UNDERSTANDING SELF-EFFICACY
IN SEARCH AS SELF-DETERMINED LEARNING

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Abstract

Working learners regularly access information with web search engines to enhance their skills and find information. *Search as learning* (SAL) is a research agenda that rethinks search from a learning perspective. This dissertation applies a new self-determined learning paradigm (a learner-centric approach focusing on agency) to SAL and unpacks the role of self-efficacy when user experience professionals learn using search engines in natural settings. Understanding self-efficacy began with the rigorous development of a SAL-specific measure of self-efficacy, followed by a mixed-method study culminating in data-prompted interviews. I found a statistically significant decline in one cognitive process, schema training, after 5 days of learning using search. Schema training refers to the known methods for finding information online; results show that some participants had an incomplete mental model of web search systems. As a result, searchers may be rewarded with feelings of gratification after their search while reinforcing poor search habits over time. The data-prompted interviews were analysed using reflexive thematic analysis. I found that although self-efficacy improved for some participants, many participants experienced a decline in self-efficacious processes over the course of a week. Participants who experienced a decline reported feelings of failure, difficulty assessing the credibility of resources, tendency to take sources at face value, and a lack of psychologically safe sensemaking opportunities within their social network. Participants who experienced an increase in self-efficacious processes reported having naturally occurring mentorships, well-defined distal goals, and a healthy amount of skepticism of information found online. This dissertation contributes a partially validated self-efficacy scale for use in SAL contexts with working learners, demonstrates how to improve ecological validity of SAL studies by combining in-situ data collection through experience sampling with follow-up interviews (i.e., data-prompted interviews), and contributes to the discussion of the design of search-centric learning systems. The implications of this research emphasise the importance of the broader learning ecology—inclusive of people, learning tasks, and systems—when discussing the design of search systems for learning purposes.

Lay Summary

Web search companies use artificial intelligence to determine the displayed content and order of web search results. Most basic searches that involve finding or verifying information satisfy information needs quickly. However, complex search tasks that require gathering information for learning purposes can be challenging—the design of search engines does not meet the human goals of learning. Yet, improvements to search engines could encourage people to learn more deeply. One concept that influences deep learning is the belief in one's own capabilities—self efficacy. The purpose of this research program was to understand the role of self-efficacy when working adults learn using search engines. This dissertation contributes a questionnaire for measuring people's perceptions of self-efficacy and a novel methodological approach of using data-prompted interviews to bring new insights into how search engines may support learning. I found that some aspects of self-efficacy improved, and others declined after a 5-day period.

Preface

This dissertation is an original intellectual product of the author, Amelia W. Cole. The results reported in Chapters 4 and 5 are covered by UBC Ethics Certificate number H20-02577.

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List of Abbreviations

ASE	Academic Self-Efficacy scale
ESE	Emotion Self-Efficacy scale
ILSE	Information Literacy Self-Efficacy scale
MILK	Metacognitive information Likert-based knowledge
MOOC	Massive open online course
OAHS	Online academic help-seeking
RESE	Regulatory Emotional Self-Efficacy scale
SA	Search Ability scale
SAL	Search as learning
SALSE	Search as Learning Self-Efficacy scale
SEMLI	Self-Efficacy and Metacognition Learning Inventory
SERP	Search engine results page
UX	User experience

Glossary

Bloom's taxonomy: A cognitive taxonomy of educational objectives for classifying educational goals, objectives, and standards (Krathwohl, 2002)
Comprehensive search: "Reflects iterative, reflective, and integrative search sessions that support critical learning" (Rieh et al., 2016, p. 19).
Digital learning ecology: "An integrated conceptualization of learning as a complex phenomenon that bridges formal, nonformal, and informal learning experiences" (Sangrà et al., 2019, p. 1615).
Digital literacy: "Cognitive processes that individuals partake in during the utilization of computer-based, multimodal information," and "must include not only the ability to effectively search for information, but also to vet and integrate that information while monitoring progress toward learning goals" (Greene et al., 2014, p. 55).
Exploratory search: "An information-seeking problem context that is open-ended, persistent and multifaceted" (White & Roth, 2009).
Heutagogy: "Heutagogy is concerned with learner-centred learning that sees the learner as the major agent in their own learning, which occurs as a result of personal experiences" (Hase, 2016, p. 112).
Information literacy: "Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" (Association of College & Research Libraries, 2015, p. 8).
Information-seeking process model: A six-stage constructivist process model that examines the cognitive, affective, and physical process learners experience during learning (Kuhlthau, 1991).
Judgements of learning: "Assesses how much information a person feels is known, usually solicited on a percentage scale (such as the judgment that 80% of the items have been learned)" (Townsend & Heit, 2010, p. 204).
Learning using search: A process by which people select, structure, manipulate, and combine information using the search engine for queries and making use of information found online (Vakkari, 2016).
Metacognition: "Any knowledge or cognitive activity that takes as its object, or regulates, any aspect of any cognitive activity" (Flavell, 2004, p. 275).
Pedagogical content knowledge: "A form of teacher understanding that combines content, pedagogy and learner characteristics in a unique way" (Gudmundsdottir & Schulman, 1987, p. 59).
Reskill: The replacement of skills; specifically improving numeracy, literacy, and problem-solving skills of low skilled workers and preparing them for jobs in the future. (Organisation for Economic Cooperation and Development, 2013).
Search as learning (SAL): A research agenda that rethinks search from a learning perspective.
Searching to learn: See learning using search.
Self-determined learning: See heutagogy.
Self-efficacy: "The conviction that one can successfully execute the behavior required to produce the outcomes'' (Bandura, 1977, p. 193).
Upskill: "The expansion of people's capabilities and employability so they can fully participate in a rapidly changing economy" (World Economic Forum, 2021, p. 11).

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Dedication

To all those working on becoming a better version of themselves: “Let us think the unthinkable, let us do the undoable, let us prepare to grapple with the ineffable itself, and see if we may not eff it after all” (Adams, 1987, p. 188).

Chapter 1: Introduction

The power in education belongs to those “who literally make the social world”

(Freire, 1970/2000, p. 9)

1.1 Digital Learning Context

The way people participate in learning across the lifespan is changing. The current demands for workplace learning require many “employees to pick up new skills on the job” (World Economic Forum, 2020, p. 5) and it’s predicted that 50% of all employees will need some form of reskilling over the next 5 years (World Economic Forum, 2020). The need to reskill, coupled with the inability to predict which skills and knowledge will be necessary to address issues such as climate change, systemic racism, and rapid technological innovations, makes the current formal education process unsustainable as the only mode of learning.

When faced with the mounting cost of university and a large amount of student debt (Chamie, 2017) some learners may turn to online learning options like massive open online courses (MOOCs) to maintain their skills (A. W. Bates et al., 2017). Others are considered *working learners* and incorporate learning into their work practice (Clark et al., 2019). However, the learning platforms that host such opportunities experience high attrition rates (Goopio & Cheung, 2021; Herbert, 2006). Most digital learning platforms borrow from traditional education systems and structure courses to have a defined length (e.g., 12 weeks), expect learners to engage according to a predefined schedule, and use traditional testing methods like single-attempt quizzes and exams (Chen & Zhang, 2017). Learners may struggle to maintain work–life balance under these traditional course models and may perceive exams as a significant barrier to success (Fetzner, 2013; Kizilcec et al., 2013).

Traditional models of education once needed to train adults for well-defined roles (e.g., accountant, lawyer, builder) commonly focused on rote memorization (Freire, 1970/2000; Robinson, 2017). Rote memorization was important because, before the worldwide web, information was tied to a physical location, like a home library, public library, or school, and required additional effort or resources to access (Freire, 1970/2000; Robinson, 2017). The emphasis on memorization prompted some learning theorists to criticise traditional models of education; they described it as spoon-feeding a series of disjointed facts to students who were subsequently ranked based on graded outputs with very little emphasis on actual learning (Blum, 2016; Freire, 1970/2000).

The criticisms and barriers to learning have created a paradigm shift in education; educational theorists and researchers are moving away from an industrial-age perspective of educating for specific roles and toward an information-age perspective that emphasises learning skills and constructs, such as creativity (Robinson, 2017), critical thinking (Blum, 2016; Freire, 1970/2000; Robinson, 2017), and global mindedness (Hannon, 2015). The goal of this paradigm shift is to create a continuous learning culture that enables learners to independently synthesise knowledge and create their own unique worldviews—views that may or may not include the mindset or practices of a dominant group (Freire, 1970/2000).

Heutagogy, or self-determined learning, is a new learner-centric paradigm that originated in 2000 and suggests reconsidering what aspects are important in teaching and learning (Hase & Kenyon, 2000). Self-determined learning focuses on learner characteristics and learning practices that align with a human-centred approach to learning. It combines ideas from the humanist (e.g., Rogers, 1969) and constructivist (e.g., Vygotsky, 1962) theories of education. Humanism is defined by the quality of students' personal involvement during the learning process. Both affect and cognition are acknowledged as important in the theory, the sense of discovery in the context of a learning event is self-initiated, and learning is evaluated by the learner (Rogers, 1969). Constructivists claim knowledge is coconstructed and that active engagement during the learning process is important (e.g., Bruner, 1976; Vygotsky, 1962). The heutagogical paradigm fosters the development of individual capabilities by highlighting human agency as the core component of learning. Heutagogy directs its attention to the internal characteristics of learners such as creativity, collaboration, positive self-concept, self-efficacy, and metacognitive activities. Metacognitive activities (i.e., activities that support understanding of one's own thinking processes, such as writing, discussing, etc.), when performed autonomously, expose the value of multiple perspectives within society (Freire, 1970/2000).

Heutagogical skills are particularly important when learners are no longer enrolled in a specific program, but need to reskill, upskill, or continually engage in learning as a part of work (World Economic Forum, 2020). The digital education landscape for continuous learners is broad and learning communities are emerging in a variety of forms using several different tools. Dialogic learning communities benefit from social media platforms (e.g., Reddit [https://www.reddit.com], Facebook [https://www.facebook.com], Twitter [https://www.twitter.com]). Structured academic learning platforms (e.g., Coursera [https://www.coursera.org], edX [https://www.edx.org]) host organised learning video content with discussion boards. Social reading platforms (e.g., Perusall [https://perusal.com], Hypothesis [https://web.hypothes.is]) provide features to make sense of online and academic information as a community. Specific community-led learning platforms (e.g., Mighty Networks [https://www.mightynetworks.com], Thinkific [https://www.thinkific.com]) are emerging to service informal learning communities. Independent learners can find networked learning content that visualises potential pathways (e.g., Learn anything [https://learn-anything.xyz], Golden [https://golden.com], i-Space navigator [http://www.unlikeminds.info/home]), and informal communication tools (e.g., Slack [https://slack.com]) make it easy to start groups and attract people with a shared domain interest. All these digital tools contribute to the development of online and offline communities of learning and individual mastery of knowledge over time.

Informal and just-in-time learning online was particularly evident in 2020 when a novel coronavirus spread quickly throughout the globe—a virus with no known treatment plan nor cure at its outset (World Health Organization, 2020). Populations have experienced a variety of outbreaks, epidemics and pandemics in history (Turner, 2020), but this virus is completely new and spreads quickly. Offices shuttered and white-collar workers were sent to work from home, some for the first time. Employees who had not worked from home before the pandemic experienced a steeper learning curve than those who had worked from home previously as they adapted to new digital workflows and collaborations (Teevan et al., 2021). Given physical distancing rules in many countries to curb the spread of the virus, the physical separation from others prevented people from learning in more traditional in-person settings and led to challenges adapting to the self-determined learning format (Blaschke, 2021). Despite these difficulties, employees benefited from remote learning by having flexibility in both place and tempo (Davidović, 2020), which highlighted the need for improved learning ecologies that support the on-the-job development of knowledge and skills (Klein-Collins & Travers, 2020).

1.2 The Role of Search in Digital Learning Contexts

Digital learning communities rely upon the web and related tools to learn and share knowledge. However, the social exchange of information is only part of the learning process. An independent learning process also occurs in which the information is searched for and used over time. Search systems are an entry point to learning. Search or information retrieval systems, including web search engines (e.g., Google), bibliographic databases (e.g., PubMed), and in-software product searches (e.g., Evernote), are integral to how people engage in the learning process. Since the introduction of search engines, information searching (i.e., search) has come to be viewed primarily as a process of expressing concepts as key terms within a search box to fetch results. Expert searchers (e.g., librarians) gain intimate knowledge of information retrieval systems and understand their constraints and limitations. In the previous century, search systems took a long time to process information and librarians supported individuals by collaborating on the parameters of a search (e.g., selecting search terms; Feldman, 2012). With the advent of the Internet and improvements in computational speed and search algorithms, search systems became more accessible and enabled nonlibrarians to independently search for and use online information. However, despite advances in speed and access to information, web search engines remain limited because they are designed to serve fact-finding missions. Web search engines may provide quick answers, but offer less support for other information needs and intents, such as in-depth learning that includes higher order thinking processes like evaluating and creating (Marchionini, 2006; White & Roth, 2009).

Search as learning (SAL) is a research agenda that reconsiders search in terms of learning. Based on studies carried out in formal academic settings, namely high school and college courses, Kuhlthau (1991) created one of the first information-seeking behaviour models that included a learning intent. The information-seeking model has six stages that describe the process of finding and using information in the context of students’ research projects. It details the cognitive, affective, and physical processes experienced by learners across both classroom and library environments. Kuhlthau contributed a novel and evidence-based holistic process model that functions in a variety of contexts, including everyday life (Kuhlthau et al., 2008). However, Kuhlthau and those who have adapted her work (e.g., Rieh et al., 2016) predominantly focused on its application using philosophies and features that align to traditional and instructional ways of thinking. The instructional way of thinking can be seen in two ways: (a) theories that inform models, and (b) study designs and parameters. Current SAL models are informed by existing models, such as the information-seeking process, that depict procedural information-seeking phases, or by cognitive frameworks, such as Bloom's taxonomy—an instructional tool designed to categorise learning by varying degrees of complexity (Kuhlthau, 1991; Marchionini, 2006; Rieh et al., 2016). Current SAL studies have frequently used convenience population samples that contained students, included simulated tasks predefined by the researchers, and assessed short-term learning based on expert reviews or predefined answers (e.g., Brandt et al., 2009; Collins-Thompson et al., 2016; Jansen et al., 2009; Knight et al., 2017; Moraes et al., 2017; Wilson & Wilson, 2013).

Under traditional education conditions, a simple search engine emphasizing fact retrieval may best serve learners if they need to recall only known terms and concepts to retrieve definitions and synthesised articles. The focus on a single answer, however, does not necessarily support learners who are engaged in critical thinking and may not support the learning capabilities needed to solve challenging problems in the future. Although early studies posited that critical thinking may occur when evaluating search results, more recent research suggests that learners tend to satisfice, to the extent that most searchers stay on the first search results page or stop searching when they have found sufficient information to service their basic needs (Agnosto, 2002; Feldman, 2012; Prabha et al., 2007; Toms & Freund, 2009; Warwick et al., 2009). Satisficing behaviours may be linked to social issues such as sharing fake news, failing to validate online information, and the spread of homogenous information that social media has made increasingly visible (Talwar et al., 2019). Head and colleagues (2019) interviewed 103 university students and 37 faculty members across the United States and found that many students were aware of the bias present in algorithms and were more likely than faculty members to use strategies learned from peers (not schools) to combat the bias present in online news sharing. Search may empower people to find information, but current tools and frameworks may not support the depth of learning working adults need to achieve from their SAL process.

1.3 Self-Efficacy

From a heutagogical perspective, deep and continuous learning is accomplished by developing the internal characteristics of learners and creating the right environmental conditions for learning to occur. Applying a humanistic lens to the activity of learning using web search engines may uncover new perspectives on how to improve learning technologies.

One of the key characteristics of heutagogy is the learners' high sense of self-efficacy, which is "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, 1977, p. 193). Self-efficacy may be an integral part of metacognition, but there is a degree of mystery as to whether self-efficacy is antecedent to or a result of metacognition (Flavell, 1979; Usher & Schunk, 2018). *Metacognition* is conceptualised as knowledge of one's own learning process. It is an integral part of active learning and is understood as a support mechanism for critical thinking over time (Efklides, 2008; Flavell, 1979; Pintrich et al., 2000; Schoenfeld, 1987; Schraw & Sperling, 1994; Schunk & Greene, 2018). Improvements to self-efficacy may be present when metacognition is modelled by individuals, prompted by questions, or otherwise scaffolded (Valencia-Vallejo et al., 2019; B. J. Zimmerman

& Ringle, 1981). But self-efficacy is also a standalone construct that is considered a learned behaviour supporting persistence in learning (Bandura, 1977).

Self-efficacy is a multifaceted construct with four psychological processes: motivational, affective, cognitive, and selection, according to Bandura (1977). Motivational processes involve persistence of effort and self-concepts. Affective processes concern emotional regulation. Cognitive processes describe the beliefs people hold about their cognitive capabilities. Finally, selection processes point to the choices people make in their environment. Although SAL researchers have investigated self-efficacy, study is often constrained to measures of a person's capabilities in their ability to search for information (e.g., Brennan et al., 2016; Kelly, 2010; Kurbanoglu et al., 2006) or a single self-efficacious process. Information science researchers have explored searchers' self-concepts (Willson & Given, 2014), emotional responses during search (D'Mello et al., 2014), environmental factors related to search (Rieh et al., 2012), and cognitive information processes during search (Gwizdka, 2010).

To date there is little investigative work exploring the complex role the four psychological processes of self-efficacy play for those who are learning using web search engines. Understanding the broader supports needed to learn independently using web search engines is an important pivot in SAL research to encompass the needs of nonstudents who are actively engaged in lifelong learning for mastery purposes. This dissertation posits that search is an oft-overlooked but important component of learning ecologies and that self-efficacy plays an important role in developing the continuous learning attitudes and behaviours needed to foster truly empowered searchers.

1.4 Study Purpose

The pandemic accelerated an already growing movement toward digital life (Cotofan et al., 2021). Learning in digital environments—particularly on an as-needed basis—means being able to find, evaluate, and use information quickly. This exploratory research program aimed to understand how to support working learners by examining their self-efficacious processes when learning using search. This research contributes to a growing body of research on SAL (Collins-Thompson et al., 2017; Hoppe et al., 2018; O'Brien et al., 2020, 2022; Rieh et al., 2016; Vakkari, 2016; M. L. Wilson et al., 2016). In this study, I applied a heutagogical lens with the aim of changing how researchers investigate learning in a nonlinear space for nonstudent populations. Heutagogy is a newer learner-centric paradigm that emphasises learner agency, promoting the development of individual characteristics and using self-referential standards for measuring learning (Blaschke, 2021; Blaschke & Hase, 2019; Hase & Kenyon, 2000). Pairing this paradigm of learning with the independent, adult learner population is essential for reflecting on how the worldwide web serves learners already in the workforce (working learners) and what can be done to improve the nonlinear environments working learners use to master their domain knowledge.

1.5 Research Scope and Objectives

This dissertation focused on early-career (0–3 years of experience) user experience (UX) professionals. Early-career UX professionals were selected due to the demand for UX practitioners within organizations. UX practitioners come from a diversity of discipline backgrounds (e.g., information science, psychology, graphic design; Rosala & Krause, 2019) and are expected to learn research skills while in the job, suggesting the population sample may be invested in continuous learning and trying to learn outside of formal institutions or resources. The research focused on the supports and barriers for self-efficacious processes when working adults learn using search engines. Specifically, the overarching research question was this: What is the role of self-efficacy when working adults learn using search engines? To answer this question, two distinct phases were undertaken. Phase 1 developed a self-report self-efficacy scale, called Search as Learning Self-Efficacy (SALSE), relevant to the SAL context to measure self-efficacy. Phase 2, a mixed-methods study, dove more deeply into the supports and barriers experienced by working learners when using web search engines to learn. The mixed-method study used multiple methods, including surveys, diaries, and data-prompted interviews, and it employed reflexive thematic analysis to make sense of learners' experiences.

The central research question was further addressed by four research subquestions. These are listed in Table 1, along with their corresponding research phase and location in the dissertation where the methods and findings can be found.

Table 1

Research Questions

Research subquestions	Phase	Section in Methods	Section in Findings
RQ1.1: How can a working adults' sense of self-efficacy be measured when learning using search?	Phase 1	3.2	4.1; 4.2
RQ1.2: Is there a significant change in self-efficacy over the course of 5 days when working adults maintain a learning diary while they learn using search?	Phase 2	3.3	5.3
RQ1.3: What is the nature of the self-efficacious experiences when working adults learn using search?	Phase 2	3.3	5.3
RQ1.4: What are the changes in working learners' self-efficacious experiences when learning using search?	Phase 2	3.3	5.3

Note. This table lists the four subquestions, their appearance in the two-phased approach to the study, and the sections where their corresponding methods and findings are in the dissertation.

Measuring and Evaluating Self-Efficacy

Self-efficacy is domain specific. Bandura (2006) recommended creating instruments for each context that reflect the person's judgement of capability. The current scales for self-efficacy in SAL are based on search or information-seeking skills (Bailey, 2017; Kelly, 2010; Kurbanoglu et al., 2006). This maintains a utilitarian view of technology (Cole & Lovejoy, 2018). Like mobile phones, web search engines are perceived as useful and existing to accomplish a specific goal, but this view neglects the socioemotional and motivational processes involved in learning. To understand how to capture a holistic view of the learning experience using web search engines, I investigated several measures of self-efficacy that mapped to the four psychological processes of self-efficacy (i.e., motivational, affective, cognitive, and selection). The first phase of the research addressed research question 1.1 (RQ1.1) and drew upon secondary research and expert opinions to cocreate an informed scale to measure the constructs outlined by Bandura's (1977) theory of self-efficacy. In this expert review phase of the study, I recruited self-identified experts in self-efficacy across both information and learning science domains using snowball sampling and asked them to examine and provide feedback on the constructs and items present on the proposed scale through email. The resulting scale was employed in the mixed-methods study (Phase 2) that involved diaries and data prompted interviews and informed the analysis of the interviews.

Data Prompted Interviews

Understanding the role of self-efficacy in self-determined SAL needs to take into the account the lived experiences of people who learn in this context. The second phase of the research program addressed research subquestions 1.2 (RQ1.2), 1.3 (RQ1.3) and 1.4 (RQ1.4). Mixed methods were used to elicit an understanding of the role of working adults' self-efficacy when learning using search in natural settings. Participants were adult learners who were not enrolled in a formal learning program (e.g., degree). In this study, I asked participants to consider their goals and aims with respect to the application of their learning and what they planned to learn over the course of the 5-day diary study. Participants were asked to complete a learning diary that asked reflective questions about their search and learning processes and the diary exercise was followed by a data-prompted interview. The analysis mixed descriptive statistics from the constructed and refined SALSE scale outputs (Section 5.3) with a reflexive thematic analysis of the interview data to understand the self-efficacy-related challenges that arose from learning using web search engines.

