editor: They are responsible for the accuracy of the text contents. They edit the step-by-step instructions and make sure the visual representations are accurate.

Designer: They are responsible for the relations between visual representations (images, icons).

Reviewer: They provide feedback and comments on the text and design.

Reviewers are the representatives of the target group.

Publisher: They examine the text, design, and comments, deciding whether the infographics are good enough to publish.

- Do the roles make sense to you?
- Which role do you think you will play?
- Do you think there's a different role that you can play?

[Project Setting]

[explain the AI's role]

- Are you comfortable with using AI to rewrite the document/instruction?
 - o (if no, why hesitate? The use of AI is very simple, as you will c What do you think if I'm telling you this App is still functional without AI?)
- What kind of AI models do you use/prefer to use (pointing at the dropdown)?
- Other options you would need?

[Project Management]

- What kind of information do you want to see here?
- What functions would help you manage/navigate through the projects better?

[Editor workspace]

You can see that most workload falls into the editor's role, your role. We are going to focus on your workspace now.

- The importing file step: Is it clear what the editor should do here? Any functions that would help the editor work better?
- What do you think your responsibilities are here? Do they make sense to you?
- Any worries/concerns? Any responsibilities that you think should be shared by other roles?
- What kind of functions/features would help you work better?

- How would you improve it? Find at least one thing that you want to change.
- Other comments? Thoughts?

[Designer workspace]

I understand that you are not a designer. Please provide feedback on the workflow.

- What do you think the designer's responsibilities are here?
- Any functions/features would improve your collaborations?

[Reviewer workspace]

- What do you think the reviewer's responsibilities are here?
- What kind of feedback from the reviewers would help you work better?
- For your best knowledge, working with newcomers, what functions/features would enable them to provide such feedback?

[Publisher workspace]

- What do you think the publisher's responsibilities are here?
- What kind of information the publisher should learn for their consideration on whether to publish the design (they may never get 100% of yes)

Free feedback

- Other comments? Thoughts?
- If you have to improve one thing, what would you change?

Appendix I: Prompt for Describe the Visuals

```
'role': 'user',  
'content': 'List 3 concepts that this icon represents, ranked by  
relevance, separated by commas; no explanation. If it is a flag, only  
return an empty string. Do not use more than 3 words for each concept.  
If the icon is abstract, describe the feelings or ideas it conveys.',  
'images': [png_bytes]
```

Appendix J: Prompt for Rewriting the Instruction

Role: "You are a patient and helpful settlement social worker in Canada."

Task: "Rewritten the following content into a step-by-step instruction in plain English. Structure the instruction using these headers: Information, Requirements, Steps, References, and Tags. Follow the templates provided for each section below, and keep the header level in the templates.

Use the same title as the original content if there is one. If not, create a concise and informative title that captures the main action and the outcomes of the process.

Keep any terms within `<span class="key_term">` as they are.

IMPORTANT: For ANY field that asks for a list or group of items:

- If items exist, provide them as a bulletin or ordered list.
- If NO items exist, return 'None.'

Examples:

- "Who": ["You", "Service staff"] ← multiple items
- "Who": ["None."] ← no one involved
- "Documents": ["ID", "Passport"] ← multiple docs
- "Documents": "None." ← no documents needed

Output ONLY the rewritten instruction in MARKDOWN. DO NOT chat or explain.

Content to rewrite: {file}

[Title of the instruction]

Summarize all requirements and documents that needed using the Template for the Requirements below. If there is no requirement, just write "No specific requirements needed before starting the process."

Template for the Requirements:

Requirements:

You

[List the specific immutable characteristics (e.g., age, sex, original country) that must be met before starting the process.]

Background

[List the background factors, skills, or knowledge required before starting the process (e.g., skills, knowledge, diploma, duration of work history, criminal record).]

Current Conditions

[List the specific conditions or circumstances that must be met before starting the process (e.g., residence, family, marital status, employment, income).]

Documents

[LIST the names of specific documents needed before starting the process (e.g., ID, proof of income, proof of residence).]

For EACH step, provide clear and concise guidance using the Template for EACH Steps below. Wherever there is a list of people/items/documents/actions, use the form of list.

Template for EACH Step:

Step [Step Number]: [Step Title, including the main action and the outcomes of the step (e.g., "Submit Application for Housing Assistance")]

Required Previous Steps

[List the titles of any prior steps that must be completed before this step. If none, state "None."]

Where

[Specify the location where the action takes place in this step. If there are multiple locations, use ul to list the locations and specify which actions correspond to each location. Indicate the type of each location.

Examples:

- "Where": "Your place" ← the action can be done at home
 - "Where": ["Website: Service Ontario
(<https://www.ontario.ca/page/serviceontario>)", "On site: Service Ontario centers"] ← there are two options for the action, one can be done online and the other must be done at specific physical locations
-]

Who

[Identify the individuals or groups who take actions in the step.]

What

[Describe the specific documents, skills, or knowledge required for this step.]

How

[Describe the specific actions or tasks to be performed in this step.]

To Whom

[Indicate the recipients of the action.]

When

[Indicate the timing or frequency for this step.]

How Much

[Specify any costs or fees associated with this step.]

How Long

[Indicate the duration required to complete this step. Use the exact information from the original content. Only estimate if the exact information is not available. If estimating, provide a reasonable range and indicate this is an estimation (e.g., "Estimation: 2-3 weeks").]

Expected Outcome

[Describe the expected result or outcome of completing this step.]

Note

[Include any extra information or considerations pertinent to this step.]

Next Steps

[List any subsequent steps that should be taken after this step. If none, state "None."]

Instruction for Information:

Summarize the information about this service, following the template below.

Template for the information:

About this service

Goal

[Identify the names of the overall outcome or the final document received (e.g., Driver Licence, Working Visa). Use the exact information from the original content.]

Service Provider

[Identify the names of specific service providers or organizations involved in the process (e.g., Service Ontario, Canada Revenue Agency (CRA)).]

3rd Party

[Identify any third parties involved in the process (e.g., notary, translator, driver school, attorneys). If none, state "None."]

Template for the references:

References

[List any relevant references, such as official websites, contact information, or additional resources related to the service.]

Tags

[List any relevant tags that can help categorize or identify the service (e.g., "driver licence", "housing", "employment", "family"), separating them by comma, including all the required and received documents.]

Appendix K: Definitions

This research defines the key terms as follows.

Infographic

This research takes the definition of **infographic** from the American Heritage(R) Dictionary of the English Language, which is “*A visual representation of information or data, such as a chart or a map, especially of information that is more easily imparted by such a representation than by written text.*”¹

The use of *infographics* in this research focuses on their function as a *visual representation of information* rather than raw data.

Participatory Design, Co-Design, and Co-Creation

Participatory Design (PD) takes the definition by Sanders as “an approach to design that attempts to actively involve the people who are being served through design in the process to help ensure that the designed product/service meets their needs.”²

Co-Design refers to “the creativity of designers and people not trained in design working together in the design development process.”³ Co-design is the

¹ Editors of the American Heritage Dictionaries, ‘Infographic’.

² Sanders, ‘An Evolving Map of Design Practice and Design Research’, 14.

³ Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’, 6.

contemporary name of *participatory design*.¹ It can combine the power of multiple stakeholders, for example, designers, clients, and the target users.²

In this paper, *Participatory Design* and *Co-Design* refer to the same type of activities but emphasize different attributes of it: PD emphasizes the inclusion of the target audience, and Co-Design emphasizes the collective creativity process.

Co-Creation expanded co-design, including “any act of collective creativity”.³ It is a superset of co-design. This paper uses Co-Creation to refer to the collaboration that goes beyond the design process in the workflow.

AI (Artificial Intelligence)

Artificial Intelligence (AI) is an umbrella concept. It means the computer systems that can “perform tasks that typically require human intelligence”.⁴ In the context of this research, **AI** refers to a small subset of it: image-generative models or text-generative Large Language Models (LLMs) or Small Language Models (SLMs).

Application, App, and the APP

The term “application” has different meanings in different contexts in this research. To avoid confusion, it uses different forms.

¹ Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’, 7.

² Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’, 9.

³ Sanders and Stappers, ‘Co-Creation and the New Landscapes of Design’.

⁴ Caelen and Blete, *Developing Apps with GPT-4 and ChatGPT*, 2.

Application means the “applying” process or the related documents while accessing the essential services, for example, the application for citizenship.

App means an instance of software or cloud-based services that people can interact with on their devices.

The fully capitalized **APP** refers to one of the outcomes of this research, which is a web-based collaborative platform that powers and accelerates the designed workflow.

Essential Services

This research borrows the definition of essential services from the Government of British Columbia during the COVID-19 pandemic. **Essential Services** are “those daily services essential to preserving life, health, public safety and basic societal functioning.”¹ In this paper, this term refers to those that particularly matter to new immigrants in Canada, for example, housing, health care, banking, and child care.

Policy and Procedure

In this research, **policy** and **procedure** mean those public-facing documents that impact people’s decisions on their life strategies or instruct people how to achieve desired tasks, such as:

¹ Government of British Columbia, ‘List of Essential Services’.

- Public **policies** that involve essential matters, for example, immigration policies by the federal government¹ or public-school policies by the local school board².
- Service **procedures** or guidebooks, for example, how to get a driver's license³ or how to apply for Employment Insurance benefits⁴.

Audience

The **target audience** of the infographic deliverables is **individuals who face language barriers** resulting from various factors. In the context of Canada, immigrants who speak official languages as a second language are the main audience.