1.6 Significance of the Study

This research program created a measurement tool inclusive of the affective, cognitive, motivational, and selection self-efficacious processes and used this to unpack self-efficacy when working adults learn using search. The findings of the mixed-methods study describe the barriers and supports early-career UX professionals face when looking for information to learn online and suggest that web search engines are limited for learning. First, some of users' desired content was inaccessible (i.e., not open source), completely textual, or included irrelevant distractions. Second, for participants with limited prior knowledge, the web provided no scaffolds or visualizations to orient where they were in the topical information space. Finally, online communities were not perceived as psychologically safe, and many participants elected to use their existing network for help and support instead of an online community. Furthermore, the findings may be used to extend research on the measurement of self-efficacy in SAL studies.

This research program drives a longer-term goal of designing a lifelong learning platform that prioritises agency and continued use of acquired knowledge over a lifespan. The premise is that if people know how to learn on their own, are critical about the underlying assumptions of knowledge, and can actively build upon their own ideas as they develop over time, working learners will be able to thrive in uncertain and changing futures. Understanding the role of self-efficacy in SAL allows for building tools that better support independence and deep learning practices. The findings from this research program are relevant not only to search communities who advocate for expanding the role of search in learning, but also to learning communities who want to create more digitally inclusive learning tools and practices.

1.7 Overview of the Dissertation

The dissertation is organised as follows: Chapter 2 provides a literature review describing three components of a search-based self-determined learning ecology: self-determined learning, self-efficacy, and SAL. Chapter 3 describes the research design and methods used in the two phases: developing a self-report measure of self-efficacy (Phase 1) and the diary study (Phase 2). In Phase 1, a scale development process featuring an expert review was conducted to assess the face validity of a self-efficacy scale and an evaluation of the scale that was deployed in Phase 2. In Phase 2 working learners completed a prestudy survey and a search diary over a 5-day period, and they were interviewed about their learning experiences with web search engines. Chapter 4 describes the results of the scale development and Chapter 5 presents the results and discussion of Phase 2. Chapter 6 includes the discussion of the findings, and Chapter 7 conveys the conclusion, including contributions, limitations, and future work.

Chapter 2: Literature Review

Professional employees have growing demands on their capability to cope with uncertainty, adapt quickly to new information, and solve increasingly complex problems; the future demands a culture of continuous learning (Blaschke, 2021; World Economic Forum, 2020). This is a relatively new phenomena as information has historically been stable, with new innovations taking decades to become mainstream (Standage, 2005). The rate of change demands information be available at the same pace as information discovery. Despite the availability of content management (e.g., WordPress) and social media (e.g., Twitter) platforms that simplify and empower people to self-publish and manage their own information, the distribution of misinformation poses great risk, increasing the demand for searchers to possess both critical and creative thinking skills (Fadel et al., 2015; Talwar et al., 2019). The future learner needs broader capabilities to locate, evaluate, and use information effectively to thrive in a diverse and information-rich society.

SAL researchers seek to better understand how humans use information retrieval systems, including search engines, as part of the learning process. Recent discussions within SAL discourse explored whether people are *learning to search* or if they are *searching to learn* (Rieh et al., 2016), and some suggested these two positions cannot be separated as both are true (Russell, 2018). Researchers who investigate “learning to search” are commonly interested in a person’s search literacy, that is, their knowledge of how to formulate search queries in order to retrieve relevant results (M. L. Wilson et al., 2016). Researchers who investigate “searching to learn” take a more holistic view of the information-seeking process, defining it as the process by which people select, structure, manipulate, and combine information both by querying the search engine and by making use of information found online (Vakkari, 2016). This dissertation is interested in the information-seeking process associated with searching to learn for adult learners who seek information using web search engines to learn while on the job.

This literature review introduces the concept of self-determined learning to better understand and support SAL. It briefly outlines the main theoretical perspective of self-determined learning and elaborates on self-efficacy, a construct that supports persistence in learning. Next, I review theoretical perspectives of and current SAL research, culminating in a discussion of its limitations when viewed through an self-determined-learning lens, and briefly explore current investigations of self-efficacy within the SAL literature. Lastly, I provide a rationale for the dissertation research by articulating why learning lenses need to change when it comes to investigating learning using search with working learners, and how focusing on self-efficacious learning processes may illuminate barriers and opportunities for working learners using search engines to learn.

2.1 Self-Determined Learning

Proponents of 21st-century learning claim that the ultimate state of learning is when learners have acquired sufficient intrapersonal skills, such as self-confidence and learning strategies (e.g., rehearsal as a useful learning strategy when memorizing facts), to determine and drive their own learning agenda (Fadel et al., 2015; Hase & Kenyon, 2000; Robinson, 2017; Rogers, 1969). Learning is defined as "an integrative experience where a change in behaviour, knowledge, or understanding is incorporated into the person's existing repertoire of behaviour and schema (values, attitudes and beliefs)" (Hase & Kenyon, 2007, p. 112). The emphasis on the internal world of the learner stems from a relatively new learning paradigm, heutagogy or self-determined learning, that merges humanist and constructivist perspectives of learning (Hase & Kenyon, 2000).

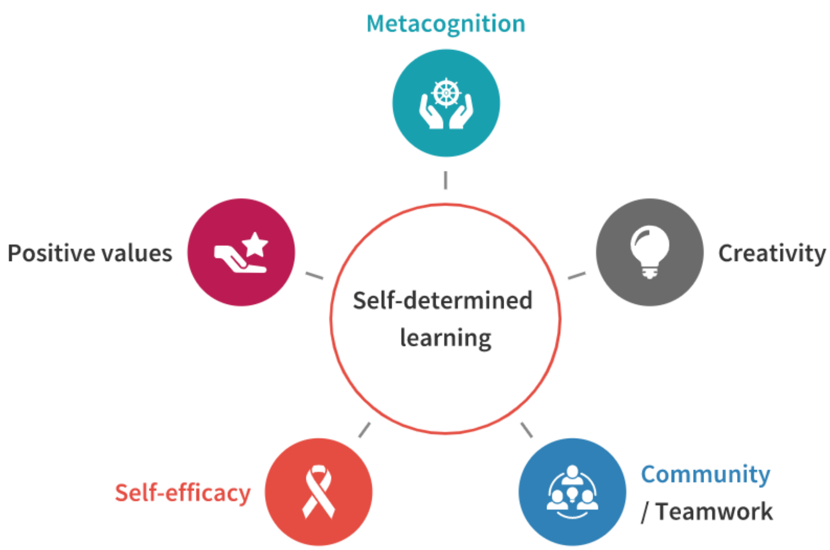
Humanism, in this context, is defined by personal agency and involvement during the learning process, acknowledging that learners initiate as well as evaluate their own learning (Rogers, 1969). Constructivists claim knowledge is coconstructed and acknowledge the importance of active engagement during the learning process (e.g., Bruner, 1976; Vygotsky, 1962). Self-determined learning incorporates elements of constructivism, such as active learning, and of humanism, such as individual agency and authenticity, as foundational contributors to the learning process (Blaschke, 2016; Hase, 2016; Hase & Kenyon, 2000). Authenticity is a crucial aspect of learning in this context in terms of both tasks and interactions. Authentic tasks closely approximate or are real-world tasks; authentic interactions occur in the learning environment between people (i.e., learners) and/or objects (e.g., lesson materials; Vygotsky, 1962). Any guidance provided by members of the learning group centre on the development of an individual's capacity to learn, which is defined as a metastate of knowing how to learn (Hase, 2016; Hase & Kenyon, 2000).

Heutagogical environments employ a nonlinear approach in which learners decide what and when knowing is appropriate. Learners are given the necessary tools to build a personal network of mentors who guide them in the learning process and teachers are not content-based authority figures (Blaschke, 2012, 2016). The argument for mastery of pedagogical content knowledge over domain knowledge is an ongoing debate in education. Arendt (1961) argued in favour of mastery of subject knowledge, but other educators have advocated for knowledge of both subject and teaching (Gudmundsdottir & Schulman, 1987; Schulman, 1987). The combination of a humanist-constructivist perspective focuses on the individual learner and their interactions with subjects (i.e., people) and objects (i.e., resources) of learning.

Heutagogy (self-determined learning) operates under five key pillars: creativity, collaboration, positive values, metacognition, and self-efficacy (Hase & Kenyon, 2000; see Figure 1).

Figure 1

Related Constructs Within Heutagogy/Self-Determined Learning



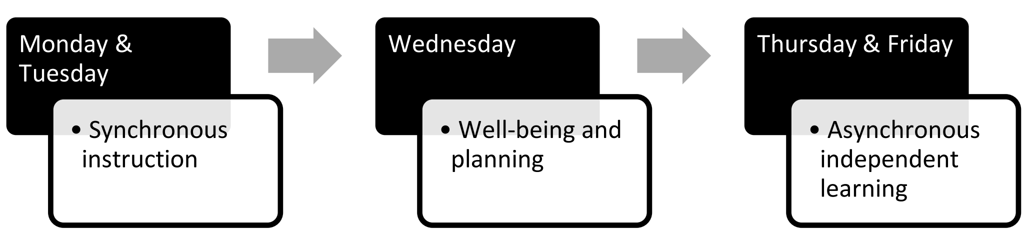
Creativity exists on a continuum that spans from "the novel and personally meaningful insights and interpretations inherent in the learning process" (Kaufman & Beghetto, 2013, p. 230) to the rare displays of creativity that have a major impact on others, such as Nobel-prize-worthy scientific findings (Kaufman & Beghetto, 2009). Kaufman and Beghetto (2009) suggested that without personally meaningful insights, there could never be Nobel-prize-worthy creativity. *Collaboration* is synonymous with group learning and generally describes a learning environment in which two or more people mutually search for understanding, solutions, meaning, or product (B. L. Smith & MacGregor, 1992). Heutagogists have applied Wenger's (1999) communities of practice and investigated the use of social media (e.g., Twitter) as an extension of creating a personal learning network in this context (Blaschke & Hase, 2019).

Positive values refer to the self-concept one develops as a learner, and recent work has included the contrast between a growth mindset (Hase, 2016), which describes a mental model of intelligence as a developing skill, and a fixed mindset, which views intelligence as a stable and natural trait (Dweck, 2007). Metacognition is commonly described as thinking about thinking, specifically metacognitive knowledge, experiences, and skill (Flavell, 1979). *Self-efficacy* is a central component in metacognitive knowledge and describes a person's ability to "successfully execute the behavior required to produce the outcomes" (Bandura, 1977, p. 193).

The move to self-determined learning is still new and considered a part of a current shift in educational theory and practice. A few alternative elementary schools, such as the Lindfield Learning Village in Australia and the Learnlife Academy in Spain, and private schools, such as Havergal College in Canada, are innovating based on this new paradigm and experimenting with novel ideas to address the learning needs of the future (Cummins & Prato, 2020b). In an example of significant change in the education system, Havergal College introduced 2 days of self-determined learning in 2020 for the purpose of increasing learners' sense of agency and well-being (Gibson et al., 2020; Havergal College, 1999; see Figure 2).

Figure 2

Havergal College (K–12) 2-1-2 Model



Note. Adapted from "The Learnlife Paradigm: From Thought to Action" by B. Gibson, S. Harris, and D. Carberry, 2020, November 9–20. [RE]Learn Conference (https://relearn2020.sched.com/event/fYKm/the-learnlife-paradigm-from-thought-to-action). Copyright 2020 Havergal College.

Opinions about the application of self-determined learning in institutionalised learning contexts vary. Proponents of self-determined learning have subscribed to the humanist concept that learning is a natural state, but they also have considered deep learning a refined skill that is acquired over time, suggesting that learning skills needs to be a deliberate practice. The debate stems from the question of when to introduce self-determined learning skills. Some researchers have recommended learners should begin with teaching-centred pedagogy, in which teachers maintain more control over the learning process, before moving into self-directed andragogy (adult learning), in which learners negotiate the learning process with their teachers, and, finally, acquire sufficient skills to practice self-determined learning (Blaschke, 2012; Grow, 1996). However, other researchers and practitioners have implemented self-determined learning earlier, during elementary school (Cummins & Prato, 2020a). This trajectory aligns with recent moves away from teaching only predefined or legislated curricula and introduces learner choice alongside the development of independent learning skills. Self-efficacy is thought to be a transferable skill that can help address the uncertainty and fast-paced rate of change in the near and distant future (Blaschke & Hase, 2016; Hase, 2016).

Although heutagogical principles can be applied to structured programs, in this research I am interested in the application of learning across the adult lifespan and the characteristics and tools independent adult learners need to thrive in an uncertain and changing world. This context is important because learners must rely on themselves and their social networks to manage their learning.

Self-organised communities play an integral role in lifelong self-determined learning environments as they often have loose structures and shift identity based on their membership (Blaschke & Hase, 2019). In these largely unstructured learning communities, knowledge is typically distributed and collaboration stems from the social and shared construction of knowledge. People are temporarily working on creating a shared understanding of a concept or skill, but may not always work on the same projects or on the same team, nor share the same end goals (Greeno et al., 1996). Unstructured community networks are thought to play an important role in learning as they allow for a variety of coregulatory activities. Coregulation "refers to the recognition of each other's perspectives and the alignment of ideas regarding the tasks to be completed" (Arciniegas-Mendez et al., 2017, p. 1052), meaning that engaging with other group members or technologies during the learning process may help learners cope with learning challenges (Hadwin et al., 2018; Järvelä et al., 2016; Popescu & Badea, 2020). For heutagogists, the end goal is to create transformative communities of learning in which learners share and build upon their knowledge together.

Heutagogists commonly have framed studies within the context of communities of practice, which are organically grown networks of professionals and hobbyists of varying levels of expertise who come together based on a shared domain-interest and identity (Lave & Wenger, 1991; Stebbins, 1992; Wenger, 1999). As human agency is one of the founding conditions of an organic community, one of the challenges is finding a balance between seeding ideas and controlling members (Kaethler, 2019; Wenger, 1999). Communities of practice are fluid and allow for membership to alter the ways of knowing within the group (Wenger, 1999, 2015). Blaschke and colleagues interpreted communities of practice broadly, and have included social networks and informal communities as part of the learning sphere (Blaschke et al., 2014; Blaschke & Hase, 2019). Thus the definition of a community is widened to include naturally forming groups of people who come together with social technologies such as Twitter, Slack, and Reddit to cocreate and share knowledge on a topic (A .W. Bates, 2019; Blaschke et al., 2014;

Kumar et al., 2018), an idea supported by research in coregulated learning (Popescu & Badea, 2020). A well-known example in science, technology, engineering, and math circles are maker communities that have come together to, for example, create personal protective equipment with 3D printing during the COVID-19 pandemic (Wiltz, 2020).

Maker communities typically have a physical location, but digital communities are equally abundant and important to the learning process. For example, communities of practice may exist as part of a professional identity, such as nursing, in which novices and experts move between their professional and personal identities in the creation of a safe space to share and learn (Terry et al., 2020). Participation in communities of practice varies widely and not everyone is an active learner at all times (Wenger, 1999). Creating active, self-efficacious learners who readily share their knowledge with other practitioners may require environmental supports. Communities may need to identify experts who can foster knowledge sharing, encourage activities that demonstrate the transfer of learning, and demonstrate the outcomes of participation (Chang & Jacobs, 2012). A highly engaged self-efficacious community may support self-determined learning by engaging capable people "who: know how to learn; are creative; have a high degree of self-efficacy; can apply competencies in novel as well as familiar situations; and can work well with others" (Hase & Kenyon, 2000, p. 3).

The next section focuses on one of the capabilities described in self-determined communities of learning: self-efficacy.

2.2 Self-Efficacy

Self-efficacy is the set of beliefs held about one's capabilities in successfully completing tasks (Bandura, 1977). One develops a sense of self-efficacy from repeated exposure to successful outcomes (Bandura, 1977). Success in this context is self-referential and constitutes an individual's "estimate that a given behaviour will lead to certain outcomes" (Bandura, 1977, p. 193), and largely depends on what skills or behaviours are targeted for change over time. Of note, Bandura (1977) was originally interested in helping people overcome fearful and avoidant behaviours, such as phobias, and focused on the individual's perception of whether they were able to successfully navigate the threatening activity. For example, for a person who was afraid of spiders, becoming able to sit in a room with a spider was considered a successful outcome or accomplishment.

Bandura (1977) described three dimensions of efficacy: magnitude, generality, and strength. *Magnitude* refers to the degree of felt expectations based on the degree of task difficulty. For example, a person may feel confident in their ability to use natural language to query a web search engine but less confident using Boolean operators in a digital library. *Generality* refers to the degree to which self-efficacy applies to all areas. For instance, an education expert may feel confident in their ability to find information related to learning theory but may struggle to find useful information related to quantum physics. *Strength* refers to individual perseverance in the mastery of an activity despite disconfirming experiences. For example, searchers may struggle to find the information they are looking for, yet many continue to work on improving their search abilities to gain a certain degree of expertise or skill.

Self-efficacy is a common thread throughout learning discourse given its positive relationship to learning outcomes (Coutinho & Neuman, 2008; Moos & Azevedo, 2008, 2009b) and persistence in problem solving (B. J. Zimmerman & Ringle, 1981). Self-efficacy is largely considered to be domain specific (i.e., low generality; Pajares & Schunk, 2001) and is often discussed using Bandura's four psychological processes: motivation, affect, cognition, and selection (Bandura, 1994).

- *Motivational processes* relate to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994). Self-efficacy is a complex construct and is mediated by self-beliefs, such as self-concept (e.g., "Maths makes me feel inadequate"), and mindsets (Pajares & Schunk, 2001). Recent work in this area has looked at perceptions of intelligence. A fixed mindset believes that intellect and skill is static (i.e., something one does or does not have). A malleable or growth mindset believes that intelligence is gained through effort and one can learn anything over time (Dweck, 2007).
- *Affective processes* regulate emotion. Bandura (1994) suggested that people who are able to develop controls over their emotional processes, such as feelings of stress and anxiety, are more likely to take bolder steps in life (i.e., take more risks). Whereas mastery is now typically associated with cognitive processes, Bandura emphasised mastery in terms of affective processes: "Mastery experiences are structured in ways to build coping skills and instill beliefs that one can exercise control over potential threats" (Bandura, 1994, p. 6).
- *Cognitive processes* involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. People are commonly guided by their goals and desired outcomes; the stronger a person's belief is in their capability, the more effort they will devote to a specific cognitive task (Bandura, 1977). Individuals with high self-efficacy are believed to set high goals and persist despite setbacks, whereas individuals with low self-efficacy are believed to set simple goals and perceive tasks to be more difficult than they actually are (Bandura, 1994; Pajares & Schunk, 2001).
- *Selection processes* refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). A stronger sense of self-efficacy may be related to

the breadth of options one might consider (Bandura, 1994). It is important to note that this is not a unidirectional process as environmental factors can also influence self-efficacy (Bandura, 1977). Bandura noted,

> People can give up trying because they lack a sense of efficacy in achieving the required behavior, or they may be assured of their capabilities but give up trying because they expect their behavior to have no effect on an unresponsive environment or to be consistently punished (1977, p. 205).

For example, Sommet et al. (2013) found admissions policies that admitted students based on their rank on an exam (versus their actual performance) reduced medical students' self-efficacy and created a situation in which students were more focused on performance goals than on mastery-oriented goals (Sommet et al., 2013).

Self-Efficacy in Self-Determined Learning

The development of an individual's self-efficacy in self-determined learning is essential, largely because of the full agency afforded to learners (Code, 2010, 2020). For heutagogists, developing a degree of confidence in one's ability is important because it cultivates a positive socioemotional perspective toward learning when it is supported by the external environment. This section describes the four psychological processes (motivational, affective, selection, and cognitive) of self-efficacy in self-determined learning.

Motivational Processes. From an intrapersonal perspective, self-efficacy is developed by orienting learners to a growth mindset (Dweck, 2007). The growth mindset is considered to shield learners from negative aspects of learning; temporary setbacks are viewed as learning opportunities rather than a reflection of a person's entire self-worth or total ability (Dweck, 2007). Developing a sense of self-worth acknowledges the individual effort a learner puts into their own work, reasoning that, by rewarding incremental improvement, the learner will continue their practice and become more engaged in the process of learning (Covington, 1984; Crocker & Knight, 2005). Growth mindset is also reported to foster more enjoyment of challenges and present a process-oriented (i.e., metacognitive) alignment to learning (Dweck, 2007), exemplifying the self-determined learning approach.

The growth mindset may support persistence in learning but may not necessarily be related to grades. Burnette and colleagues (2020) performed an experimental intervention with 238 students to understand if a growth-mindset intervention could promote entrepreneurial self-efficacy. They found that students in the growth-mindset condition reported greater self-efficacy and task persistence than the control group; there were no differences between groups in reported grades (Burnette et al., 2020). Self-efficacy is also related to the way one sees oneself. A study that examined academic self-concept as social versus studious in 1,366 undergraduates found that learners with a social orientation (e.g., inclination to hang out) had a lower sense of self-efficacy and a preference for performance goals than learners with a studious orientation (e.g., preference for reading) who displayed mastery goals (Komarraju & Dial, 2014). However, the study did not examine students' purposes for attending university, nor the other communities to which they belonged and how these groups may have influenced them socially or supported certain behaviours and outcomes.

Affective Processes. Self-efficacy may be influenced by the emotional support received during the learning process. Emotional support in this context does not necessarily mean making learners feel good about themselves; it involves making them feel like valued and respected members of the learning community (Miller, 2018). Determining the impact of emotion during the learning process is challenging because to date, although findings indicate that emotion does play a role in the learning process, results are not conclusive regarding the impact of emotion on learning. Putwain and colleagues (2013) surveyed 206 undergraduate students to understand the relationship between academic self-efficacy, academic emotions (e.g., joy, anxiety), and academic performance and found that learning-related emotions may have a reciprocal relationship with academic self-efficacy (Putwain et al., 2013).

However, the relationship between emotion or mood and self-efficacy varies across studies. Brand and colleagues (2007) performed two experiments on a total of 138 students to assess the effect of mood on learning and transfer tasks. They found that a learner's mood prior to the learning phase affected the number of repetitions needed to attain mastery during the learning task, but mood did not affect the learners when they applied the knowledge during the transfer task (Brand et al., 2007). Mielniczuk and Laguna (2020) surveyed 206 entrepreneurs to understand the relationship between self-efficacy, emotion, and innovative behaviours, which they characterised as the process of creating new ideas. They found both self-efficacy and innovative behaviours were mediated by positive emotions (Mielniczuk & Laguna, 2020). Villavicencio and Bernardo (2016) surveyed 1345 students to understand the relationship between positive affect and mathematics achievement, finding that enjoyment and pride increased the sense of self-efficacy (Villavicencio & Bernardo, 2016). Rowe and Fitness (2018) interviewed 36 students and faculty to understand the experience of emotion in a university environment. They found negative emotions to be both detrimental and beneficial depending on the specific emotion (e.g., anger) and the emotional regulation skill of the individual (Rowe & Fitness, 2018). The variation found in the literature may stem from how concepts are defined and the duration/type of studies. Short-term and qualitative studies showed temporary benefits to negative emotions, whereas long-term studies tended to show a positive relationship between positive emotions and self-efficacy (Mielniczuk & Laguna, 2020; Villavicencio & Bernardo, 2016).

Cognitive Processes. The belief in one's capabilities to learn paired with goal setting can correspond to positive academic achievement (B. J. Zimmerman et al., 1992). Two recent studies reaffirmed this relationship using survey-based approaches. Alhadabi and Karpinski (2020) surveyed 258 students to understand the relationship between grit (persistence), academic goal orientation, self-efficacy, and academic performance. They found that self-efficacy positively influenced mastery goal setting (Alhadabi & Karpinski, 2020), a finding supported in another survey-based study with 478 students (Honicke et al., 2020). Researchers have recently tried to understand both the cognitive and noncognitive functions of self-efficacy, because it is a predictor of achievement (Moos & Azevedo, 2009a, 2009b; Stankov & Kleitman, 2014). An important facet of self-efficacy for adult learners is the development of information-literacy self-efficacy, which supports lifelong learning through the continued ability to find, use, and evaluate information encountered online (Hee et al., 2019).

Selection Processes. Selection of the environment or environmental factors can influence confidence in one's abilities. In formal learning environments, self-efficacy can be influenced by the environmental conditions set by the teacher or the university. For example, Cobo-Rendón and colleagues surveyed 194 students in a university environment to understand the relationship between well-being, self-efficacy, and academic performance. The survey took place at two points approximately 1 year apart. They found a quarter of university students were more likely to have an increase in negative emotions over time (Cobo-Rendón et al., 2020). They attribute the increase of negative affect to an inability to overcome adversity and stress and to acknowledge the importance of promoting mental health throughout their university career. The idea of well-being has increased in relevancy due to the pandemic, and a number of schools are changing their learning environment to better support students with the increase in perceived adversity. In structured learning environments this has translated into the development of the 2-1-2 model, in which weekly education structure includes 2 days of class work, 1 day of reflection and recharging, and 2 days of mastery-oriented work (Cummins & Prato, 2020a).

Informal groups, such as communities of practice, can improve self-efficacy over time. Kelly and colleagues (2020) performed a quasi-experimental study with 69 teachers to understand the impact of a 2-week community of practice learning environment comprising novices and experts on teacher self-efficacy. They found science teachers developed a stronger sense of self-efficacy at the conclusion of the program. However, engineering and technology teachers demonstrated no change in self-efficacy. The authors hypothesised that the survey assessed confidence in using technologies within integrated learning environments—techniques already familiar to and employed by engineering and technology teachers (Kelley et al., 2020). In health sciences, Lalloo and colleagues (2020) investigated the change in self-efficacy in a virtual community of practice comprising 336 health professionals and found improvements in self-reports of both knowledge and self-efficacy. In the workplace, Chang and Jacobs employed an explanatory mixed-methods design to understand the influence of problem solving self-efficacy on the level of involvement in communities of practice, finding that people with a stronger sense of self-efficacy were likely to share knowledge within their community (Chang & Jacobs, 2012).

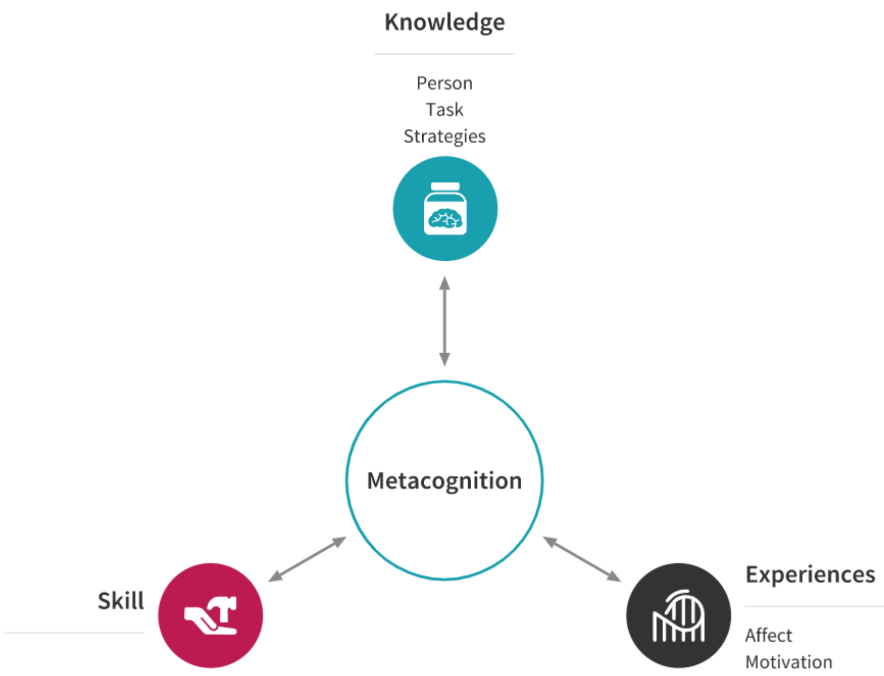
All four psychological processes of self-efficacy play an important role in learning. A positive academic self-concept, the ability to regulate emotions and moods, a well-paced learning schedule, the development of a social learning network, and mastery-goal setting all appear to be elements in creating efficacious learning contexts. However, evidence of self-efficacy is typically collected using a survey-based approach, which can either provide a single snapshot into a person's perception of self-efficacy or be taken at several points to understand changes over time. Very few studies have used a mixed-methods approach to understand the context and reasons for improvement in self-efficacy more deeply.

Self-Efficacy and Metacognition

Researchers have not agreed if self-efficacy and metacognition are distinctly separate or interrelated constructs. Self-determined learners use metacognitive strategies as part of their active and deep learning processes (Hase & Kenyon, 2000); this helps learners understand not only how they learn, but also how they use their learning skills to adapt to new situations. A cornerstone of self-determined learning is developing autonomous human learners who engage in reflective activities during the pursuit of learning goals (Booth, 2014; Hase, 2016). Metacognitive theorists also emphasise reflection on how one learns and how to improve thinking processes (Şendurur & Yildirim, 2019). Metacognition is defined as "any knowledge or cognitive activity that takes as its object, or regulates, any aspect of any cognitive activity" (Flavell, 2004, p. 275). Flavell (1979) differentiated cognitive strategies from metacognitive ones, such that, "Cognitive strategies are invoked to make cognitive progress, metacognitive strategies to monitor it" (p. 909). Flavell (1979) identified components of metacognition, such as knowledge and experiences, which have been extended to include skill as shown in Figure 3 (Efklides, 2008; Schraw & Moshman, 1995; Schraw & Sperling, 1994).

Figure 3

Metacognition



Recent work in metacognition and self-efficacy suggested a complex relationship between the two constructs. Research into whether self-efficacy predicts metacognition or vice versa produced no consensus.

On one hand, researchers have posited that self-efficacy may predict or mediate metacognition, such that beliefs in one's own ability influences the use of metacognitive strategies (Usher & Schunk, 2018). For example, Coutinho and Neuman (2008) surveyed 629 students with the aim of testing a model of metacognition, self-efficacy, achievement goal orientation, and performance, and found that self-efficacy was the strongest predictor of metacognition (Coutinho & Neuman, 2008). In 2009, Coutinho surveyed 173 students to examine the relationship between metacognition, self-efficacy, and performance and found that students' task performance was mediated by self-efficacy and not metacognition (Coutinho, 2009). Self-efficacy may mediate metacognition because learners with a higher sense of confidence in their abilities may place more effort in the learning process (Aurah, 2013; Coutinho & Neuman, 2008; Hoffman & Spatariu, 2008), or because they have greater agency and ability to self-regulate their metacognitive strategies (Hase, 2014).

Other researchers suggested that metacognition mediates self-efficacy. Moos and Azevedo (2008) performed a 30-minute experiment with 37 students using think-aloud protocols to examine the effects of scaffolding on self-efficacy and metacognition in a web environment. Interestingly, they found that self-efficacy declined in both conditions across the learning task (Moos & Azevedo, 2008). The researchers conducted a follow-up multimethod study using a combination of surveys and think-aloud protocol to examine the relationship between self-efficacy and metacognition in a web environment. They found the relationship between self-efficacy and learning outcomes was mediated by the extent to which participants engaged in metacognitive monitoring (Moos & Azevedo, 2009b).

Others speculated the relationship between self-efficacy and metacognition may be interdependent as learners require both the confidence in their capabilities and knowledge of a variety of strategies that support the various definitions of success in learning (Cera et al., 2013; Code, 2020). The interdependency between metacognition and self-efficacy was further elaborated in Cera and colleagues' 2013 study in which they surveyed 130 students to detect the metacognitive skill used to prepare for a final exam. They found that autonomy and a strong sense of self-efficacy were positively related to higher awareness of metacognition and vice versa (Cera et al., 2013), suggesting that metacognition and self-efficacy were interrelated and may be necessary in self-education contexts (Code, 2020).

In this dissertation, I posit that self-efficacy is a separate but essential construct that can be improved through scaffolding of metacognition, particularly for novices (Jackson et al., 1998; McNeill et al., 2006). Wood and colleagues (1976) defined scaffolding as the support structures that empower learners to solve a problem, perform a task, or achieve a goal they would have not been able to achieve alone, taking the learner beyond their level of competence (Wood et al., 1976). Scaffolding has also been defined as an act that supports the construction of knowledge and provides the basis for independent learning; a scaffold is only useful insofar that it can be reused by learners at a later time (Holton & Clarke, 2006).

Definitions and categories of metacognitive scaffolding in digital learning environments vary. Two categorization schemes are (a) planned and adaptive, and (b) supportive and reflective. Planned scaffolds are referred to as hard or static, and they describe contextual predefined supports such as questions or prompts. Adaptive scaffolds may be referred to as soft, dynamic, or situational and refer to spontaneous supports usually provided by human tutors or instructors (Azevedo et al., 2008; Saye & Brush, 2002). Another categorization scheme is supportive and reflective (Jackson et al., 1998). Supportive metacognitive scaffolding refers to intellectual support for domain knowledge. Reflective metacognitive scaffolding is directed at understanding thought processes and reasoning or assisting with what is known or how to think about a topic. For example, some researchers use exploratory questions, reflections, models, or problem-solving process maps to prompt scaffolding (J. Y. Kim & Lim, 2019).

Reflection on the process of learning may influence a learner's self-efficacy. Valencia-Vallejo and colleagues (2019) performed an experiment with 67 students over the course of 2 months to understand the influence of metacognitive scaffolding on academic self-efficacy. The researchers divided the students into two groups: one that received prompts regarding the planning, monitoring, and evaluation of learning and the other that did not. The students who received metacognitive scaffolding had a stronger sense of academic self-efficacy than those who experienced no scaffolding (Valencia-Vallejo et al., 2019). Gentner and Seufert (2020) performed an experiment with 70 students to understand the effectiveness of prompts on strategy use, learning outcomes, and self-efficacy. They found that metacognitive prompts were useful in developing an individual's self-efficacy, but their benefit may be limited to novices. They recommended that prompts should fade as learners develop expertise in their area (Gentner & Seufert, 2020).

Summary

Self-efficacy is an essential component of the learning environment due to its relationship with a variety of facets of learning, such as metacognition, persistence in learning, and academic performance. In a self-determined learning environment, learners are encouraged to learn autonomously and may need to rely on a strong sense of confidence and prerequisite capabilities to complete the task. Self-efficacy and metacognition have a mutually beneficial relationship: the more confident one is, the more likely one may be to engage in deeper learning practices, and the more one engages in deeper learning practices, the more confident one becomes in one's own capabilities to accomplish the task ahead. Of metacognition's three components—skills, experiences, and knowledge—metacognitive scaffolding focuses on prompting skills (such as cognitive reflections), not experiences and knowledge. With the movement toward educating the whole person, positive learning environments need to emphasise reflective activities that address the learner's internal world (cognitive, emotional, social) and encourage reflection on the external characteristics of the learning tasks and strategies.

2.3 SAL

If learning is a lifelong skill that is needed to address the uncertainty of future problems, learning ecologies and platforms need to empower the discovery process associated with independent learning, creativity, and invention, thereby transitioning ownership of meaning making to each learner (Baumeister & Landau, 2018). A ubiquitous but overlooked learning technology is search engines. But what does search mean? The term "search" is conflated in the literature, often referring to both the verb that describes the human activity that makes use of search systems (Fidel, 2012) and the noun that describes a search system (Hearst, 2009).

Search, in the context of information technology, is commonly viewed as a conversation between humans and machines (Oddy, 1977), where the purpose of the machine is to enhance human capabilities (Licklider, 1960). Search is both a human activity and a technological system. Some SAL studies have focused on search *as* learning whereas others have "explore[d] links between searching and learning" (Vakkari, 2016, p. 7). This dissertation takes the latter perspective. In the acquisition of information, people engage in behaviours such as information *seeking*, which describes purposefully looking for information to support the act of decision making or problem solving; information *surfing*, a form of browsing behaviour that lacks a specific purpose; and information *encountering*, a more passive approach to information seeking in which a person serendipitously or casually comes across information (Erdelez, 1999; Fidel, 2012). Human activities in search also consist of a host of information behaviours such as querying, scanning, reading, and using information (Marchionini, 2006).

Search systems are designed to offload parts of the information-seeking process by performing information-seeking support activities, such as content indexing, query processing, query matching, and displaying results (Feldman, 2012). The goal of search is to help searchers find information quickly by mediating the dialogue between the human user and the machine. In the case of web search engines, humans enter search terms into a search box and the system responds by listing a set of webpages for human searchers to scan on a search engine results page (SERP). SERPs are designed to connect searchers to information immediately by chunking information into scannable segments. Results are ranked and displayed based on a statistical algorithm that determines the relevancy of a piece of information based on many factors, including the frequency of query terms on a page, recency, and the popularity of a web page (M. J. Bates, 2012; Brin & Page, 1998; Kong & Allan, 2013). Web search engine companies such as Google [https://www.google.com], Bing [https://www.bing.com], and DuckDuckGo [https://duckduckgo.com] make explicit choices when creating the algorithms, effectively deciding what is important based on web content (e.g., frequency of words), the link structure of the web, and human interaction data (e.g., queries, search history) in order to rank and retrieve information (Balog, 2018; Devezas, 2020; Lu et al., 2020).

The emphasis on matching query terms to answers suggests search systems are running into similar criticism as traditional education models: spoon-feeding disjointed facts to learners. Search systems were designed with retrieval—not learning—in mind, but as the demand for lifelong learning persists and the most convenient open-access source for digital information is the internet, individuals will continue to seek learning materials using web search engines (C. L. Smith & Rieh, 2019, 2020). The next section explores how SAL researchers incorporated learning when using search engines to find, evaluate, and use online information.

Learning Theory in SAL

The use of learning theory in SAL plays an important role in research into and understanding and designing of search systems for learning purposes. SAL researchers draw from a variety of theories, models, and frameworks to describe or explain learning using search. The bulk of this work is framed using pedagogical instructional theories, namely constructivism or cognitive constructivism, which assert that humans actively construct knowledge in a process led and directed by a teacher. The assumption that a human or algorithm mediates the learning process by organizing topics, activities, and tasks ignores a fundamental aspect of learning: agency. Agency exists in the limited sense of, for example, choosing between three essay topics, as well as in the broader sense, wherein learners choose their subject matter, activities, and tasks. Limiting understanding of SAL to just one lens and one context affects what constructs are measured and how outcomes are framed within information and learning science communities. Investigating studies with a heutagogical or self-determined learning lens means creating an inclusive area of study that respects the processes, needs, and contexts of varied learning populations. The next section addresses constructivism and its application in search models.

Constructivists posit that people actively work to construct knowledge based on their previous experiences and beliefs about the world (Karagiorgi & Symeou, 2005). Whereas variations stem from research on constructivism (e.g., radical constructivism, a sense-making theory based on personal knowing), the basic premise remains that knowledge can be formed through individual and social processes (Karagiorgi & Symeou, 2005). In the context of education, constructivism is often discussed in terms of instructional methods or teaching practices. Its aim is to move teachers away from lecture-based models and toward active, learner-centred models where the instructor's role is to facilitate knowledge discovery (Feden, 1994; Karagiorgi & Symeou, 2005). Facilitation occurs through the selection of activities, environment, related objects, and content that are placed in the context of a meaningful learning goal (Feden, 1994; Karagiorgi & Symeou, 2005). Modern constructivist ideas build upon past ideas of reflective thinking (Dewey, 1910), individualism and sociality during the learning process (Vygotsky, 1962), and cognitive support structures to increase individual learning gains (Bruner, 1976; Wood et al., 1976).

Whereas constructivism focuses on the social nature of learning (i.e., with people), cognitivism (a form of constructivism) occurs within the individual (i.e., within the self). Cognitive constructivism is a mentally active process that builds upon prior knowledge in learning. Originally attributed to developmental psychologist Jean Piaget (Von Glasersfeld, 1982), cognitivism is concerned with what happens in an individual's mind and often focuses on unobservable constructs, such as memory (Greeno et al., 1996). Memory is particularly important in this theoretical framework as it serves to create the building blocks of understanding (Oakley et al., 2018) through the processes of encoding, error detection, and continued practice (Lane, 2012). Cognitive models of learning overlap with constructs such as metacognition (i.e., thinking about thinking) as learners regulate their cognitive processes during learning (Lane, 2012).

Cognitive-constructivist definitions of learning using search state that "searching is reconceptualised as a learning process best measured in terms of conceptual changes in existing knowledge structure and beliefs, as well as the outcomes for search tasks" (Rieh et al., 2016, p. 31). Kopak et al (2010) support this perspective and assert that "as people move through information, they are actively constructing meaning and make use of both explicit and implicit features of the information itself as guides in this process" (Kopak et al., 2010, p. 359). Inherent in both statements is the idea that learning is a process through which individuals make sense of or construct knowledge from the information they encounter online.

SAL models are rooted in learning theories and frameworks with most of the evidence-based theoretical work centering on Kuhlthau's (1991, 1993) constructivist perspective of the information-seeking process. More recent SAL models draw from an educational psychology perspective and may use either Bloom's taxonomy or blend multiple theories. This section discusses three selected SAL models representative of the current SAL research landscape: information-seeking process model (Kuhlthau, 1991), exploratory search (Marchionini, 2006), and comprehensive search (Rieh et al., 2016).

Constructivism and the Information-Seeking Process Model

Information scientists borrow from both constructivist and psychological theories of learning to understand the information-gathering process. Kuhlthau (1991) conducted five studies that investigated the process of information seeking across both classroom and library environments, creating a six-stage information-seeking process model. The six-stage model begins at initiation when "a person first becomes aware of a lack of knowledge or understanding" (Kuhlthau, 1991, p. 366). During this phase people generally feel uncertain or experience some degree of apprehension. The second stage is selection and marks when the general topic is chosen; this decision often coincides with feelings of optimism and readiness. The third stage, exploration, occurs when people begin to extend their knowledge on a given topic but also reengage with their previous feelings of confusion, uncertainty, and doubt about their research process. The fourth stage is formulation, when the idea solidifies, and feelings of uncertainty diminish. The fifth stage, collection, involves a person gathering the needed information with increased efficiencies between the user and the system. Finally, the sixth stage, presentation, concludes the research. Although Kuhlthau (1993) did not explicitly describe what presentation entails, they did say that it results in a "personalised understanding of the problem"

(p. 344). This final stage often coincides with either feelings of satisfaction (if the search had gone well) or disappointment (if the work did not culminate in a satisfactory product; Kuhlthau, 1991)

Subsequently, Kuhlthau (1993) incorporated instructional theory into the information-seeking process model, drawing upon Jerome Bruner's phases of interpretation and John Dewey's phases of reflection (as cited in Kuhlthau, 1993). Kuhlthau selected these theorists because they used a hypothesis-driven process that exemplified the process Kuhlthau discovered through studies of academic information seeking. Kuhlthau's argument was that information seeking is often portrayed as a linear and objective process, rather than an interleaved process that combines cognition, affect, and action. Kuhlthau argued that information seeking begins with uncertainty, defined as "a cognitive state which commonly causes affective symptoms of anxiety and lack of confidence" (Kuhlthau, 1993, p. 347). Affective symptoms can often significantly alter cognition (Pekrun & Linnenbrink-Garcia, 2012). Kuhlthau et al. (2015) later evolved the information-seeking process model into a generalised guided-inquiry model used to provide scaffolds (or learning aids) for K–12 instruction during the research process. Kuhlthau's work played an important role in determining the future of SAL, as the use of the constructivist lens expanded the scope of research within the domain to include "the totality [of] what a person knows, that is, a personal knowledge or belief system" (Vakkari, 2016, p. 8).

Bloom's Taxonomy and Exploratory Search

Although Kuhlthau (1991, 1993) incorporated several constructivist theories of learning into an information-seeking process, other researchers borrow from frameworks used in educational psychology, such as Bloom's taxonomy.

Bloom's taxonomy is a common cognitive framework used by SAL researchers that organises learning stages based on the concept of mastery learning (Krathwohl, 2002). Mastery learning describes how learners proceed through stages of learning from beginner to advanced (Pintrich, 2003). Bloom's taxonomy contains two dimensions: cognitive and knowledge.

The cognitive dimension includes remember, understand, apply, analyse, evaluate, and create. *Remember* is the ability to recognise and recall terms and content used in a specific domain. *Understand* refers to the ability to extract meaning from content, which includes activities such as interpreting, exemplifying, classifying, and explaining. *Apply* is the ability to carry out a procedure in a situation or context. For example, a student who knows the appropriate steps to take to carry out a research project is likely to have a successful project at its conclusion. *Analyse* is the ability to break down material into its parts, which involves activities such as organizing content into conceptual maps and differentiating between items. *Evaluate* is the ability to assess something based on established criteria and involves activities such as critiquing. Finally, *create* is the ability to pull together disparate elements and put them into a new form, and includes activities such as planning and producing (Krathwohl, 2002). For example, a journalist may pull together many sources including statistics and interviews to drive a narrative for a late-breaking story.

The knowledge dimensions consist of four types: factual, conceptual, procedural, and metacognitive, and were created because cognitive processes have different levels of complexity. *Factual* knowledge is the basic elements (e.g., terms) one must know in a discipline. For example, a veterinarian would need to understand the anatomy of several animals. *Conceptual* knowledge is the relationships between those elements and how they fit into the broader structure (e.g., theories). For example, the same veterinarian would need to understand how cancer manifests in different animals. *Procedural* knowledge describes the skills used to perform an activity. For example, a veterinarian would need to know how to treat cancer in an animal. *Metacognitive* knowledge “involves knowledge about cognition in general as well as awareness of and knowledge about one’s own cognition.” (Krathwohl, 2002, p. 214). For example, in studying for an exam, a student would first need to understand what kinds of questions (e.g., essay, multiple choice) are on the exam to devise an approach to studying.