Immigrants and Newcomers

This research adopts the definition from Statistics Canada's approved standard for **immigrant**. It "refers to a person who is, or who has ever been, a landed immigrant or permanent resident. Such a person has been granted the right to live in Canada permanently by immigration authorities. Immigrants who have obtained Canadian citizenship by naturalization are included in this group."⁵

¹ Immigration, 'Canada's Immigration System'.

² Toronto District School Board, 'Policies and Procedures'.

³ Ministry of Transportation, 'Getting Your Driver's Licence | The Official Ministry of Transportation (MTO) Driver's Handbook | Ontario.Ca'.

⁴ Employment and Social Development Canada, 'EI Regular Benefits'.

⁵ Statistics Canada, *Immigrant*.

According to *2024 Annual Report to Parliament on Immigration by Immigration, Refugees and Citizenship Canada (IRCC)*, **newcomers** are “Foreign Nationals (who [are] not Canadian Citizens) who [have] been in Canada for a brief time (usually less than five years)”.¹

Users

Users of the outcome workflow and APP are the people who will create the output infographics for the target audience. They can be settlement experts, graphic designers, and representatives of the target audience.

Settlement Expert

In the context of this research, an **expert** refers to a person who has experience working with the target audience community and possesses expertise in the policies and procedures that this community needs most. An expert is capable of interpreting the policies and procedures in a proper way to deliver the information to the target community.

¹ Immigration, ‘ARCHIVED – 2024 Annual Report to Parliament on Immigration’, n. 1.

Appendix L: AI Use in This Research

Use AI as a Research Tool

My use of AI as a research tool is mainly to search.

When I needed to locate sources, I still used Google Search in the traditional way of inputting keywords, while using ChatGPT as if having a conversation.

I sometimes used Google Gemini's summaries and reference links, which are shown at the top of the search result list, for identifying and locating resources.

I used ChatGPT to locate resources that I could not recall details about. For example, I would ask, "I read an article about the discontinuing of Codex impacting research. Find the source." The problem is that ChatGPT can only find open online sources but not the ones in books or behind paywalls. Therefore, it was not very helpful for this task but sometimes saved some time.

At the beginning of this research, I tried NotebookLM (now called Gemini Notebook) and did not like it. The gap I wanted to fill with AI tools is locating strong studies on specific topics. Therefore, the issue with NotebookLM is similar to ChatGPT's one above: its data sources. If I could find the original documents, I would read them myself rather than the AI's summaries.

Use AI as a Development Tool

During developing the prototype, I used GitHub Copilot through VS Code. I used both the inline auto-completion and the chat window. I used both Ask and Agent modes in the chat.

For the inline auto-completion, I would review the generated suggestions before accepting, and, usually, modify the code afterward. I found this function works best with a series of similar code blocks, as the AI could use my code and comments as context. However, it also caused me to be unfamiliar with some code, which led to difficulties in debugging. I also sometimes found the inline suggestions interrupting my thought flow and therefore annoying.

I mainly use the chat window to ask basic questions and debug. For example, I asked it to generate a regex based on my description to save time. As for debugging, I found it was good at identifying syntax bugs and common mistakes (for example, inconsistent variable names, which were, ironically, generated by the inline suggestion). Copilot saved significant time for me as I could continue programming while waiting for it to review code and generate solutions. I disliked that the Agent mode would implement the solutions directly. It increased my unfamiliarity with the code and made further debugging more difficult. So, I instructed it only to answer the question and provide suggestions without “touching my code”. The debugging suggestions sometimes conflicted with each other. The most interesting finding for me was that AI is best at improving AI prompts. I also

used Gemini’s summaries and reference links for general development knowledge or design patterns for basic functions if I was in a hurry, while worrying that this action was jeopardizing the source websites’ income.

Using AI as a development tool enabled me, who understands web technologies foundations but is not a hardcore developer, to finish a prototype within a tight timeframe.

Use AI as a Writing Tool

I wrote this paper without content generated by AI. I used Microsoft Editor and Grammarly (pro version) to check spelling and grammar. I sometimes took Grammarly’s suggestions to simplify the sentences.

I used ChatGPT to identify better terms or terms I know but have forgotten the spelling of. For example, I asked questions like “an adj for something needs a lot of resources to function”, or “the word is similar to ‘situation’, starts with C”. I am fond of this “reverse dictionary”, as I could not search like this without a conversational UI enabled by the natural language models.

I chose not to generate text in my paper not to reject the use of AI, but for my own practice and growth (and fun). However, while students increasingly apply AI to their writing process, I noted that the instructors’ expectations of students’ work have shifted slightly but surely. I can see that the use of AI can be normalized and even implicitly mandated in the future, just as we take access to the internet for granted today, even though it is actually not.

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