A well-known model that incorporates Bloom’s taxonomy was developed by Marchionini in 2006. They created a conceptual model using a task-based approach that differentiated types of searches using Bloom’s taxonomy. The model contains two types of searches: lookup and exploratory. Lookup searches assume the searcher is seeking facts, related to the remember category of Bloom’s taxonomy. Exploratory searches, on the other hand, encompass the understand, apply, analyse, and evaluate categories of Bloom’s taxonomy. Exploratory searches contain two different kinds of search intents: learning and investigative. *Learning* searches use the understand and apply dimensions because searchers are looking for information to compare and must understand the relationship between items. *Investigative* searches are complex and encompass analyse and evaluate because the searchers’ intent is to synthesise, evaluate, or analyse the information found. Exploratory searches are different from fact-finding searches because they occur within “an information-seeking problem context that is open-ended, persistent and multifaceted” (White & Roth, 2009, p. 6), and search activities tend to occur over longer periods of time (Marchionini, 2006; White & Roth, 2009).

Marchionini’s (2006) model is a task-based approach to searching that sparked several studies exploring how different cognitive levels of search tasks influence learning. Search tasks are “goal-directed activities carried out using search systems” (Wildemuth et al., 2014, p. 1119).

Marchionini's model has been used intentionally by some researchers who have used all six levels of Bloom's taxonomy to understand the relationship between cognitive levels of learning and search behaviours (e.g., Jansen et al., 2009). However, not all studies are intentional about the use of Bloom's taxonomy in Marchionini's framework. Moraes et al. (2017) compared learning using search systems to instructor-designed artefacts (e.g., lecture video) to determine whether search is an effective learning strategy. The authors described the search process using Marchionini's exploratory search model and measured learning gains using a recall-based assessment (i.e., vocabulary knowledge scale test) to calculate learning gains. However, the authors admitted the lower-order task defined by Bloom's taxonomy was unintentional and therefore cited Marchionini's model without fully using it to designate or identify search tasks (Moraes et al., 2017). The majority of authors cite Marchionini to frame the context of SAL, yet explore fundamentally different aspects, such as collaboration (Knight et al., 2017) and the measurement of learning (Collins-Thompson et al., 2016; M. J. Wilson & Wilson, 2013). Furthermore, SAL research has limited the use of Bloom's taxonomy to its cognitive dimensions with little attention paid to the knowledge dimensions (except Collins-Thompson et al., 2016), which includes metacognition.

Blending Theories with the Comprehensive Search Model

Rieh et al. (2016) argued that Marchionini's (2006) task-based approach emphasised the search process at the expense of the learning process. In response, they proposed a cognitive-constructivist model for SAL called comprehensive search. They framed the search process using a constructivist lens and claimed comprehensive search "reflects iterative, reflective, and integrative search sessions that supports critical learning" (Rieh et al., 2016, p. 19). The model draws from Bloom's taxonomy, an educational psychology framework, and is demarcated by three types of learning: receptive, critical, and creative learning. *Receptive* learning is akin to Marchionini's look-up search activities, which represent the lower levels of Bloom's taxonomy. *Critical* learning is aimed at modifying or extending the way one thinks about one's viewpoints and includes activities such as reviewing, criticizing, and evaluating ideas. *Creative* learning is about taking what is understood and generating new ideas. This model makes a shift toward a process of learning in which information is acquired through diverse perspectives and emphasises critical thought. The advantage of this model is that it maps learning and search behaviours in a way that makes it feasible to understand how learners navigate online search environments. Like Kuhlthau's (1991) information-seeking process, this model has been used to describe learning using search but has not yet been empirically validated. Other researchers agreed with the premise of this model and claimed that SAL needs a broader literacy framework to generate a bigger picture of the scope of learning using search (Frerejean et al., 2019; Koesten et al., 2016; Reynolds & Hansen, 2018).

Reflecting on Self-Directed Learning and SAL

Investigating SAL through the lens of a new learning paradigm may shift attention to research areas of search that have been overlooked. Self-determined learning emphasises learner agency, which implies that learners have control over what, when, and how they learn. As more people turn to web search engines to adapt to the ever-changing information landscape, more attention needs to be paid to informal learning contexts and the needs of learners in such contexts.

SAL pioneers have articulated an opportunity to use search as a tool in support of learning. However, they have not fully acknowledged the shifting landscape of learning theory. Although there is some research pertaining to the concepts described in self-determined learning (e.g., metacognition), SAL study designs lack alignment with the broader self-determined learning paradigm. This lack of alignment is elaborated on in this section with respect to the design of studies to investigate SAL.

The majority of SAL studies recruit from student populations (Brandt et al., 2009; Chen et al., 2020; Collins-Thompson et al., 2016; Jansen et al., 2009; Knight et al., 2017; Moraes et al., 2017; Pardi et al., 2020; M. J. Wilson & Wilson, 2013). Self-determined learning is an inclusive theory of learning that addresses many different learning populations. The reliance upon student populations in SAL studies is a limitation when the research goals and aims are not specific to a university setting (O'Brien et al., 2017). Such study populations have been given the label WEIRD (Western, educated, industrialised, rich, democratic) and identified as "among the least representative populations one could find for generalizing about humans" (Henrich et al., 2010, p. 61). Therefore, findings with large population samples are not generalizable to other populations and contexts of learning. There is a need and opportunity to expand investigations outside of the student populations.

SAL studies are often conducted in a lab and typically assess learning in shorter durations (e.g., 30 minutes). Although models of SAL incorporate the concept of iterative searches or repeated interactions with a topic over time, most SAL studies are designed as short-term experimental studies. The convenience factor of studying learning in a single session is useful for quantifying search behaviour and measuring associations between search and learning processes and outcomes but lacks the authenticity of naturally occurring learning.

Experimental studies are commonly used in SAL studies, using assigned information-seeking tasks on specific topics. Information-seeking tasks "focus on the satisfaction of an entire information need" (Byström & Hansen, 2005, p. 1057), which is defined as "an act to determine how to handle the information requirements for the task at hand" (Byström & Hansen, 2005, p. 1056). In user studies, information-seeking tasks are commonly characterised by the degree to which the task reflects the real world and are labelled assigned, simulated, and natural (see Figure 4; Vakkari, 2005).

Figure 4

Information-Seeking Task Types

The most common tasks in SAL studies are *assigned tasks*, which are defined as tasks that are predefined by someone else and do not necessarily "reflect the information needs of the searchers" (Vakkari, 2005, p. 421). Assigned tasks have been used to capture prosocial or behavioural data from everyday information-seeking tasks (Jansen et al., 2009; Knight et al., 2017; Yu et al., 2018) and learning gains from search tasks (Moraes et al., 2017; O'Brien et al., 2020, 2022). Assigned tasks commonly use formalised questions or problems as part of their creation but may not necessarily align with participants' actual information needs. For working learners, assigned tasks may be delegated tasks or an imposed query, in which one person takes on the goals of another, such as a manager asking an employee to learn about conducting focus groups.

Simulated tasks are predefined tasks, but contain "short textual descriptions tailored to suit the test participants by presenting a realistic situation that motivates the test participant to search the [information retrieval] IR system" (Borlund, 2003, p. 313). For example, if a researcher was designing a study investigating information behaviour patterns of working learners, the researcher might first investigate which tasks best simulate the real-life information needs of their population sample and create the study tasks accordingly. The difference between assigned and simulated tasks is the degree to which the tasks are targeted at a specific group of people and how much research has been done beforehand to understand the population's information needs and tasks (Borlund & Bogers, 2018). Borlund's (2016) framework for simulated work task situations is frequently used in SAL studies. For example, Brandt et al. (2009) wrote a simulated task asking computer scientists to build a web chat application while monitoring their search queries and resources. M. J. Wilson and Wilson (2013) used a topic-based approach asking participants to search for general life (e.g., buying a dog), product (e.g., ebook readers) or technical (e.g., antivirus software) information. Collins-Thompson et al (2016) used the same topic-based approach and asked students to choose between writing a term paper about oil spill clean-up or government open data policies. Chi (2021) wanted to understand the behavioural differences between searching for severe or mild medical conditions and created health information-seeking tasks using a sample of lay people (Chi, 2021).

The degree of reality of tasks in a lab setting is an interesting dilemma as it is difficult to create tasks that span the breadth of human pursuits. Although processes and steps are in place to enhance the ecological validity of tasks, advocates for natural tasks in research recommend early analyses of real-world information needs to inform the design of tasks (Borlund & Bogers, 2018). The benefit of simulated tasks is that they allow for more control over the tasks, making it easier to analyse and compare data across participants.

Natural tasks are initiated by and reflect the real-life information needs of a person (Vakkari, 2005). For example, working learners may decide to upskill and self-select to learn a new research method to advance in their careers. The degree of agency is high for the participants, but it is difficult to compare their search outcomes with other learners. The best example of a natural task used in information-seeking studies is by Hert (1996). They stopped library patrons as they entered the library and asked them to participate in a research study. Participants were led to a separate room to search while the researchers recorded their search queries for analysis (Hert, 1996). Not all natural search tasks are self-determined, however. Vakkari (2005) classified a classroom assignment as a natural task because the learners had a choice in what they were going to research, opening an interesting debate about the degree of realness of a task, and whose reality learners are opting into.

Self-determined learning proponents recommend that learners choose their own tasks, which is at the more extreme end of the task continuum (see Figure 4). And although working learners may experience a broad range of control over their tasks (e.g., manager-assigned versus self-selected), the choice of resources, strategies, and outcomes are largely up to the individual. Studies that aim to address everyday information seeking or want to understand learning outside of formal academic settings would benefit from performing additional research to better match the information-seeking task to the participant groups' actual information needs or choosing research methods that better enable the analysis of natural tasks.

SAL studies also often look at products of learning (e.g., essays) and use external assessments, such as multiple choice (e.g., Moraes et al., 2017), true and false questions (Gadiraju et al., 2018), or written summaries (e.g., Collins-Thompson et al., 2016; O'Brien et al., 2020, 2022; M. J. Wilson & Wilson, 2013) to measure learning. Written summaries align with a constructivist approach to teaching and learning, but when applied in a single lab experiment, this approach assesses only a single output resulting from short-term learning and is not necessarily indicative of a substantive change to the learner's underlying values or knowledge—a common definition of learning (De Houwer et al., 2013). Additionally, the subjective nature of assessment places control in the hands of the evaluator, who may have expert-level knowledge of a domain and impose a degree of correctness and certainty to information. The assessor may not understand a learner's goals in that moment, nor have a full grasp of the sources used by a searcher to formulate these learning expressions. For example, a novice learner, when confronted with a new topic area using a credible database in a single experimental session, may be satisfied with information found early on in the process (White & Roth, 2009), which may represent the learner's approach to that particular problem on that particular day.

In summary, SAL studies often recruit from student populations, typically use short-term experiments with assigned tasks, and focus on the products or outcomes of learning. Although these insights are valuable, the study outcomes only represent learning in the context of institutionalised and formal environments. This investigation acknowledges the value of all research contributions and seeks to extend the ideas currently represented in SAL in a new context, acknowledging the variety of contexts for learning that may benefit from having a different lens applied. This dissertation study examines one potential factor present in a self-determined view of learning using search: self-efficacy (Bandura, 1977).

2.4 Self-Efficacy in SAL

Self-efficacy influences the way one performs in both learning and search (Daniel, 2014). Difficult learning situations often require a degree of self-confidence in one's own ability to produce desired outcomes (Bandura, 1977). For search to be an entry point and a part of the process of learning, self-efficacy with regards to searcher's information literacy needs attention. Kurbanoglu and colleagues (2006) define information literacy as

> The abilities to recognise when information is needed and then to initiate search strategies designed to locate the needed information. It includes evaluating, synthesizing,

and using information appropriately, ethically, and legally once it is accessed from any media, including electronic or print sources. (p. 730)

A self-determined learner has a degree of confidence in their information-seeking ability. Hee et al. (2019) discovered that information literacy self-efficacy can predict persistence in learning throughout the lifespan. They advocated for continuous education on information self-efficacy (Hee et al., 2019). But how can search systems support this perspective? This section explores the four processes in the self-efficacy framework within the context of search.

Motivational processes relate to the effort put into an activity and are dependent on one's beliefs about the self (Bandura, 1994). Different kinds of search self-concepts are dependent on levels of search experience and perceptions of search technologies. For example, a "scattered searcher" is disorganised and unfamiliar with the technology; a "settling searcher" will stick to the same resources and strategies and become overly reliant on technology to find information; a "shrewd searcher" will engage in several strategies and resources and use feedback from the search system to persist in information seeking (Willson & Given, 2014).

Affective processes involve the ability to regulate emotion (Bandura, 1994). Self-efficacy in information seeking is largely influenced by negative emotions, such as uncertainty and anxiety, which are common during the information-seeking process (Kuhlthau, 1991). People with a strong sense of self-efficacy can often persist in an activity (Bandura, 1994); however, the development of self-efficacy in the first place is challenging in information environments. Students with a strong sense of generalised self-efficacy often begin their information-seeking journey by asking other people (rather than online sources) for help (Williams & Kim, 2012). This may point to a degree of confusion that occurs when interacting with information and systems. From an informational perspective, emotions like confusion over contradictions within the text are beneficial to the learning process (D'Mello et al., 2014), but confusion about how to use the search system itself is not necessarily beneficial to the learning process.

Cognitive processes involve the acquisition, organization, and use of information. Learning searches are thought to be initiated by an information need, problem, or goal (Pirolli & Card, 1999; Savolainen, 2018; Taylor, 1962). Search models (e.g., exploratory search) drawn from learning models and frameworks (e.g., Bloom's taxonomy) emphasise the process of search, whereas other models acknowledge the importance of the entire information-seeking process when conceptualizing search as a learning process (Kuhlthau, 1991; Marchionini, 2006; Rieh et al., 2016). Research interest in the cognitive aspects of search is prevalent because the act of searching involves a high degree of information processing when formulating a search query (Gwizdka, 2010), suggesting two areas of support: the first when a person initially generates a search query and the second when a learner moves through the SAL process.

Selection (environmental factors) in the context of search is the choice of content and search systems. Search can be challenging because although search functionality is a common feature of user interfaces in a range of systems, search functions and syntax differ between search tools (e.g., Evernote vs. an academic library discovery system). The easy-to-use interface of web search engines creates a false belief that a person is a capable searcher, which may lead to complacent behaviours after searchers have found sufficient information (Elsweiler et al., 2011; Simon, 1956) or when search algorithms created the illusion of expertise (Agosti et al., 2010; Feldman, 2012). This is corroborated by findings that people have a higher degree of self-efficacy in web search than in academic digital library searches (Rieh et al., 2012). Although many library search systems now contain a single search box like that of a web search engine, content is organised using defined taxonomies, and advanced search features and filters (e.g., Boolean operators) may be needed for searches (Rasmussen, 1999). Complex search interfaces that require different skill sets may be perceived as emotionally overwhelming, complex, and difficult to use (Rieh et al., 2012), which may lower a person's self-efficacy when searching.

2.5 Study Rationale

SAL is a research agenda directed at the learning that occurs when people use digital search systems and tools. SAL has been influenced largely by instructional theories rooted in constructivism and cognitive frameworks in educational psychology (Kuhlthau, 1991; Marchionini, 2006; Rieh et al., 2016; Vakkari, 2016; White & Roth, 2009). In this dissertation, search is viewed as a digital learning tool that connects learners to information and supports human agency in learning; learners can choose what, when, and how to learn. However, current search systems neglect the varieties of human intents behind the use of search, such as learning, and constrain the learning potential of the systems.

Although various types of search systems (e.g., web search engines, digital libraries) are included in SAL investigations, SAL studies are primarily designed with a focus on formal approaches to learning (e.g., classrooms) and a reliance on experimental studies to understand the process of learning (Brandt et al., 2009; Chi, 2021; Collins-Thompson et al., 2016; Moraes et al., 2017; O'Brien et al., 2020; M. J. Wilson & Wilson, 2013; Yu et al., 2018). This means that samples are usually selected from student populations who are given predefined tasks (Brandt et al., 2009; Chen et al., 2020; Collins-Thompson et al., 2016; Jansen et al., 2009; Knight et al., 2017; Moraes et al., 2017; Pardi et al., 2020; M. J. Wilson & Wilson, 2013), and that learning assessments tend to rely on observations, expert reviews of written summaries, or recall and recognition tests (Collins-Thompson et al., 2016; Gadiraju et al., 2018; Moraes et al., 2017; O'Brien et al., 2020, 2022; Urgo & Arguello, 2022; M. J. Wilson & Wilson, 2013). Additionally, the concepts and constructs of interest tend to follow the norms and expectations associated with formal education; these do not extend to a heutagogical learning paradigm, which may be better suited to working learners.

By applying the lens of self-determined learning to the field of SAL, study designs shift beyond lab experiments to real-life methods held in high regard because of the causal relationships one can analyse (Braun & Clarke, 2021). The objective is not to exclude experiments from the suite of methods, rather to suggest more alignment to the paradigm, methods, and research questions. If learning changes over time (De Houwer et al., 2013), then to study learning is to acknowledge duration as a key factor in study design. What one learns after 15 minutes is going to be different than what one learns in a week, a month, or a year.

The population sample is also an important factor; the people of interest are important for situating the work. Focusing on students is beneficial for school-related research questions, but it is not representative of the learning experience of adults in general. This study targeted working adults belonging to a shared discipline, UX. UX professionals were selected for two reasons: (a) job demand, and (b) discipline diversity. UX professionals are in high demand. As of July 15, 2022, LinkedIn reported a total of 480,458 open positions with the title “user experience” worldwide, with 15,021 open positions in Canada alone. This is nearly two times what was reported by LinkedIn 2 years prior. On December 15, 2020, LinkedIn reported 229,537 open positions worldwide with the title “user experience”: with 7,397 open positions in Canada. The growing demand for UX professionals is enhanced and complicated by its diversity of disciplines. A 2019 survey of 693 UX professionals found that just over 80 percent of the workforce currently holds a bachelor’s degree in the field of design (e.g., graphic design; Rosala & Krause, 2019). However, between 60% and 95% of the UX workforce do not have an education related to UX (Inal et al., 2020; Rosala & Krause, 2019). The majority of UX professionals (59%) use online courses as the primary form of education (Rosala & Krause, 2019), which may be in response to the everchanging nature of the UX role. Kikin-Gil (2020) states,

> The role of designers is changing, there is no doubt. It will become more about their ability to define the problem to solve; how should they solve it; consider the broad implications on society, people, and the environment; and to learn how to control the machines with their words. (p. 1)

This shift in the role of UX designers means that they need to learn new research methods that extend beyond usability testing and interviews (Young, 2020). The breadth and depth of information and skills UX professionals need throughout their career may indicate a continuous learning cycle for this profession. Although less than 32% of UX professionals participated in formal UX communities in 2019 (Inal et al., 2020), there may be growing interest in the formation of informal groups that emerge through digital community tools, such as Slack.

Education is rapidly shifting and placing deeper emphasis on learning processes. Proponents of self-determined learning posit that creativity, collaboration, positive values, self-efficacy, and metacognition will equip humans with the necessary skills for coping with an uncertain and changing future; it offers learners more agency in the selection of learning tasks, topics, and processes, and supports self-assessment (Blaschke, 2021; Blum, 2016, 2020; Code, 2020; Fadel et al., 2015; Hase & Kenyon, 2000). However, the self-determined learning framework has been understudied in the online searching space, with some exceptions (Blaschke, 2018, 2021) since it originated in 2000.

Learning using search is an autonomous process by which people select, structure, manipulate, and combine information using a search engine for queries and making use of information found online (Vakkari, 2016). The learning process requires knowledge of how to use search systems: A searcher needs to break information down into its conceptual parts, typically by formulating a query and entering it into a search system, and select and use appropriate information sources (Kuhlthau, 1991; Rieh et al., 2016). SAL also requires knowledge of learning processes: Searchers may need to engage in metacognitive strategies such as reflection (e.g., revisiting the process), help-seeking (e.g., asking for assistance), and self-monitoring processes (e.g., creating and using checklists) to support their understanding of information and develop deeper learning practices (Gorrell et al., 2009; Toma, 2017).

This dissertation is interested in self-efficacy, which is congruent with a self-determined learning perspective and may be useful when exploring autonomous learning processes, such as when people learn using search. Early evidence suggests that self-efficacy predicts the continued use of online learning platforms (Panigrahi et al., 2018), but when a person learns using search they lack the metacognitive monitoring supports (e.g., scheduled tasks) that are often present in structured online and in-person learning environments. Search experiences can interfere with a person's self-efficacy when looking for information (Rieh et al., 2012), and regardless of time spent searching, people do not naturally improve their search skill without some form of search intervention or training (Hsieh-Yee, 1993; Vakkari et al., 2003; Wildemuth, 2004). However, it is thought that metacognition and reflective thinking can overcome deficiencies in both search and domain expertise (Land & Greene, 2000).

As researchers, educators, and employers move toward the future of learning, particularly across the lifespan, it is critical to investigate ways to develop deeper learning practices that further develop learners' creative and critical thinking abilities.

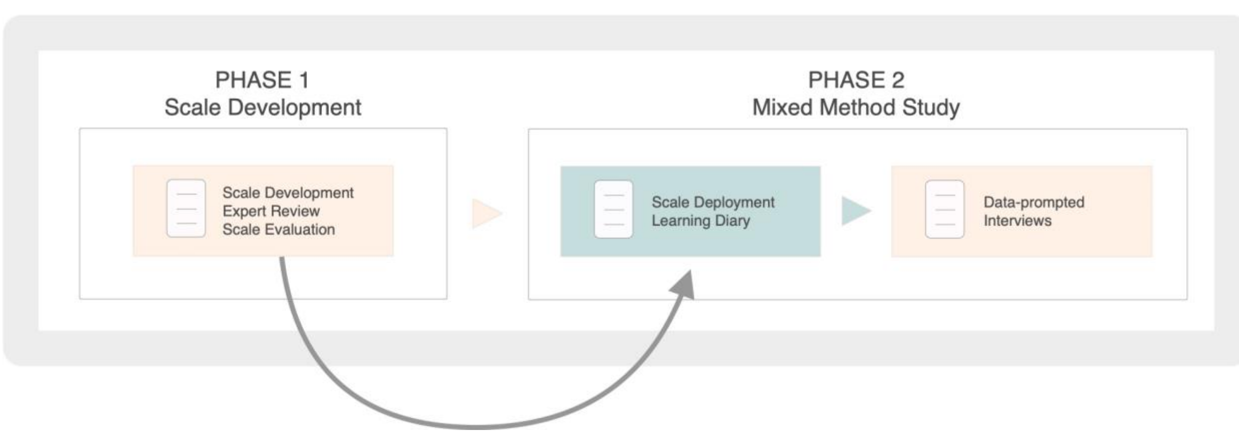
Chapter 3: Methodology

This chapter outlines the methodology used in this dissertation. A pragmatic approach that "is concerned with the issue of how knowledge is created" (Goldkuhl, 2012, p. 141) was taken. This form of pragmatism does not take an a priori position on methods; rather, methodological choices are decided upon according to the purpose of the research. The researcher observes and explores others' actions to see what is successful and could be applied in practice (Goldkuhl, 2012). The methodological choices were based on the applied heutagogical lens of self-determined learning that recognises individual agency in learning and uses self-reported measures of learning. The complexity inherent in the abstract nature of self-efficacy suggests that multiple methods are needed to fully understand a working adult's experience of self-efficacy when learning using search. This is supported by others who advocate for the inclusion of multiple methods in information studies (Fourie & Julien, 2019).

The research program has two interrelated phases: Phase 1, self-efficacy scale development and evaluation, and Phase 2, a mixed-methods diary study with data-prompted interviews (see Figure 5).

Figure 5

Research Program



The objective of the measuring and evaluating self-efficacy phase was to create and review a measure of self-efficacy in the context of SAL to support the objectives of the diary study. I used the scale development process (see Section 3.2) outlined by DeVellis (2017) and drew upon best practices outlined by McCay-Peet (2013) and O'Brien (2008). The purpose of this phase was to assess a proposed scale with experts prior to implementing it in the diary study. Additional scale-evaluation work took place with participants of the diary study.

The objective of Phase 2, the mixed-method study, was to understand what changes occur in the self-efficacious experiences of working adults when learning using web search engines. The second phase of the research program took a mixed-methods research approach (see Section 3.3). Mixed methods "collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry" (Tashakkori & Creswell, 2007, p. 4). The mixed-methods approach has evolved significantly since its inception in the 1980s and now addresses the growing need for more complete analysis of complex problems and phenomena (Creswell & Clark, 2017). The purpose of this phase of the study program is to understand how working adults document and describe their self-efficacious experiences when learning using search.

3.1 Positionality

As the researcher-author, I designed, conducted, and analysed both phases of the study with support and guidance from my advisory committee. As a nontraditional student, I bring with me a pragmatic learner-centred lens within the context of my educational experiences, including informal communities of practice, corporate training, community college, teaching-focused universities, and research-focused universities. My background as a program manager in software and consulting informed my interest in and understanding of working learners—I wanted to understand how to design tools that create and sustain positive lifelong learning behaviours and mindsets. I brought with me the assumption that learning is an independent process; I once considered it purely cognitive and attributed any struggles I experienced to a lack of capability—my capability. Throughout my investigation into self-determined learning and the writing of this dissertation, I developed a broader understanding of the impact of the social world on the learning process. I embedded myself in UX communities by taking industry-led courses and participating in UX research studies. During my research process, when I spoke with my participants and analysed the data in a reflexive way, I found myself reframing my ideas about the importance of relationships in our respective communities. I previously experienced gratitude for intellectual contributions to my personal growth and development, but I was profoundly moved by socioemotional themes that I identified in the data, such as unconditional regard. This research project became more than understanding SAL—it became about the human experience of learning that honours the social practices and environments that are so important to solving problems. As a researcher I hope to further investigate the social influences on information seeking. As a mentor I strive to use the findings from this dissertation in my practice: to work on developing a sense of confidence in others (as well as myself), to listen as best I can, and to work consciously on themes I identified in the research data that have a potential impact on self-efficacy.

3.2 Phase 1: Developing and Evaluating a Measure of Self-Efficacy

Self-determined learning theory advocates for human agency in the learning process and is interested in the development of each individual learner. Self-efficacy plays an important role in learning, as self-efficacy not only influences learning outcomes, but is also mediated by metacognitive scaffolding in the form of prompts or instructions (Gentner & Seufert, 2020; Moos

& Azevedo, 2008, 2009b; Müller & Seufert, 2018; Zepeda et al., 2015). Self-efficacy is domain specific and measures should be created for each context and reflect respondents' judgement of capability (Bandura, 2006). Self-efficacy is different from measures of self-esteem or locus of control wherein self-esteem is a judgement of self-worth and locus of control refers to one's belief about the active role one takes (or does not take) in producing specific outcomes (Bandura, 2006).

Existing information-seeking self-efficacy scales are skills-based, focusing on a searcher's knowledge of search systems or information literacy skills. Two self-efficacy scales are of particular interest to SAL: Search Ability (SA, Bailey, 2017) and Information Literacy Self-Efficacy (ILSE, Kurbanoglu et al., 2006).

The purpose of measuring search ability is to develop better support tools for searchers of varying degrees of expertise. One approach to investigating search ability is to explore self-efficacy in the context of search (Kelly, 2010). Search self-efficacy has been defined as one's confidence in one's ability to find information using digital search systems. Kelly (2010) argued that (a) there were few rigorously created self-efficacy instruments designed to measure search expertise, and (b) the instruments that were validated were outdated. Using a 21-item electronic Search Self-efficacy scale by Debowski and colleagues (2001) as a foundation, Kelly recruited three graduate students during a research seminar on Interactive Information Retrieval to work on revising Debowski et al.'s scale. This resulted in a 14-item numeric rating scale that asked participants to self-report, "how confident they were that they could execute the tasks described by the items" (Kelly, 2010, p. 3). The items in the scale were specifically framed as classic information-seeking tasks. For example, one item asked participants to rate their confidence in the task, "Identify the major requirements of the search from the initial statement of the topic."

The scale was piloted with university students (*N* = 23) and analysed using principal component analysis. The scale was found to lack sensitivity in distinguishing respondents' search ability in part due to the low population sample and the lack of difficulty of some of the original items.

In 2016, Brennan and colleagues (2016) wanted to understand whether the revised Search Self-Efficacy scale could detect variation in search ability and pooled eight studies to create a sample large enough (*N* = 327) for factor analysis. The study concluded that the scale was not yet sensitive enough to detect differences in search expertise (Brennan et al., 2016). Bailey and Kelly (2016) extended the work on search self-efficacy, using a combination of interviews and focus groups and found personality characteristics such as persistence, flexibility, curiosity, adaptability, and humility may also influence search expertise. A subsequent dissertation that included additional consultations with search experts (i.e., cognitive interviews) as well as a preliminary test with 837 participants showed that, although personality characteristics were inconclusive, prior experience, self-reported search ability, and search skill may be more stable proxies for measuring search self-efficacy (Bailey, 2017). The contribution of this work pointed to the skills and capabilities needed to effectively search for information online. Its limitations being its intended use in measuring search expertise, excluding the full information-seeking process.

The ILSE scale captures a learner's self-efficacy in the information-seeking process when using electronic web, digital library, and print resources (Kurbanoglu et al., 2006). Based on the information seeking literature, the authors derived seven main categories of interest: (a) defining the information need, (b) initiating the search strategy, (c) locating and accessing resources, (d) assessing and comprehending the information, (e) interpreting, synthesizing, and using information, (f) communicating information, and (g) evaluating the product and process

(Kurbanoglu et al., 2006). The individual items were specific to kinds of actions performed during search (e.g., use truncation techniques), similar to the questions developed as part of the SA scale (Bailey, 2017), although Kurbanoglu et al. (2006)were not cited in this work. The ILSE has been validated as a measure of information literacy self-efficacy (Kultawanich et al., 2015; Mahmood, 2017).

Both the SA and the ILSE scales are explicit as to their purposes: SA measures search capabilities and the ILSE measures information-seeking capabilities and search ability. Compared to the SA scale measuring search self-efficacy, the ILSE scale is more specific about the kinds of practices and techniques used in information seeking and searching. However, some questions are outdated and address systems and processes found in formal academic settings (e.g., library catalogues). Some questions in the ILSE need additional refinement; for example, one question is double-barrelled: "Determine the authoritativeness, currentness and reliability of the information sources."

Kelly (2010), Bailey (2017), Brennan and colleagues (2016), and Kurbanoglu and colleagues (2006) considered the information-seeking process, cited Bandura's theory of self-efficacy, and emphasised cognitive processes. However, neither scale explicitly reflects the four psychological processes of self-efficacy. Cognitive, affective, selection, and motivational psychological processes are equally relevant and necessary to understand the multidimensional nature of self-efficacy when learning using search. This creates a need to better understand self-efficacy not only in terms of online searching skills and capabilities, but in understanding the holistic learning experience when using search and how that influences one's perception of capabilities.

Given the limitations of existing measurement scales and the domain-specificity of self-efficacy, this program of research constructed a self-efficacy scale, drawing upon and modifying existing instruments, for the purpose of understanding the changes in self-efficacious processes when working adults learn using search. The purpose of Phase 1 was to develop and test the reliability and validity of a self-efficacy scale (SALSE) for use in the second phase of the research study. I specifically explored reliability, face validity, and construct validity of the SALSE. Reliability is concerned with "how much a variable influences a set of items" (DeVellis, 2017, p. 83). Face validity is concerned with the "the extent to which item content appears relevant to the construct of interest" (DeVellis, 2017, p. 102), and, if performed with appropriate procedures in place, may increase the confidence that the scale items adequately reflect the theoretical constructs. Construct validity is the "theoretical relationship of a variable to other variables" (DeVellis, 2017, p. 94). This section outlines the scale development process, including the expert review study procedures. Details of the expert review study and findings from the administration of the scale with diary study participants are included in Chapter 4.

Constructing the SALSE

Measurement scales are "collections of items combined into a composite score and intended to reveal levels of theoretical variables not readily observable by direct means" (DeVellis, 2017, p. 15). Scales are assessed based on whether the items share a common cause (e.g., sad and joyless) or a common effect (e.g., characteristics that predict voting decisions). DeVellis (2017) outlined eight steps for producing a reliable and valid scale:

1. Understand the domain of interest.
2. Generate an item pool.
3. Select a format of measurement.

4. Review initial item pool with experts.
5. Consider inclusion of validation items.
6. Administer items to a development sample.
7. Evaluate the items.
8. Optimise scale length.

The following sections describe these steps in greater detail as they applied to the creation of the self-efficacy scale used in this dissertation.

Understand the Domain of Interest

The first step in creating the SALSE scale was to understand the domain of interest, or what I wanted to measure. DeVellis (2017) recommended this step to build confidence in a scale by understanding which constructs are important to measure and grounding them in theory where available. This study drew upon the theory of self-efficacy, a highly contextual construct. For example, a person with a strong sense of self-efficacy managing people may have a weak sense of teaching self-efficacy. This means that each context in which self-efficacy is measured needs a unique scale containing the skills and knowledge that are relevant in that context and may not necessarily be transferable to other contexts (Bandura, 2006). The domain specificity of self-efficacy makes it challenging to use preexisting scales; it requires researchers to investigate each activity domain and create new scales that fit their specific context (DeVellis, 2017). Furthermore, self-efficacy should be distinguished from other constructs such as self-esteem, locus of control, or outcomes expectancies. In many cases, self-efficacy scales need to be written in a way that focuses on the difficulties or challenges a person might face in a specific context and be inclusive of all the factors influencing self-efficacy, such as cognition, performance, affect, and environmental conditions (Bandura, 1994, 2006).

To better understand self-efficacy, I conducted an in-depth literature review (see Chapter 2) and an assessment of existing measurement scales. This research focused on the psychological processes identified in Bandura's (1977) theory of self-efficacy: motivation, affect, selection, and cognition (see Table 2). These psychological processes provided a framework through which to examine existing measurement scales, and the degree to which items reflected these processes.

Table 2

Construct Definitions of the Four Psychological Processes of Self-Efficacy

Processes	Definition	Source
Motivational	Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self.	(Bandura, 1994)
Affective	Affective processes regulate emotion. Bandura believed that people who are able to develop controls over their emotional processes, such as feelings of stress and anxiety, are more likely to take bolder steps in life.	(Bandura, 1994)
Cognitive processes	Cognitive processes involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. People are commonly guided by their goals and desired outcomes; the stronger a person's belief is in their capability, the more effort they will devote to a specific cognitive task.	(Bandura, 1989)
Selection processes	Selection processes refer to the choices people make with regards to their environments (e.g., career choices). A stronger sense of self-efficacy is considered to be related to the breadth of options one might consider. It is important to note the bidirectional relationship between learners and their environments. People do, to some extent, choose their environments, but environmental factors also influence self-efficacy. This portion of the scale identifies the search system (environment) as having an impact on a person's search self-efficacy.	(Bandura, 1977, 1994; Rieh et al., 2012)

Generate an Item Pool

The next step involves generating an item pool and choosing which items to include. It is ideal to have 3 to 4 times as many items as needed to allow for flexibility in choosing the final items in the scale (DeVellis, 2017). Items for self-efficacy scales can be selected from many existing scales. The goal of the SALSE scale created for this dissertation was to address the complexity of self-efficacy by measuring all four psychological processes. Five scales were initially selected (Gorrell et al., 2009; Kirk et al., 2008; Kurbanoglu et al., 2006; Midgley et al., 2013; Thomas et al., 2008) because of their alignment to these processes. The aim of including these four processes was to provide a more complete picture of self-efficacy.

Forty-four unique question items were selected from five existing validated self-efficacy scales in varying stages of development (Gorrell et al., 2009; Kirk et al., 2008; Kurbanoglu et al., 2006; Midgley et al., 2013; Thomas et al., 2008): Academic self-efficacy (ASE); Emotional self-efficacy (ESE); Metacognitive Information Likert-based Knowledge (MILK); Self-Efficacy and Metacognition Learning Inventory (SEMLI); and ILSE. One item was presented to the expert reviewers twice; the duplicate question is removed from this analysis. Table 3 provides a summary of the selected scales by aligning the self-efficacious process (“construct”) to the scale names and reliability. Selected scales all have an alpha greater than .7, which indicates moderate to good reliability (DeVellis, 2017).

Table 3

Self-Efficacy Scales Used in the Original Construction of SALSE

Referenced scales	Original *n* of items	Reliability in original study	Source	Self-efficacy processes	*n* items selected for current study
Academic Self-Efficacy (ASE)	5	α = .78	Midgley et al., 2013	Motivation	2
Self-Efficacy and Metacognition Learning Inventory (SEMLI)	30	α = .98	Thomas et al., 2008	Motivation Cognition	4 10
Emotional Self-Efficacy (ESE)	32	Test α = .96 Retest α = .85	Kirk et al., 2008	Affect	5
Metacognitive Information Likert-based Knowledge (MILK)	60	α = .84	Gorrell et al., 2009	Cognition Selection	15 1
Information Literacy Self-Efficacy Scale (ILSE; long form)	28	α = .92	Kurbanoglu et al., 2006	Selection	7
Total	155				44

The ASE is a 5-item scale designed to measure the belief in one's capability to complete schoolwork. It is a unique scale that is part of a larger collection of scales, called the Patterns of Adaptive Learning scales (Midgley et al., 2013). The ASE was selected because it measures beliefs in one's capability in a learning context, and Bandura (1994) discusses motivation and the persistence of effort in additional to beliefs about the self. Three of five items were included in the proposed SALSE scale. Two items were removed due to duplication of items that were drawn from and expanded upon by Thomas and colleagues (2008) discussed below.

The ESE is a 32-item scale that measures a person's emotional self-efficacy across four dimensions: understand, perceive, use, and manage emotions (Kirk et al., 2008); it is conceptually rooted in a model of emotional intelligence (Mayer et al., 2002). Bandura (2003) discussed the role of emotional regulation in learning as a critical psychological process. The proposed dissertation scale drew from the Manage Emotions subscale and focused on five items related to regulating one's emotions; items related to regulating other people's emotions were excluded.

The SEMLI is a 30-item scale that measures a students' metacognition, self-efficacy, constructivist connectivity, learning risk awareness, and control of concentration in the sciences (Thomas et al., 2008). The current study was interested specifically in the Self-Efficacy subscale (six items), which describes motivational processes and emphasises self-concept, and the Monitoring, Evaluation, and Planning subscale (nine items), which contains items pertaining to self-regulated learning. The constructivist connectivity, learning risk awareness, and control of concentration were not included in the SALSE scale due to the specificity of these subscales to science classrooms and focus on learners' challenges with the task or attention. Although interesting, these ideas were considered more behavioural than cognitive, and therefore out of scope for this work. For the proposed SALSE scale, the entire Monitoring, Evaluation, and Planning subscale and five Self-Efficacy subscale items were adopted. One self-efficacy item was excluded as it referenced a similar concept of mastery as Midgely and colleague's (2013) ASE scale adopted for this study.

The MILK is a 60-item questionnaire compiled from the literature on information seeking and metacognition. This scale was used to capture the cognitive psychological processes of search because of its explicit emphasis on the search process. It consists of five subscales with 12 items each and covers metacognitive activities in search: schema training, planning, monitoring, evaluation, and transfer (Gorrell et al., 2009). The instrument was designed to measure levels of metacognitive strategy used during a search. The Evaluation subscale has been used in qualitative studies to understand the relationship between metacognition and web credibility (Madden et al., 2012), demonstrating the applicability of the scale in other contexts. Of note, Gorrell's (2009) questionnaire was not based on Bandura's four psychological processes but used Flavell's (1979) theory of metacognition, which meant the items selected for SALSE were adapted based on their perceived fit to Bandura's cognitive psychological processes. For example, in the proposed SALSE scale, I recategorised an item from the Schema Training subscale that referenced goal orientation as part of the Motivational subscale. Thirteen items in total were drawn from three subscales: Schema Training, Planning, and Evaluation.

The ILSE scale has long-form (28-item) and short form (17-item) scales that assess student information literacy self-efficacy in the use of electronic web, digital library, and print resources (Kurbanoglu et al., 2006). The items pertain to defining the information need, initiating the search strategy, locating and accessing resources, assessing and comprehending the information, interpreting, synthesizing, and using information, communicating information, and evaluating the product and process (Kurbanoglu et al., 2006). This scale was originally selected because of its emphasis on the information-seeking process (versus search-specific capabilities or expertise) and adherence to Bandura's selection processes that describe the choices people make, as well as the technological challenges they face when seeking information using search engines (environmental conditions). Eight items were selected from the subcategories of Locating and Accessing Resources (five items), Initiating the Search Strategy (two items), and Communicating Information (one item). Because SAL in a typical work context (outside of specialised jobs) is specific to the web, physical library references were excluded (except for using print sources—which may be a common resource for employees learning on the job).

After selecting the items, additional attention was paid to the wording of each item. Scale development experts recommend that items be concise, written at a sixth-grade level, contain one ideas (i.e., are not double-barrelled) and consist primarily of positively worded items to avoid participant confusion (DeVellis, 2017). For self-efficacy scales, experts recommend writing statements with the word "can" to represent a person's capability and to avoid the use of future tense (e.g., "will") because it addresses intention rather than perceived capability (Bandura, 2006). Many items were reworded to fit the above criteria.

Select a Format of Measurement

Choosing a rating scale for self-efficacy largely depends on what is being measured (DeVellis, 2017). Options for selecting the type of response format include Likert scales, semantic differential scales, visual analog, numeric response, and binary options (see Table 4 for general advantages and disadvantages, sourced from DeVellis, 2017).

Table 4

Advantages and Disadvantages of Selected Rating-Scale Response Types

Response type	Scale	Advantages	Disadvantages
Likert	Declarative sentences rated with equal intervals of agreement and disagreement usually on a 5- or 7-point scale	• Useful when measuring opinions, beliefs, and attitudes	• Mild statements may generate too much agreement
Semantic differential	Bi or unipolar adjectives placed on either end of a scale between 0 and 100	• Useful in theoretical models • Good for latent variables • Good for calculating more subtle changes between pre and post measurement sessions • Difficult for participants to remember their precise responses	• Varied interpretations of the differences between values on the continuum
Visual analog	Continuous line between a pair of descriptors (e.g., *no pain* and *worst pain*)	• Potentially sensitive • Good for calculating more subtle changes between pre and post measurement sessions • Difficult for participants to remember their precise responses • More often used with a single-item scales	• Varied interpretations of the differences between values on the continuum • Difficult to use when the construct contains multiple dimensions
Numeric response	Response options presented as a row of numbers.	• Potentially aligns with how the brain processes information	• Varied interpretations of the differences between values on the continuum
Binary	Response options are in pairs or equally weighted	• Captures multiple latent variables (e.g., blue, unhappy, sad) into a single construct (e.g., depression) • Easy to answer	• Not sensitive to change • Easier for participants to remember • Difficult to analyse

Many existing self-efficacy scales use Likert scales, which use a declarative sentence followed by five or seven rating points. Labels for Likert scales are often on a continuum represented by equal intervals of disagreement and agreement. All scales noted in Table 4 followed either a 5- or 7-point Likert scale, although they varied in the response options and statements used prior to the list of declarative sentences. Bandura (2006) recommended the preceding statement to the scale be written in a way that participants are asked to rate their degree of confidence; however, only the ESE and ILSE scales focused on feelings of confidence or competence (Kurbanoglu et al., 2006; Midgley et al., 2013). The ASE scale focused on the setting (i.e., "In this class...") and the SEMLI scale focused on frequency (i.e., "How often you do each of the following..."; Thomas et al., 2008). A numeric response (i.e., 1 through 10) was used by the original Search Self-Efficacy scale with *totally unconfident* at one end, *reasonably confident* in the middle, and *totally confident* at the other end (Kelly, 2010). Rarely are self-efficacy scales written as binary choices (e.g., can do, cannot do), nor do they use visual analogues.

Bandura (2006) recommended a continuous semantic differential scale with the following labels: *Cannot do at all* at 0 and *Highly certain can do* at 100. The preference for the continuous measurement is that people often do not select the extreme ends of a scale, putting most data in the middle. A 0 to 100 measure is more likely to capture more variability and subtle changes, particularly in studies with a pre and post measure of self-efficacy (Bandura, 2006; DeVellis, 2017). Thus, rather than use the rating scales of the existing measures adopted and adapted for use in this study, I followed Bandura's guidance: the SALSE scale uses a semantic differential scale and asked participants to rate their degree of confidence between *Cannot do at all* (0) to *Certainly can do* (100).

Review Initial Item Pool with Experts

Once scale items are selected and a rating scale chosen, scale items are reviewed by experts—a process commonly referred to as an expert review. The purpose of the expert review is to identify the face validity of the content in terms of how well the items represent the construct of interest (DeVellis, 2017). I identified four experts in self-efficacy and information seeking who could help to evaluate the question items. The average size of an expert review is around three participants, but Rubio (2005) suggested that some scales can include as few as two participants or as many as 20.

Recruitment

Experts in self-efficacy ($N = 15$) were solicited to participate in the study. Participants were recruited based on perceived expertise in self-efficacy; field or discipline in information science, education, or psychology; education; and years of work in the field (see Table 5). The first round of participants was identified based on a search in Google Scholar for publications with the keyword *self-efficacy* and within my social network ($n = 10$); each participant's online profile was reviewed to ensure self-efficacy was a theme in their work. I individually emailed them the recruitment email (see Appendix A.1), resulting in two confirmed participants. The second round of recruitment benefitted from the academic social capital of dissertation committee members, who were enlisted to encourage other faculty members to respond to the invitation, resulting in an additional two confirmed participants. The third round of recruitment occurred from snowball sampling which added one potential participant, but they were unavailable to participate. Thus, the final total sample for this review was four experts.

Table 5

Phase 1 Participant Inclusion and Exclusion Criteria

Factor	Inclusion criteria	Exclusion criteria
Age	19–no limit	< 19 years
Education	Master’s degree Doctoral degree	Under high school High school Bachelor’s degree Professional degree
Employment status	Full-time; part-time; unemployed; retired	Student
Domain	Education or information science or psychology or communication	
Expertise	Self-efficacy	
Years of work experience in field	3+ years	< 3 years
Language	Fluent in English	

Procedure

Participants who responded to the call for participation were offered the choice of participating in the expert review over email (providing asynchronous written feedback) or over Zoom conference software (sharing synchronous verbal feedback). Giving experts a choice around the medium of communication supported the possibility of recruiting experts in different time zones and maintaining respect for their time. This study was conducted during one of the peaks of the pandemic in 2021 when experts were dealing with significant uncertainty and changes in teaching and research mediums (e.g., shift from in-person to online teaching in university classrooms) alongside additional health and family concerns. All participants chose email. Each participant was sent an individual email with the following Word documents attached: Informed Consent Form (see Appendix A.2) and an Expert Review Survey (see

Appendix A.3). Participants returned the informed consent via email and then began the expert review survey. The expert review was later analysed by me and my supervisor and was evaluated at a high-level for reliability from a small-scale pilot (see Figure 6).

Figure 6

Process Diagram for the Expert Review Study

Instrument: Expert Review Survey

Experts in self-efficacy were asked at the beginning of the review process to evaluate the definition of constructs and document any concerns using an open-text field. The contents of the Expert Review Survey (see Appendix A.3) were as follows:

1. Study instructions and materials
   - A Word document with the following items: study instructions, table in which to self-report their expertise in self-efficacy, definitions of the psychological processes of self-efficacy, and the proposed scale with the individual items categorised into Bandura's four psychological processes.
2. Construct-level evaluation
   - Participants were asked to provide feedback on the construct as well as the working definitions (McCay-Peet, 2013).
3. Item-level evaluation
   - DeVellis (2017) recommended three categories of questions that support the feedback process: (a) item relevancy, (b) item clarity, and (c) missing items from the list of questions. Each participant was asked to assign each item a rating of

high, medium, or low for relevancy and clarity (DeVellis, 2017). Experts also noted whether an item should be included or excluded, and there was an open-text field for general feedback or concerns, or to suggest additional items.

Participants were given 1 to 2 weeks to reflect on the items on the scale and provide feedback. The researcher received the Expert Review Survey within 19 to 41 days from the initial email date. Two of the expert review surveys were returned with some blank spaces and the researcher exchanged one email with each of these participants for clarification. They indicated the spaces were left blank because they had no feedback on those particular elements.

Each participant was given a set of instructions at the outset of the study alongside definitions of each of the constructs. Participants were asked to provide feedback on the construct's definition and review individual items. For each item, participants were asked to make a final judgement call about whether an item should be included or excluded as a measure of the SALSE scale, and to determine the relevancy and clarity of each statement. Whereas Rubio (2005) used a 4-point scale and analysed the data for interrater reliability, other researchers have used a qualitative approach to interpret expert review feedback (DeVellis, 2017; McCay-Peet, 2013). This study took a qualitative approach because experts were able to add items more fluidly to the scale and make qualitative recommendations for changes.

DeVellis (2017), however, stated several concerns regarding the subjective nature of how face validity has been defined and performed in the construction of scales, specifically that expert reviews for face validity may be weak because, despite having agreement, the scale items may not measure what they are intended to measure and expert reviewers may accept items because the instrument looks like ones they know, thereby accepting it as a measure. This is a known risk when reviewing instruments with experts and why DeVellis made a case for scale evaluation. This study followed the basic procedures outlined by DeVellis to ensure as much rigour as possible in the selection and review of constructs, rating scales, and items.

Scale Evaluation

The next four steps involve evaluation of the scale: Step 5, consider inclusion of validation items, Step 6, administer items to a development sample, Step 7, evaluate the items, and Step 8, optimise scale length.

DeVellis (2017) recommended the inclusion of other validation items, such as the social desirability scale to determine “how strongly individual items are influenced by social desirability” (p. 136) or scales that reduce bias in surveys. The inclusion of other items was not included in the Phase 2 study because, as a diary study with many components, adding another component would have contributed to participant fatigue. This is listed in the limitations of the study.

DeVellis (2017) recommended administering items to a development sample to check on its internal consistency and interitem correlations. The recommended sample size is 300 people; however, DeVellis acknowledged that some scales have been created with smaller sample sizes. The SALSE scale was administered to a small sample (N = 16) as part of Phase 2; each person completed the scale twice, approximately 5 days apart, resulting in 32 total responses. Given the small sample size, factor analysis was not feasible, but reliability was checked and reported on (see Section 4.2). It is important to note that the scale’s alphas carry some degree of risk as they may appear deceptively good when in reality the internal consistency of the items may really be due to chance (DeVellis, 2017). It is for this reason the following two recommended processes (evaluation of items and optimise scale length) were recommended as part of the scale development process. Although these steps were included using a pilot test of the scale, additional work is needed to fully validate the items in the scale.

Of note, there were additional steps taken after the expert review to increase the validity of the question items. Although the experts I identified were particularly strong in self-efficacy and some were information scientists, expertise in SAL was not captured in the expert review survey. For this reason, I added a review process with my supervisor (Dr. Heather O'Brien), who conducts research in SAL and scale development and evaluation, to support the evaluation of the feedback from the expert review. Together Dr. O'Brien and I combed through the responses to the constructs and individual question items to understand and prioritise the feedback (see Appendix A.4). This collaborative effort resulted in identifying new scales, and further revising question items to fit our understanding of self-efficacy in SAL. Feedback and changes to the SALSE scale from the expert review survey are provided in Chapter 4.

Summary

The SALSE scale is built on a theoretical foundation of self-efficacy and was created using the scale development process outlined by DeVellis (2017) and examples in practice from McCay-Peet (2013) and O'Brien (2008). Existing measures of self-efficacy were used in its construction and evaluated based on their reliability and dimensionality. The constructs and individual items were then evaluated by self-efficacy experts in both learning and information science domains. Some stages of the scale development process that fall under scale evaluation were not rigorously applied at this stage, as the focus of the first study was to first develop and test the face validity of the scale for use in the mixed-methods study. The construct validity and reliability of SALSE were examined using data from Phase 2 and are reported in Chapter 4. I recommend that before the scale is applied further in practice that the scale is revised and tested with a larger development sample.

3.3 Phase 2: Mixed-Method Study

This section describes the recruitment, procedure, instruments, and changes from the pilot study of the mixed-method study. Findings for this study can be found in Chapter 5.

Research Design

Phase 2 employed a fixed mixed-method approach in which “the use of quantitative and qualitative methods is predetermined and planned at the start of the research process” (Creswell & Clark, 2017, p. 52). The rationale for mixing data types was that although self-efficacy can be measured, quantitative data can indicate only whether a change occurred and to what degree; qualitative data can reveal why something occurred. The intent of mixing methods was to present a more complete view of self-efficacious processes.

This study used a convergent design with an identical sample, which collected both quantitative and qualitative data from the same participants to provide a comprehensive analysis of the research problem (Creswell & Clark, 2017). A convergent design typically consists of a quantitative, qualitative, and mixed research question (Creswell & Clark, 2017). The quantitative and qualitative data were analysed separately; however, the mixed research question drew from the same construct (i.e., self-efficacy) captured in both qualitative and quantitative data types to categorise themes identified during the reflexive thematic analysis. Figure 7 provides an overview of the research design.

Figure 7

Study Procedure (Mixed-Method Convergent Design)

Note. The study design included three surveys: a demographics presurvey and pre and post surveys containing the Search as Learning Self-Efficacy (SALSE) scale which bookended the learning diary. The learning diary data were collected using experience sampling forms, which were summarised into an experience sampling dashboard for each participant. The experience sampling dashboard was used to prompt the participants' memories and unpack their self-efficacious experiences learning using search.

Recruitment

There were two phases to the recruitment process: call for participation and prescreening. The call for participation used preexisting UX groups who use social platforms such as Slack (e.g., UXR&S, Hexagon, Indi Young), Mighty Networks (i.e., Leaders of Awesomeness, UX group), Meetups (e.g., VanUE), Twitter (i.e., #designtwitter), and LinkedIn (e.g., UXPA). Online community groups were targeted because they are preexisting networks of people composed of novices and experts within the UX domain who may have mixed abilities in search. University listservs were excluded to avoid recruiting students enrolled in a degree program because the interest was in informal learning environments. The recruitment messaging targeted adults who were not currently enrolled in a structured academic degree program who wanted to improve their ability to learn using online resources (see Appendices B.1 and B.2). People enrolled in online MOOCs were excluded because these are structured programs. However, if a learner conducted a search resulted in watching videos from an online resource, such as a MOOC, they were included. For inclusion and exclusion criteria, see Table 6.

Table 6

Phase 2 Participant Inclusion and Exclusion Criteria

Factor	Inclusion criteria	Exclusion criteria
Age	19–65	< 19 > 65
Education	Highschool Bachelor's degree Master's degree Doctoral degree Professional degree	Under high school
Gender identity	Any	None
Employment status	Full-time; part-time; unemployed	Student Retired
Learning Resources	Blog content Social media networks YouTube videos Websites	In-person courses Degree programs
Program enrolment	–	All University; college; paid structured courses (e.g., MOOC)
Years of work experience in field	0–3 (Early career)	3+ years
Community belonging status	User-experience communities	All other groups
Language	Fluent in English	

Note. MOOC = massive open online course.

Following the call for participation, I actively screened participants over Zoom to discuss the study process, ensure they had a learning goal, confirm intent to participate in the study, and review the informed consent (see Appendix B.3). To qualify for this study, participants needed to have a self-identified topic of sufficient complexity to prompt learning for at least 5 days

(Borlund, 2016) with an applied use for their learning goal (e.g., write a chapter, prepare for a job interview, conduct a UX study). They also needed to have their own laptop and internet access.

The screening concluded with noting the award structure for this study, which was broken into two parts: the learning diary and the interview. Each day a participant completed an experience sampling form, they received $3. Participation in the interview was reimbursed $25. If participants completed at least 3 days of experience sampling forms and the interview, they received full compensation ($40) for their participation. The goal of this award structure was to incentivise participation until the end of the study.

Procedure

The study began with a presurvey containing demographic and learning goal questions. Participants then completed a survey to measure their self-efficacy (i.e., SALSE from Phase 1). The survey was completed twice: once at the beginning of the study and again at the end of the study. A learning diary prompted reflection on the learning process of study participants and was completed by each participant at least three times throughout the 5-day period. The learning diary contained both quantitative and qualitative questions. The final component was a qualitative, data-prompted interview in which data from the learning diaries were summarised and shared back with participants, who were asked to elaborate on their perceptions of self-efficacy. Email reminders and follow-up messages were sent to help keep the participants on track (see Appendix B.4). For instances of cash payments, participants were asked to sign a receipt of payment (Appendix B.5). All participants received a study debrief within a day of the final interview (Appendix B.6).

This study prioritised the interview data for two reasons. First, the diary was intended to be used as a memory prompt to improve the ecological validity of the situations described during the data-prompted interviews; the data resulting from the diary were also present in the reflections captured during the interviews. Second, the diary helped support the challenges in studying SAL. Search is perceived as thinking—an automatic process of finding information. Using real-world learning scenarios centred the challenges learners face when using both search and learning strategies in tandem. This may lead to the development of tools and resources to support lifelong and self-determined learners using web search engines.

Instruments

There were several instruments used in the study: (a) presurvey (see Appendices C1–C.3), (b) SALSE scale (see Appendix C.4), (c) learning diary and experience sampling dashboard (see Appendices C.5 and C.6), and (d) data-prompted interview protocol (see Appendix C.7). This section reviews each instrument and the rationale for its inclusion in the study.

Presurvey

The purpose of the presurvey was to collect participants' demographic information. This was important because the study was primarily qualitative, and the findings were not expected to be generalizable outside of this context. The presurvey also provided metacognitive prompts early on to assess participants' prior knowledge of the learning diary topic and self-assessed level of subject expertise (Kruger & Dunning, 1999). These data were used to assess the change in the participant's metacognitive experience of "feelings of knowing" (Pintrich, 2000). Additional forethought and planning questions asked participants to reflect on their learning goals and their intended applied use of the learning, both of which are essential parts of metacognition and self-regulation (Flavell, 1979; Usher & Schunk, 2018).

SALSE

The SALSE scale was developed during Phase 1 of this study program. Self-efficacy scale data were captured using this newly constructed scale to identify if there was a change in self-efficacy from the beginning to the end of the diary study. Additionally, the scale was used to help categorise the qualitative data to understand thematic differences between participants who lost or gained a sense of self-efficacy over the diary data collection period. The 50-item SALSE scale can be found in Appendix C.4.

Learning Diary

Diaries give researchers access to private spaces and are a common approach to gain access to unobservable phenomena over time (Bratteteig et al., 2012; D. H. Zimmerman & Wieder, 1977). In this case, the learning diary was used as a memory prompt to support the ecological validity of experiences discussed during the data-prompted interviews. The diary design was inspired by experience sampling methods, which capture lived experiences as they occur (Hektner et al., 2007) and provide opportunities to use participants' diary data in personalised interviews (Kwasnicka et al., 2015). Experience sampling methods were originally designed to understand flow experiences (Csikszentmihalyi & Larson, 1987) and have since been adopted within multiple disciplines (e.g., education, clinical work, information science). More recently they have been referred to as ecological momentary assessments, but that term and experience sampling methods are often used synonymously (Trull & Ebner-Priemer, 2009). Experience sampling methods differ from traditional diaries; instead of collecting behaviour logs or end-of-study reflections, participants were signalled at regular intervals through email or text messaging to submit the diary (i.e., experience sampling form) in real-time or near real-time.

The modified experience sampling form consisted of quantitative (Likert scales) and qualitative (open text fields) prompts and was estimated to take 5 minutes for participants to complete. The diary was created in Expiwell [https://www.expiwell.com/], an experience sampling data collection web platform, and each person was asked to create a memorable username to use on the platform for the duration of the study. The researcher mapped usernames to anonymised participant IDs (e.g., P001) to make it more difficult to identify the participants within the study data.

Zirkel and colleagues (2015) recommend four types of signals (i.e., random sampling, fixed sampling, event-focused, or context sampling), that support real-time data collection. In this study, participants were signalled to complete the diary using event-focused sampling, which is when data collection coincides with a trigger (Zirkel et al., 2015). In this case, the trigger was self-identified when participants used a search system to learn about their topic. This meant that participants were largely accountable for remembering to complete the diary but were supported by daily emails, a common research tactic in diary studies.

Development of the learning diary intentionally used Flavell's (1979) theory of metacognition (i.e., person, experience, and skills) and mixed both search and learning questions (see Table 7). The diary served both as a metacognitive prompt for the participants and as a reflection tool for their SAL experiences. The diary focused on the metacognitive categories of person and experience and touched only upon metacognitive skills with the perception of learning. The learning diary template can be found in Appendix C.5.

Table 7

Learning Diary Question Rationale

Purpose	Question	Rationale
		Person
Search goals (qualitative)	What did you hope to learn from your search session?	Search goals prompt short-term (proximal) goals, which are considered to enhance self-efficacy; it is assumed learning goals would prompt long-term (distal) goals (Pajares & Schunk, 2001; Pintrich et al., 2000).
Search queries (qualitative)	What search queries (e.g., UX methods) did you use in your search? [write down the keywords, or copy and paste your web history, or attach a screenshot]	Search queries were added as a prompt to support the participants' memory of specific queries during the data-prompted interview.
Task difficulty (qualitative)	Did you experience any challenges?	A task difficulty prompt asks participants to briefly reflect on the challenges and provides some insights into how much was unknown about the task (Wildemuth et al., 2014; Pintrich et al., 2000). This question is intentionally left open-ended and does not assume the types of challenges (e.g., search system) so as not to lead the participant.
		Experience
Search effort (quantitative)	How much mental effort did you put into your search?	A perceived effort prompt was added to help explain feelings of self-efficacy when using a search system (Rieh et al., 2012; Pintrich et al., 2000).
Affect (quantitative)	How do you feel about your search session? Check one: [list]	An emotion prompt was added to log the emotional state of the participant after their search. Emotion may play an important role in persistence of both search and learning (Efklides et al., 2018; Kuhlthau, 1991; Winne, 1995). This question used Pekrun and Linnebrink-Garcia's (2012) affective circumplex model of academic emotions.
		Skills
Perceptions of learning (quantitative)	How much do you think you learned during this session?	This metacognitive monitoring question prompted participants to reflect on the change in their perception of learning (Pintrich et al., 2000). Perception of learning is subject to cognitive biases, such as the Dunning-Kruger effect that suggests novices do not accurately assess their own abilities well (Dunning, 2005) and recent findings that one's perception of learning is not equivalent to actual

Purpose	Question	Rationale
		learning (Persky et al., 2020). Yet self-assessment remains an important factor in metacognitive monitoring and development (Blaschke et al., 2014; Conley, 2014).
	Did you ask anyone for help? If yes, who did you reach out to?	This metacognitive control question prompted participants to consider resources they used outside of the digital system (McCord & Matusovich, 2019), which captures information on how participants might use community networks to regulate their learning (Arciniegas-Mendez et al., 2017).
Prior knowledge (quantitative)	How would you rate your current knowledge on your topic?	Prior knowledge prompts were used in lieu of the more formal assessments of judgements of learning and were selected to support metacognitive monitoring (Persky et al., 2020; Pintrich et al., 2000).

Data-Prompted Interviews

Data-prompted interviews use previously collected data during the interview process to enhance understanding of participants' experiences (Kwasnicka et al., 2015). I used Bandura's four psychological processes in the creation of the interview protocol.

Retrospective interviews are often held at the end of studies that use diaries and experience sampling methods to understand participants' record of activities (Hektner et al., 2007; Mason et al., 2010; D. H. Zimmerman & Wieder, 1977). In this study, the ecological validity of the retrospective interview was enhanced by presenting a visual record of diary entries to the participant during the interview. Data-prompted interviews use data collected from participants to guide the interview process.

The three aims of data-prompted interviews are to (a) stimulate and guide discussion, (b) explore interpretation of data with the participant, and (c) discuss participant's views of the data (Kwasnicka et al., 2015). As data-prompted interviews use real data as a guide, semistructured interview protocols were used. Semistructured interviews allow flexibility in question order (Bryman, 2012) and have been used in some metacognitive studies to understand a person's thoughts and feelings (Pintrich et al., 2000; Wolters & Won, 2018). It is important to note that the exact interview questions were prompted by the data derived from the learning diary entries. For example, if a person did not describe any challenges while learning using search, the question about challenges noted that they did not mention any challenges and were asked to elaborate on their absence. For this reason, data-prompted interviews also encourage researchers to use listening techniques to help clarify any assumptions the researcher makes in response to participants' statements (Miller, 2018). The researchers use open-ended questions and statements to clarify the meaning behind what the person is saying, and affirmed participants' statements by focusing on positive (rather than negative) aspects (Miller, 2018) to make interviewees feel valued and heard.

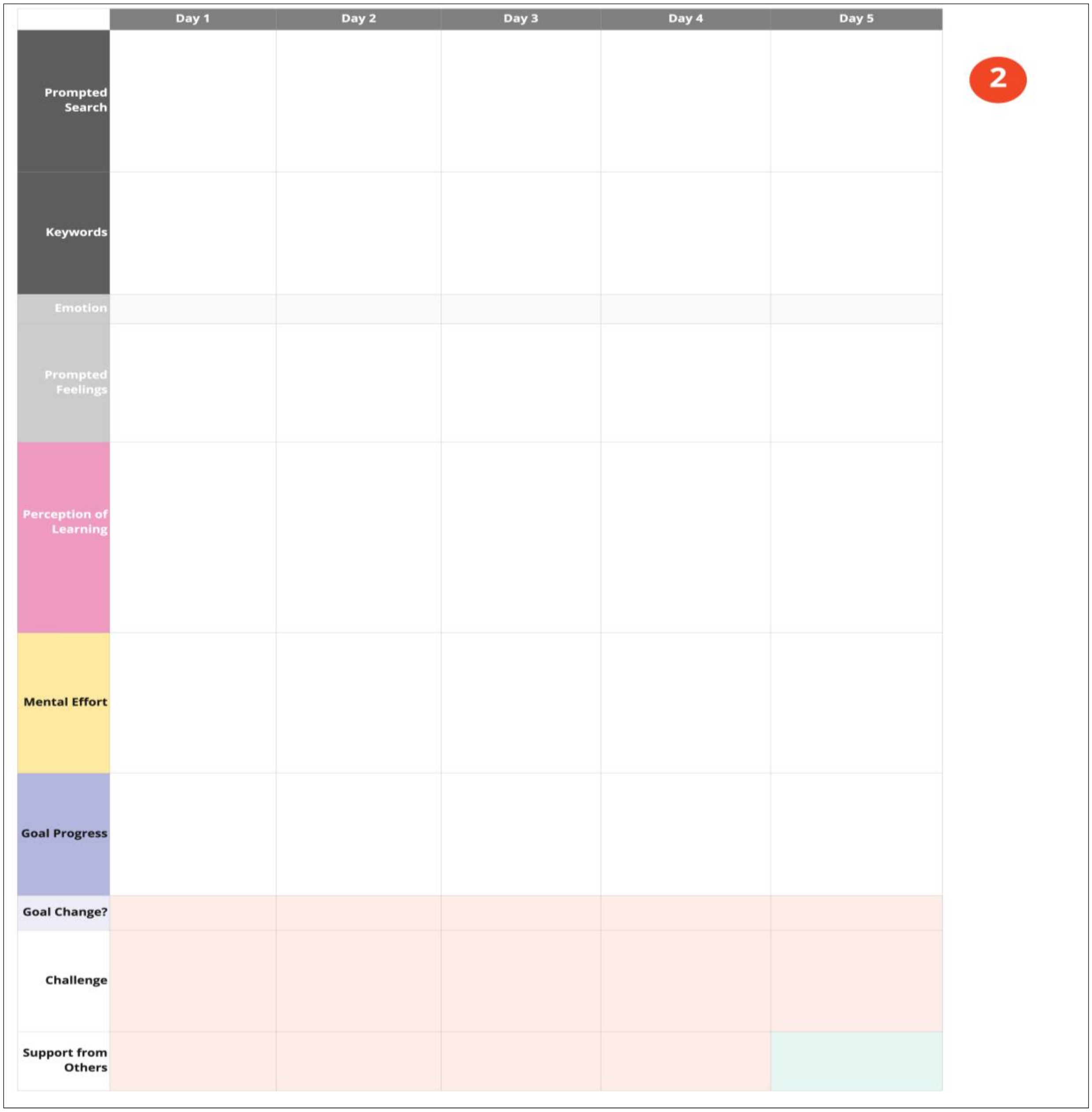
Prior to the data-prompted interview, I created a customised experience sampling dashboard for each participant using their diary data and prepared the learning diary for PDF export (see Figures 8 and 9 for examples).

Figure 8

Example of the Top Half of the Experience Sampling Dashboard

Figure 9

Example of the Bottom Half of the Experience Sampling Dashboard (Blank)



Note. Shorthand of diary questions is on the left side of the table: prompted search, keywords, emotions, prompted feelings, perception of learning, mental effort, goal progress, goal change, challenges, support from others. Across the top of the table are the days numbered from 1 to 5. In some cases, there were 6 days for participants who requested an additional day.

The data-prompted interview protocol was developed based on Bandura's theory of self-efficacy using the four psychological processes: motivation, affect, environment, and cognition. The rationale behind choosing each of the categories is outlined in Table 7. For the semistructured interview protocol, see Appendix C.7.

Interview Protocol Rationale

The interview protocol was developed based on the four psychological processes of self-efficacy. In Table 8 the psychological process is defined followed by the question categories (e.g., learning goals) and their rationale.

Table 8

Interview Protocol Rationale

Psychological process	Definition	Concept	Rationale
Motivational	Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994).	Learning goals	Learning goals are assumed to be distal goals (Pajares & Schunk, 2001; Pintrich et al., 2000). Questions in this category were added to determine the extent to which the participant felt they met the learning goal that was set at the beginning of the study. It is posited that success in meeting their learning goal may be associated with improvements to their cognitive self-efficacy (Bandura, 1977).
		Search effort	The participants' responses were placed on an experience sampling dashboard and the interviewer asked the participant to reflect on their investment in search. Questions in this category interrogated the reasons behind the investment in search (or lack thereof). It was hoped this question would support understanding of what search and system challenges arose for participants.
Affective	Affective processes are the ability to regulate emotion (Bandura, 1994)	Emotions	Questions in this category asked participants to refer to the experience sampling dashboard and reflect on the affective experience of learning during search; participants were asked to cite

Psychological process	Definition	Concept	Rationale
			specific examples in the diary. It was anticipated that the emotions experienced during a search would influence a person's self-efficacy.
Selection	Selection processes refer to the environmental factors that influence self-efficacy (Bandura, 1994)	Search system and ability	Search and search system knowledge can influence a person's self-efficacy (Rieh et al., 2012). Questions in this category asked participants to reflect on changes to their search ability and sought to understand whether the participant felt a sense of improvement in their ability to search over time.
		Community network	Coregulation of learning is an important feature of learning networks (Hadwin et al., 2018), but members do not always share the same goal or focus on the same activities (Wenger, 1999). Social presence may be positively correlated with self-efficacy in online learning environments (Shea & Bidjerano, 2010). Questions in this category asked participants to reflect on their social sphere and the influence it had on their ability to learn using search.
Cognitive	(Meta)cognitive processes in this instance refers to the processing of initial judgements against the results (Bandura, 1994).	Learning progress	*Progress check-in* is a metacognitive monitoring technique. Questions in this category were added to understand what supported or challenged their learning progress.
		Expertise assessment	Learners with lower knowledge scores are overconfident about their answers, whereas learners with higher knowledge scores are underconfident about their answers (Kruger & Dunning, 1999). Questions in this category checked whether participants changed their perceptions of their expertise in their learning topic after a week of searching, and why the change occurred or did not occur. It was an intentional self-check and asked the learners to focus on their own self-concept rather than compare themselves with others.

Additional qualitative data captured from the learning diary, including search goals, queries, and challenges, were exported from Expiwell to Miro [https://miro.com], a digital workspace used for visual collaboration, which was then subsequently saved in PDF format and shared with the participants to support their recall of learning events that occurred during the 5-day period.

The data-prompted interviews occurred within 2 to 3 days of the last diary entry and took place over Zoom. Each interview lasted between 45 and 60 minutes, and participants were asked a series of questions based on above framework. The researcher-generated timeline was shared with the participant using Miro with collaborative editing enabled so the participant could edit or modify the timeline to reflect their experiences. All sessions were audio recorded to the cloud and later transcribed using a combination of Zoom's auto-transcription feature and manual transcription.

Pilot Study

Pilot studies were conducted with three participants to ensure the quality of the instruments and procedure. The pilot study followed all protocols and procedures as outlined above in the formal study. Changes resulting from the pilot studies were minimal and are described as follows.

Tools. The platform for the diary was switched from Qualtrics [http://qualtrics.com] to Expiwell, as Expiwell is specifically designed for experience sampling methods and the use of semantic differential scales. In addition, Mural.ly was replaced with Miro, as Miro had a free education package that provided more opportunities for sharing data with participants.

Documents. As a result of the tool change, the informed consent was updated to include acknowledgement of the risk to data being temporarily stored in the United States. The prescreen and data-prompted interview protocols were also updated for more clarity about the study protocol and question intent respectively. An example of a completed diary was added to the prescreening protocol to show participants what the diary could look like in advance of the study.

Summary

The purpose of Phase 2 of the research program was to understand how working learners describe their self-efficacious processes when learning using search. A convergent mixed-method design was selected to give a complete picture of the problem. A variety of instruments were used to gather data, including questionnaires, scales, learning diaries, and interview protocols. The constructed scale from Phase 1 was used to assess the change in self-efficacious processes and organise the qualitative data from the data-prompted interviews in Phase 2. Learning diaries were employed to support learners' reflections on their learning and search process, and the data-prompted interviews used the learning diaries as the basis for conversation and explication during the interviews. A pilot study was conducted with three individual subjects and followed the same protocol and procedures of the main study. Minor changes to informed consent, tools, and some question reframing in the document were changed and resubmitted to the Behavioural Research Ethics Board for approval.

3.4 Ethics

In qualitative research, participants are afforded the autonomy and respect of their lived experience and all constraints on behaviour and considerations are the responsibility of the researcher (Iphofen & Tolich, 2018). Human participant inclusion in research typically covers four main areas of concern: the potential harm to participants, the lack of informed consent, invasion of privacy, and deception (Bryman, 2012; Diener & Crandall, 1978).

This proposed research drew upon two distinct pools of human participants.

- The first pool in Phase 1 consisted of experts from education, information science, and psychology to provide additional face validity to a SAL self-efficacy scale presented to participants in Phase 2.
- The second pool in Phase 2 consisted of working adults who belong to preexisting online UX communities and were asked to complete several surveys, provide metacognitive learning outputs in the form of a survey-based learning diary as well as participate in a data-prompted interview about their self-efficacy in search and learning.

There were no known risks to the participants outside of what they may encounter in their daily life and an informed consent was provided to each participant prior to beginning to each study (see Appendix A.2 and Appendix B.3). The personally identifiable information captured was either a mobile phone number or email address that was used to transmit data to the researcher. After the study conclusion, all raw data in the form of messages and multimedia received from participants were zipped and stored as well as documented in an excel database on UBC's cloud data storage with any personally identifiable information removed and replaced with a participant ID. There was no planned deception in these studies.

3.5 Chapter Summary

This dissertation used a variety of methods to understand the role of self-efficacy when working adults learn using search. The study was carried out in two phases: scale development and evaluation and a mixed-methods study that used the constructed SALSE scale and data-prompted interviews.

The purpose of the first phase of the research program was to develop a scale of self-efficacy, determine its face validity with self-efficacy experts, and evaluate the results using a small development sample (from Phase 2). The scale applied Bandura's theory of self-efficacy to several existing scales to determine their suitability for the current program of research. Selected question items were drawn from relevant, existing scales in alignment to the four psychological processes of self-efficacy. An expert review using experts in self-efficacy was conducted to enhance SALSE's face validity, and a separate review was conducted with a SAL expert during the final selection of items. The outcome of the process was a proposed self-efficacy scale for use in the context of learning using search. Results from the expert review and administration of SALSE in Phase 2 are discussed in Chapter 4.

The purpose of the second phase of the research program was to understand how working learners describe their self-efficacious processes when learning using web search engines. A convergent mixed-method design was selected alongside a variety of instruments, including surveys, scales, learning diaries, and interview protocols. The main research instruments drew from Bandura's (1977) theory of self-efficacy (i.e., scales, interview protocol) and Flavell's (1979) theory of metacognition (i.e., learning diary) in their creation. Results from the data-prompted interviews are discussed in Chapter 5.

Chapter 4: Developing a Self-Report Measure of Self-Efficacy

SAL has, conceptually, been of interest since Kuhlthau's germinal work in 1991, but "the importance of learning as a search outcome and in providing explicit support for learning while searching is a rather recent development" (Eickhoff et al., 2017, p. 400). Self-efficacy is a multidimensional keystone construct in adult and lifelong learning (e.g., Hase & Kenyon, 2000) that includes motivation, affect, cognition, and selection (Bandura, 2006). Thus, creating specific measures that capture the domain specificity and different contexts of SAL is important in reflecting searchers' judgements of capability (Bandura, 2006). Common self-efficacy scales in SAL measure a form of search ability (Bailey, 2017; Kelly, 2010) and information literacy (Kurbanoglu et al., 2006), and have not yet extended beyond the cognitive capabilities of search. The SALSE scale was created as part of this research program to provide a more holistic view of learning when using search, drawing upon all four psychological processes (motivational, affective, cognitive, and selection) of Bandura's (2006) theory of self-efficacy.

Chapter 3 explained the first four steps of scale development from a process perspective: Step 1 unpacked the domain of self-efficacy by understanding its use in learning and in search, Step 2 generated items by bringing together a pool of items from previously validated scales, Step 3 selected a format of measurement to align with Bandura's recommendation on how to measure self-efficacy, and Step 4 explained the approach used to review the initial item pool with experts. This chapter continues DeVellis's (2017) scale development process beginning with the feedback collected during the expert review process. This chapter also provides an initial look at the recommended evaluation steps when creating a scale, which included administration to a development sample, an evaluation of the items, and an optimization of the scale, and the extent to which the current research was able to address them. The research question addressed in this chapter is RQ1.1: How can a working adults' sense of self-efficacy be measured when learning using search?

4.1 Expert Review Study

The purpose of the expert review was to test the face validity of constructs and items in the scale for use in the mixed-methods study (Phase 2). Face validity is concerned with "the extent to which item content appears relevant to the construct of interest" (DeVellis, 2017, p. 102) and increases confidence that scale items adequately reflect the theoretical constructs. This section describes the expert participants and feedback they provided on the scale constructs and items resulting in a more robust measure of self-efficacy.

Participants

Four participants (*N* = 4) completed all aspects of the expert review. Participants in this study were doctoral degree holders with an average of 18.25 years of research experience in education (*n* = 2), communication (*n* =1), or information science (*n* = 1). Participants were employed by a formal academic institution (*n* = 3) or private corporation (*n* = 1).

Self-reported expertise in self-efficacy was measured by asking participates to rate their familiarity across seven distinct aspects of self-efficacy (theory of self-efficacy inclusive of Bandura's four psychological processes, and the relationships between self-efficacy and metacognition and self-regulation using a Likert scale ranging from 1 (*none*) to 5 (*substantial*). All participants reported at least some familiarity with Bandura's (2006) theory of self-efficacy. Table 9 displays the average, minimum, and maximum values of self-reported expertise per question. Experts may have underestimated their knowledge and considered only their expertise within a specific area of self-efficacy (e.g., social self-efficacy). Search ability was not captured because the focus of the scale was not originally intended to differentiate participants based on their search ability or technique familiarity. However, the final review of items (after expert review) was conducted with another researcher (my supervisor), who advocated for the inclusion of search ability given findings from studies that support the influence of search ability on learning outcomes (O'Brien et al., 2022).

Table 9

Self-Reported Self-Efficacy Expertise on a 5-Point Likert Scale

Theory / construct	*M*	Min	Max
Self-efficacy	3.25	3	4
Cognitive processes	3	3	4
Motivational processes	3	2	4
Affective processes	2.5	2	4
Selection processes	3.25	2	3
Metacognition and self-efficacy	3.25	2	5
Self-regulation and self-efficacy	3.25	2	5

Note. Min = Minimum; Max = Maximum.

Expert Review Feedback and Analysis

Expert reviewers completed a survey in Word and sent it to the researcher via email. For the expert review survey template, see Appendix A.3. To begin the analysis, I transferred all the items from the expert review survey into an excel document. Expert reviewers were anonymised during the analysis using a participant ID. The details of their responses were extracted into several worksheets: demographics, construct feedback, and each psychological process. Metacognition and self-regulation were captured to understand the nuances of expertise within self-efficacy. The construct feedback worksheet contained a vertical column for each psychological process with a row for each participant's IDs responses. Feedback was copied into the cells. The psychological process worksheets contained detailed information about the original scale (i.e., source, validity checks, Cronbach alpha, construct category), question items (i.e., original wording, revised wording, and final item), and reviewer feedback (i.e., include/exclude, relevancy, clarity, and open feedback). There were also columns for use by the researchers: the final decision to include/exclude the item, justification for removing or retaining it, and general notes. I and my supervisor analysed the results of the expert review survey over video conferencing software on two separate occasions with one of us sharing our screen. We first looked at the study participants' open text feedback concerning the construct definitions of the four psychological processes involved in self-efficacy and then examined the study participants' feedback pertaining to the individual question items. The next sections discuss the feedback experts provided on the rating scale, constructs, and individual items in the pool.

Rating Scale Feedback

Following Bandura's guidance, the items were framed based on the degree of confidence between *cannot do at all* (= 0) to *certainly can do* (= 100). No changes to the rating scale were recommended by the expert reviewers and this rating scale was retained.

Construct-Level Feedback/Evaluation

Participants were first asked to provide feedback on the definition of the four psychological processes of self-efficacy (see Table 10 for the construct labels and definitions). They were asked if there were any additional constructs they would measure in relation to self-efficacy. Careful attention was paid to the feedback concerning Bandura's advice on avoiding similar but related constructs, such as self-esteem or locus of control. Self-esteem refers to a judgement of self-worth and focuses on individual's protecting their sense of personal value (Covington, 1984). Locus of control refers to one's belief about the active role one takes (or does not) in producing specific outcomes (Bandura, 2006). Self-esteem and locus of control are different from self-efficacy because self-efficacy is about belief in the self to achieve outcomes, whereas self-esteem focuses internally on self-worth and locus of control focuses on the object of control (internal vs external).

Table 10

Original Construct Definitions Presented to Expert Reviewers for Feedback

Construct	Definition
Motivational	Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994).
Affective	Affective processes regulate emotion. Bandura (1994) believed that people who are able to develop controls over their emotional processes, such as feelings of stress and anxiety, are more likely to take bolder steps in life.
Cognitive processes	Cognitive processes involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. People are commonly guided by their goals and desired outcomes; the stronger a person's belief is in their capability, the more effort they will devote to a specific cognitive task (Bandura, 1989).
Selection processes	Selection processes refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). A stronger sense of self-efficacy is related to the breadth of options one might consider. It is important to note the bidirectional relationship as people do choose their environments, but environmental factors also influence self-efficacy (Bandura, 1977). This portion of the scale identifies the search system (environment) as having an impact on a person's search self-efficacy (Rieh et al., 2012).

Reviewers did not make any adjustments to the definition of the four psychological processes as they were presented to them. However, some reviewers suggested additional constructs, such as perceived benefits, anticipated outcomes, confidence in knowledge held by learners, social processes, and survival, and expanded upon the ideas presented in the current definition of selection processes. They did not always provide a fulsome rationale for including additional constructs or expanding on the definitions. The following sections review these additional constructs, share input from the experts when it was provided, and discuss the reasoning for including or not including this input from the experts in the final scale.

Perceived benefit “refers to the perception of the positive consequences that are caused by a specific action” (Leung, 2013). Understanding the beliefs learners hold regarding the outcomes of their actions is an interesting facet to include because context plays a critical role in the development of self-efficacy scale items. Scales have been created for perceived benefits in the context of understanding data-driven language learning (Mizumoto et al., 2016), outcomes after a traumatic stressor (McMillen & Fisher, 1998), utilitarian or hedonic orientation towards perceived benefits when shopping for gifts (Jeng, 2013), and the influence of play when searching for product information (Mathwick & Rigdon, 2004). These perceived benefit scales are well-aligned with the engagement construct (O’Brien et al., 2018) and may be useful when accounting for the utilitarian value of search. However, it remains unclear what self-efficacious factors would intersect with the perceived benefits of learning using search. Perceived benefits were not included in this initial scale development process due to scope. It may be beneficial to conduct a future study asking these questions to better understand the beliefs people hold about the benefits of learning using search.

Anticipated outcomes was a construct included in the feedback, but is distinct from self-efficacy (Bandura, 2006). Anticipated outcomes are aligned with social cognitive theory and related to the self-regulation of motivation. Self-efficacy is related to the beliefs that one can produce the desired outcomes. Bandura notes, “the likelihood that people will act on the outcomes they expect prospective performances to produce depends on their beliefs about whether or not they can produce those performances” (Bandura, 2001, p. 10). Thus, when the central focus is self-efficacy, it references the belief in one's capability to produce outcomes and does not focus on the anticipation of outcomes. As a result, no action was taken to include this construct, though this feedback raises interesting points about inclusion of scales to differentiate between measures of self-efficacy and anticipated outcomes.

Confidence in one's knowledge was recommended for inclusion. I agreed this is important if creating a standalone scale, but this scale was to be deployed in Phase 2, where changes to confidence in knowledge would be collected qualitatively. As such, I felt confidence would be elicited in the data-prompted interviews. Other researchers, however, may want to measure the confidence in one's knowledge, especially when there is no interview component, or there is a need to triangulate survey and interview data.

Social process was another recommended category for inclusion by two reviewers. They raised issues with learning and self-efficacy being viewed as an individual process, arguing it is a relational and social process. Although social processes extend outside of Bandura's explicit categorization of the psychological processes, social influence on self-efficacy through modelling, vicarious experiences, and persuasion (Bandura, 1977, 1994) make it an integral part of the theory. Social self-efficacy is defined as being confident and capable in social activities (Sherer et al., 1982). It is largely determined by the skills one has in making friends (Sherer et al., 1982) and has been applied in research designed to understand the efficacy of social interactions on common tasks in the workplace (H. M. Smith & Betz, 2000). However, when people learn using search, social self-efficacy may be more related to help-seeking behaviours and coregulation of activities that support the information-seeking process or learning habits. This feedback led to the inclusion of an additional scale, the Online Academic Help-Seeking (OAHS) scale. OAHS is a 10-item scale that defines online help seeking as "the spontaneous behavior of requesting assistance from others through the Internet" (Cheng & Tsai, 2011, p. 151). The scale consists of items that include information searching and making formal and informal queries.

Survival was included in the feedback on selection as it influences choices or options. From a survival perspective, information features, such as colour and context, play a role in determining relevance and refinding information (Dumais et al., 2016). Although relevant to learning, survival focuses on the features needed to remember information. Although search engines provide features that support fact-finding (Feldman, 2012), they do not yet provide features that support higher levels of learning (Marchionini, 2006; C. L. Smith & Rieh, 2020), such as those included in Bloom's taxonomy (Krathwohl, 2002). Although an interesting construct to explore, the methods used in Phase 2 (i.e., diary, interview) were less conducive to discussing the features of search systems that pertain to memory, so this was not included in the revised scale.

Selection may also be interpreted as choices people make with regards to the selection of information resources, but choices also may be considered part of planning, as searchers choose from a variety of print and electronic resources from (Stewart, 2000), which can be further subcategorised by digital library (e.g., publisher, aggregate database) and web search engine (Bethel & Rogers, 2019). Because there is such a wide variety of search systems, expert search ability may require knowledge of when and how to use specific resources.

Selection may also be interpreted by the environmental conditions that influence choice; designers can intentionally make a system difficult for users with "dark patterns" (Gray et al., 2018). Although most design work aims for useability and ease of use, the business of the web may intentionally limit access to information; the system itself can impede discovery of information based on its complexity or the knowledge people have of how search systems work. Fitting search terms to each system is necessary to retrieve relevant results (Taylor, 1968). However, algorithms cover-up the lack of search skill and instead afford searchers a perceived skill they do not possess (Agosti et al., 2010; Feldman, 2012). Given the population of interest for the follow-up study (UX designers and researchers), it is unlikely the population is unfamiliar with using the worldwide web, but to what extent they are familiar with search may vary depending on the kinds of training they received. The central theme of self-efficacy is the ability to overcome barriers, and the ability to search is predicated upon skills, which are based on both knowledge of search systems and information resources. As such, the environment poses constraints stemming from the construction of search systems, and this is distinctly separate from overcoming individual challenges of cognitive planning and choosing resources. The barriers of selection may instead be understanding how to search within specific search systems. As this project focuses on the web as a resource, this section proposes limiting the items drawn from search-specific skills found in the ILSE (Kurbanoglu et al., 2006), which although validated, is very general in its inclusion of all kinds of search skills and resources. I decided to include the search techniques (e.g., ability to use Boolean operators, apply date of publication limiters) drawn from Bailey (2017) to provide a holistic view of the SAL experience.

In summary, reviewers were in alignment with the four psychological processes of self-efficacy, but suggested some additional constructs, such as perceived benefits, anticipated outcomes, confidence in knowledge, social processes, survival, and new ways of seeing selection. Although I would have liked to incorporate all constructs, I added scales pertaining only to social processes and search ability for the reasons described above. This led to the addition of the OAHS and SA scales. Each of these constructs could improve understanding of learning using search and I am grateful to the reviewers for their expert opinions.

Item Pool Feedback/Evaluation

Based on guidance from DeVellis (2017), reviewers were asked to evaluate each question item on the scale according to two criteria: (a) relevancy and (b) clarity; there was an additional option for “include/exclude,” and space to provide “open feedback.” Include/exclude asked participants to make a judgement call on whether the item was an appropriate measure of the psychological process. Relevancy asked participants to judge its applicability on a scale of *low*, *medium*, and *high*. Clarity referred to their perceptions of the comprehensibility of the statement and is inclusive of potential bias and assumptions made by some of the questions. Participants were asked to assess the sentence characteristics on qualities such as ambiguity, simplicity, conciseness, and phrasing (e.g., double negatives and double-barrelled) on a scale of *low*, *medium*, and *high*. The open feedback column provided additional room for participants to rationalise their assessment, although most participants included the rationalization in the same cell as the rating. The original scale constructs can be found on Table 3 in Chapter 3.

Most reviewers opted to retain the items presented in the scale with minor modifications to item clarity. For example, one participant raised the question in the Cognitive Planning subscale about whether participants rating themselves on the item “Plan my search strategy before I begin a learning task” would know the definition or outputs of a search strategy. In all, 12 items were recommended for exclusion across all four psychological processes, but there was no clear consensus between experts.

For the Motivation subscale, one reviewer recommended the exclusion of one item, “I know I can master the skills needed to learn independently using search,” because this subscale did not include items that indicated learning how to search; no other reviewers commented on the item.

For the Affective subscale, one reviewer recommended exclusion of two items ("If I encounter difficulties, I can easily change a negative emotion to a positive emotion" and "Correctly identify my own negative emotions"). These items were questioned for their purpose in the scale and whether respondents would fully understand why they was being asked.

Inclusive of all the cognitive subscales one reviewer recommended excluding four items ("Find alternate sources of information if I am having a hard time understanding information online," "Choose which words I am going to enter in the search box," "Judge how well the information I find matches my learning needs," and "Plan where I am going to look for information") due to their overlap with other items that could be slightly modified to represent the ideas in the question items. Another recommended excluding two items ("I stop from time to time to check my progress on a learning task" and "Choose which words I am going to enter in the search box"). The first item was recommended for exclusion because it assumed the monitoring of progress and searching are not the same thing. The second item was like another item in the list.

For the Selection subscale, one reviewer recommended excluding two items ("Use electronic information sources" and "Use different kinds of print sources [e.g., books, periodicals, encyclopedias, chronologies]"). They said the former was too basic of an idea and the latter represented resources that were not likely used in the modern world). One reviewer recommended the exclusion of one item ("Limit search strategies by subject, language, and date in a search system") because it felt specific to a kind of search system. The most beneficial data for my analysis were the item-level written feedback comments as they helped me to understand rationales for inclusion or exclusion.

Following the expert review, I and my supervisor evaluated the feedback from the reviewers and made significant changes to the scale (see Section 4.1). I used the overall feedback to revise the scale items by reexamining both the purpose and phrasing of each item. Additionally, I selected new question items from the existing scales and new scales to better meet the feedback provided. For the written revisions to the item-level questions see Appendix A.4.

The next section provides high-level feedback from the reviewers on items intended to measure each of the four psychological processes. A summary of the scales used in the final questionnaire and their reliability are presented in Table 11. The revised selected scales resulting from feedback from the expert review study are described in following sections.

Table 11

Scale-Modification Matrix

	Before expert review		After expert review		
Category	Scale name	Selected scale items	Scale name	Items in final scale	Source
Motivation	Academic Self-Efficacy (ASE)	2	-same-	3	Midgley et al., 2013
	Self-efficacy and metacognition learning inventory (SEMLI)	4	-same-	3	Thomas et al., 2008
Affective	Emotional Self-Efficacy (ESE; Kirk et al., 2008)	5	Regulatory Emotional Self-Efficacy (RESE)	8	Caprara et al., 2008
Cognitive	Metacognitive Information Likert-Based Knowledge (MILK)	15	-same-	8	Gorrell et al., 2009
	Self-efficacy and metacognition learning inventory (SEMLI)	10	-same-	8	Thomas et al., 2008
	N/A		Online Academic Help-Seeking (OAHS)	9	Cheng & Tsai, 2011
Selection	Information Literacy Self-Efficacy (ILSE)	28	-same-	4	Kurbanoglu et al., 2006
	Metacognitive Information Likert-Based Knowledge (MILK)	1	-removed-		Gorrell et al., 2009
	N/A		Search Ability (SA)	7	Bailey, 2017
Total		65 items		50 items	

Note. This table lists the scales used before and after expert review in the creation of the final item pool categorised by the type of self-efficacious psychological process.

Motivational Processes of Self-Efficacy Feedback. Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994). The purpose of motivational items was to understand changes to motivation, defined as persistence and self-beliefs. Experts reviewed a total of five items: three items from the ASE scale (Midgley et al., 2013) and two items from the SEMLI Self-Efficacy subscale (Thomas et al., 2008).

The motivational self-efficacy scale items were largely accepted. Modifications to some of the items were requested, such as ensuring the items were all worded positively to avoid confusion in the scoring. One reviewer was particularly aware of the use of "search" in the items and asked whether that was standard language for the way people think about search. And one reviewer commented on the concept of persistence not being adequately represented. Feedback from the review resulted in a few changes to the questions. Whereas the question items in both Midgley et al.'s (2013) and Thomas et al.'s (2008) scales were similar, Midgely et al.'s items were more representative of persistence and effort, whereas Thomas et al.'s questions were more representative of self-concept. The final scale removed two items from the SEMLI scale because they focused on how the information would be used or applied, which was out of scope for this research. See Table 12 for revisions made to the items.

Table 12

Motivational Processes: Status of Self-Efficacy Items

Prefeedback items	Postfeedback items	Scale name	Source
I know I can learn on my own if I don't give up.	Revised: Learn on my own if I try.	ASE	Midgley et al., 2013
I know that even if the work is hard, I can learn it.	Revised: Even if the work is hard, I can learn it.	ASE	Midgley et al., 2013
I know I can master the skills needed to learn independently using search.	Revised: Master the skills needed to learn independently.	SEMLI	Thomas et al., 2008
I'm confident that I will understand the most complex information that I read online if I try.	Revised: Understand complex concepts from information I find online.	SEMLI	Thomas et al., 2008
I'm certain I can figure out how to organize the information I find online.	Removed	SEMLI	Thomas et al., 2008
I'm confident I will be able to apply the information I find online to my work or learning goals.	Removed	SEMLI	Thomas et al., 2008
	Added: Understand the basic concepts from information I find online.	SEMLI	Thomas et al., 2008
	Added: Figure how to do the most difficult tasks.	ASE	Midgley et al., 2013

Note. ASE = Academic Self-Efficacy; SEMLI = Self-Efficacy and Metacognition Learning Inventory.

Affective Processes of Self-Efficacy Feedback. The purpose of the affective process items list was to understand changes to one's ability to regulate emotion when learning using search. Experts reviewed five question items from the ESE scale (Kirk et al., 2008). One reviewer questioned the implications of the scale and argued that the scale's question items were priming participants to choose stronger emotions. Two reviewers remarked that they did not see a clear reason why being able to correctly identify negative emotions was important or relevant in this context. Upon further investigation of the feedback, I concurred and found at least two items in the original scale focusing on either the ability to correctly identify negative emotions and changing negative emotions to positive emotions, which may cast judgement on the presence of negative emotions and the hedonistic value placed on positive emotions (Moore, 2019). Based on the overall feedback of the items in the scale and due to the low number of items, I replaced this scale in its entirety with a subscale from the Regulatory Emotional Self-Efficacy Scale (RESE).

RESE contains both positive and negative affective dimensions and stems from Bandura's previous work in understanding affective self-efficacy (Bandura et al., 2003). The RESE contains three subscales: Perceived Self-Efficacy in Expressing Positive Affect, Managing Despondency, and Managing Negative Affect. The latter two pertain to managing negative affect. The reliability of the scale was tested across three populations (Italians, Americans, and Bolivians) with each subscale achieving at least an $\alpha > .64$ (Caprara et al., 2008). All included RESE items were rewritten in a way that addressed regulation from the perspective of reducing the impact or effect of emotions on the learning experience using terms such as "reduce "or "keep." See Table 13 for revisions made to the items.

Table 13

Affective Processes: Status of Self-Efficacy Items

Prefeedback items	Postfeedback items	Scale name	Source
If I encounter difficulties, I can easily change a negative emotion to a positive emotion.	Removed	ESE	Kirk et al., 2008
Regulate my own emotions when close to reaching a learning goal.	Removed	ESE	Kirk et al., 2008
Calm down when feeling angry.	Removed	ESE	Kirk et al., 2008
Regulate my own emotions when under time pressure.	Removed	ESE	Kirk et al., 2008
Correctly identify my own negative emotions.	Removed	ESE	Kirk et al., 2008
	Added: Express joy when good things happen to me.	RESE	Caprara et al., 2008
	Added: Feel gratified when I accomplish what I set out to do.	RESE	Caprara et al., 2008
	Added: Rejoice in my successes.	RESE	Caprara et al., 2008
	Added: Express enjoyment freely when learning.	RESE	Caprara et al., 2008
	Added: Keep from feeling dejected when I do not understand what I’m learning.	RESE	Caprara et al., 2008
	Added: Keep from getting discouraged by strong criticism.	RESE	Caprara et al., 2008
	Added: Reduce how upset I feel when underappreciated.	RESE	Caprara et al., 2008
	Added: Keep from getting discouraged in the face of difficulties.	RESE	Caprara et al., 2008

Note. ASE = academic self-efficacy; RESE = regulatory emotional self-efficacy.

Cognitive Processes of Self-Efficacy Feedback. Cognitive processes involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. The purpose of these items is to understand the change in cognition during the information-seeking process. I used Gorrell et al.'s (2009) MILK framework (i.e., schema training, planning, monitoring, evaluating, and transfer) to categorise individual items, but drew from a variety of scales to create the final item list.

The cognitive self-efficacy subscales were largely accepted by the reviewers with recommendations related to preferences for some items over others. Planning subscales had the most feedback with two reviewers pointing out that planning a search is likely not going to occur with lay searchers. They wondered if the questions in the scale implied there was only one opportunity to plan—a process that may not capture the reality of working learners who may encounter changes in priorities and other factors. Significant revisions were made to the question items to improve their clarity, and an additional scale was included that addressed the social processes from the construct-level feedback (Section 4.1).

The next section describes the feedback segmented by the four subscales involved in cognitive processes borrowed from Gorrell's (2009) metacognitive search taxonomy: schema training, planning, monitoring, and evaluation.

Schema Training–Cognitive Processes of Self-Efficacy Subscale. In schema training it is assumed that search tasks require a person to understand the "known methods for finding information" (Gorrell et al., 2009, p. 453) that are manifested in the use of graphic organisers such as mind maps and to-do lists, as well as fact checking behaviours to resolve content conflicts**.**

Experts reviewed four items from the MILK taxonomy (Gorrell et al., 2009) related to schema training. Feedback from the review process resulted in one item ("Remember the information sources I find") being removed because it was not considered relevant for the context of the scale's use; remembering information sources was considered by the researchers to be too general and not supported in the information seeking literature—most people have difficulty refinding precise information they find online (Capra et al., 2005) and may not distinguish between what is stored in personal memory and what is stored online (Ward, 2021). One item ("Identify the type of information I need for my learning tasks") was retained and two were revised for phrasing purposes. Four new items were added to represent the dynamic nature of web searching more adequately and schema training. See Table 14 for revisions made to the items.

Table 14

Schema Training Cognitive Processes: Status of Items

Prefeedback items	Postfeedback items	Scale name	Source
Remember the information sources I find.	Removed	MILK	Gorrell et al., 2009
Identify the type of information I need for my learning tasks.	Retained: Identify the type of information I need for my learning tasks.	MILK	Gorrell et al., 2009
Choose words that tell a search engine what I am looking for.	Revised: Choose words or phrases that tell a web search engine what I am looking for.	MILK	Gorrell et al., 2009
Use different searching approaches depending on the particular goal I have.	Revised: Use different search approach depending on the particular goal I have.	MILK	Gorrell et al., 2009
	Added: Find alternate sources of information if I am having a hard time understanding information online.	MILK	Gorrell et al., 2009
	Added: Use strategies (e.g., mind maps) to help me understand the information I find when searching online.	MILK	Gorrell et al., 2009
	Added: Decide on the type of information I need to complete a learning task.	MILK	Gorrell et al., 2009
	Added: Use the information I find online to generate new words/terms.	MILK	Gorrell et al., 2009

Note. MILK = Metacognitive Information Likert-Based Knowledge.

Planning–Cognitive Processes of Self-Efficacy Subscale. *Planning* tasks assume searchers know what information they need to find, which implies they have already identified the information need, problem, or question they need answered. Experts reviewed nine items: four items from the MILK taxonomy (Gorrell et al., 2009) and five items from the SEMLI subscales (Thomas et al., 2008). Most items were removed from the MILK planning subscale because they focused on search strategies, which was better captured in the shorter SEMLI subscales. One item from the SEMLI subscale was retained, one item was revised due to phrasing, and one item was added because of its better representation of goal-oriented planning. See Table 15 for revisions made to the items.

Table 15

Planning Subscale: Status of Items

Prefeedback items	Postfeedback items	Scale name	Source
Plan where I am going to look for information.	Removed	MILK	Gorrell et al., 2009
Choose which words I am going to enter in the search box.	Removed	MILK	Gorrell et al., 2009
Plan my search strategy before I begin a learning task.	Removed	MILK	Gorrell et al., 2009
	Added: Create a search plan before I look for information online.	SEMLI	Thomas et al., 2008
Can decide what information is relevant and what is not.	Removed	MILK	Gorrell et al., 2009
Adjust my search plan if I am not making progress on a learning task.	Removed	SEMLI	Thomas et al., 2008
Assess whether or not a search plan is necessary for a learning task before I search.	Removed	SEMLI	Thomas et al., 2008
Predict possible problems that might occur with my search.	Retained: Predict possible problems that might occur with my search.	SEMLI	Thomas et al., 2008
Select a search system (e.g., web search or library search) that is best to use before I begin a learning task.	Removed	SEMLI	Thomas et al., 2008
Understand the aim of a search task before I begin searching.	Removed	SEMLI	Thomas et al., 2008
	Added: Articulate my goal before I begin looking for information online.	SEMLI	Thomas et al., 2008

Note. MILK = Metacognitive Information Likert-Based Knowledge; SEMLI = Self-Efficacy and Metacognition Learning Inventory.

Monitoring–Cognitive Processes of Self-Efficacy Subscale. *Monitoring* refers to the awareness of progress being made on the task as well as understanding the credibility or reliability of information found (Gorrell et al., 2009). Experts reviewed three items from the SEMLI scale (Thomas et al., 2008). Feedback from the expert review resulted in the following changes: two items were revised in the monitoring subscale to generalise the item to its context of use. One item was removed from the SEMLI Monitoring, Evaluation and Planning subscale because it was too general and replaced with a search-specific question. To address the feedback about social processes from the construct review, nine additional items were added from a newly identified OAHS scale that draws from formal (five items) and informal (four items) query subscales. Items were significantly adapted in wording to meet the self-efficacy scale construction guidelines as outlined by Bandura. However, these scale items were better aligned to the SAL research agenda in natural settings. See Table 16 for revisions made to the items.

Table 16

Monitoring Subscale: Status of Items

Prefeedback items	Postfeedback items	Scale name	Source
Check in on my progress when learning using search.	Revised: Keep track of my progress when I am searching for information online.	SEMLI	Thomas et al., 2008
Stop searching from time to time to check my learning progress.	Revised: Stop and check my progress on a learning task when searching online.	SEMLI	Thomas et al., 2008
I’m confident that I will understand the basic concepts that I read online.	Removed	SEMLI	Thomas et al., 2008
	Added: Adjust my search terms if I am not making progress.	SEMLI	Thomas et al., 2008
	Added: Find an expert to help me with something I’m learning.	OAHS	Cheng & Tsai, 2011

Prefeedback items	Postfeedback items	Scale name	Source
	Added: Email experts within my network for help with something I'm learning.	OAHS	Cheng & Tsai, 2011
	Added: Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning.	OAHS	Cheng & Tsai, 2011
	Added: Reach out to experts in my community (e.g., Slack, LinkedIn) for help with something I'm learning.	OAHS	Cheng & Tsai, 2011
	Added: Reaching out to experts using my personal network (e.g., text messaging) for help with something I'm learning.	OAHS	Cheng & Tsai, 2011
	Added: Find a group of friends or peers that can help me with something I'm learning.	OAHS	Cheng & Tsai, 2011
	Added: Find help by posting to web forums when I'm learning something.	OAHS	Cheng & Tsai, 2011
	Added: Ask peers for help using popular blogging sites (e.g., Medium) when I'm learning something.	OAHS	Cheng & Tsai, 2011
	Added: Ask peers questions on community websites (e.g., Reddit) when I'm learning something.	OAHS	Cheng & Tsai, 2011

Note. OAHS = Online Academic Help-Seeking; SEMLI = Self-Efficacy and Metacognition Learning Inventory.

Evaluation–Cognitive Processes of Self-Efficacy Subscale. Evaluation refers to the ability to critically evaluate a search and the relevance of what is found as well as how to use the information. Experts reviewed a total of seven items: five items from the MILK evaluation subscale (Gorrell et al., 2009) and two items from the SEMLI scale (Thomas et al., 2008). Most feedback in this area suggested that people may not necessarily have a variety of approaches for executing on a single learning strategy (e.g., memory recall) and questioned whether inclusion of specific strategies would be relevant in this scale. Others were unclear about what was meant by the strategies mentioned. I decided to remove four items because they were not well aligned to the concept of evaluation. Instead, I revised the three remaining items because of their focus on the assessment of key elements in the information-seeking process in a learning context. See Table 17 for revisions made to the items.

Table 17

Evaluation Subscale: Status of Items

Prefeedback items	Postfeedback items	Scale name	Source
Have a variety of approaches to recall what I need from my search.	Removed	MILK	Gorrell et al., 2009
Understand what I read online.	Removed	MILK	Gorrell et al., 2009
Remember what I learned	Removed	MILK	Gorrell et al., 2009
Judge how well the information I find matches my learning needs.	Revised: Judge how well the information I find matches my learning needs.	MILK	Gorrell et al., 2009
Assess the effectiveness of my search keywords.	Removed	MILK	Gorrell et al., 2009
Assess how much I am learning during a search task.	Revised: Assess how much I'm learning during a search.	SEMLI	Thomas et al., 2008
Evaluate my search processes with the aim of improving them.	Revised: Evaluate my searches as I look for information online.	SEMLI	Thomas et al., 2008

Note. MILK = Metacognitive Information Likert-Based Knowledge; SEMLI = Self-Efficacy and Metacognition Learning Inventory.

Transfer–Cognitive Processes of Self-Efficacy Subscale. Transfer refers to learning that is carried between (search) tasks. Experts reviewed two items from the MILK transfer subscale (Gorrell et al., 2009). See Table 18 for revisions made to the items. Because web search systems are not commonly discipline-specific, it may be assumed that the skills in learning using one web search engine (e.g., Google) can be easily applied to other web search engines (e.g., Bing, DuckDuckGo; Gorrell et al., 2009). It is important to note information literacy instruction is shifting to teach the conceptual models of search systems and is aimed at the transferability of search skills between disciplines (Fuchs & Ball, 2021). This suggests that the strategies used in previous search tasks may be carried forward in new search tasks (Gorrell et al., 2009). I removed the transfer subscale because it was not applicable to the context under which self-efficacy was investigated, although I acknowledge the inclusion of these items may be valuable when thinking about longitudinal investigations (e.g., months) across different types of tasks.

Table 18

Transfer Subscale: Status of Items

Prefeedback items	Postfeedback items	Source
Use procedures that have proved useful in other tasks to help me to work out what information I need now.	Removed	Gorrell et al., 2009
Apply lessons I have learned from previous searches.	Removed	Gorrell et al., 2009

Selection Processes of Self-Efficacy Scale Feedback. Selection processes refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). The purpose of this item set was to understand if learning using search changes search ability. Experts reviewed a total of nine items: one item from the MILK taxonomy (Gorrell et al., 2009) and eight items from ILSE (Kurbanoglu et al., 2006). Reviewers were curious about whether web searchers would find the questions relevant to their task and they suspected lay searchers would not know what was meant by some questions, e.g., would all participants understand what a search strategy means? It was a significant challenge to find the right balance between technical specificity of terms, such as Boolean operators, and the generality of words such as "functions." In the end, I removed one item from the MILK taxonomy as well as four items from the ILSE scale with outdated phrasing (e.g., "Use electronic information sources") or used techniques that were better captured by the SA scale. The SA scale is an 11-item scale that rates the familiarity of tools and techniques in search. I added seven items (see Table 19) that represented search techniques, but excluded four items with vague statements (e.g., "Find articles of same quality as expert searcher"; Bailey, 2017).

Table 19

Selection Processes: Status of Items

Prefeedback items	Postfeedback items	Scale name	Source
Know the functions that a search engine offers.	Removed	MILK	Gorrell et al., 2009
Limit search strategies by subject, language, and date in a search system.	Revised: Use the advanced features of a web search engine (e.g., allintitle:).	ILSE	Kurbanoglu et al., 2006
Initiate search strategies by using keywords and Boolean logic (e.g., AND, OR, NOT).	Revised: Use Boolean logic (e.g., AND, OR, NOT) to refine my searches.	SA; ILSE	Kurbanoglu et al., 2006; Bailey, 2017
Use different kinds of print sources (e.g., books, periodicals, encyclopedias, chronologies).	Removed	ILSE	Kurbanoglu et al., 2006
Use electronic information sources.	Removed	ILSE	Kurbanoglu et al., 2006
Locate information sources in a digital library (e.g., ACM Digital Library).	Revised: Find information in a specialized digital library (e.g., ACM Digital Library).	ILSE	Kurbanoglu et al., 2006
Use different kinds or types of digital libraries.	Removed / Duplicate	ILSE	Kurbanoglu et al., 2006
Use internet search tools (such as search engines, directories, etc.).	Revised: Use a web search engine to find information I need.	ILSE	Kurbanoglu et al., 2006
Use different kinds (types) of digital libraries.	Removed	ILSE	Kurbanoglu et al., 2006
	Added: Use truncation techniques to broaden my search.	SA	Bailey, 2017

Prefeedback items	Postfeedback items	Scale name	Source
	Added: Limit my searches using quotes	SA	Bailey, 2017
	Added: Limit my searches by publish date	SA	Bailey, 2017
	Added: Limit my searches by location	SA	Bailey, 2017
	Added: Limit my searches by type of information	SA	Bailey, 2017
	Added: Limit my searches by price	SA	Bailey, 2017
	Added: Exclude specific sites from my searches	SA	Bailey, 2017

Note. ACM = Association for Computing Machinery; ILSE = Information Literacy Self-Efficacy; MILK = Metacognitive Information Likert-Based Knowledge; SA = Search Ability.

4.2 Evaluating the SALSE Scale

Development samples are often administered to many people (i.e., 300+) because smaller samples may result in high internal consistencies (DeVellis, 2017). In Phase 2, I deployed the SALSE scale to conduct some preliminary analysis, bearing in mind the limitations of small-scale implementation while also having a way in which to understand the role of self-efficacy with working adult learners searching on self-selected tasks in their natural environments (Phase 2). Natural setting studies are commonly highly qualitative and not conducive to large-scale survey administration. During the Phase 2 study, the scale was presented to participants before they started a self-generated learning task and again at the end of the 5 days. Sixteen individuals completed the SALSE on two different occasions, providing 32 cases for analysis. (For the full study design, see Section 3.2. For recruitment and participant details refer to Sections 3.2 and 5.1 respectively.)

Important considerations for understanding the newly developed SALSE scale are reliability and validity. Reliability is defined as the consistency or reproducibility of the measurement in this context. Validity is defined as the accuracy of the measure. Several different types of validity can be considered: content validity, criterion-related validity, and construct validity (DeVellis, 2017). Content validity is linked to the definition of the construct and uses nonempirical evidence to assess whether a set of items reflects a specific content domain. Face validity (Section 4.1) is often conflated with content validity, but content validity is more rigorous with defined. Criterion-related validity shows the measure is differentiated in a way that predicts the criterion of importance (e.g., behaviour) and is determined using empirical evidence such as correlation, regression, and factor analysis. Construct validity studies the relationship among the latent variables using, for example, correlation or factor analysis (DeVellis, 2017).

This dissertation focuses on examining the reliability, face validity (through the expert review described above), and construct validity of SALSE. The remainder of this chapter describes the reliability analysis of the scale data. Construct validity is explored in Chapter 5, as the SALSE is used to segment participants according to their change in self-efficacy to probe this change in the interview data. Criterion-related validity was not performed as neither learning outcomes nor inclusion of other validation scales were included in Phase 2 to avoid participant fatigue.

Reliability

All analyses were conducted in SPSS version 28. Data cleaning was conducted to check for missing responses and ensure all the data were accurate. There was no missing data and none of the question items require reverse scoring. Data from participants who completed the full study (both the surveys and the interview; $N = 16$) are included in this analysis.

Subscale averages were calculated in SPSS by summing the items per subscale and dividing by the number of items. Pre and posttest items were combined for a total of 32 observations (i.e., 16 participants x 2). Because this questionnaire has different numbers of question items in each subscale, the mean of each subscale is reported to give equal weight to each subscale (O'Brien et al., 2018). Cronbach's alpha scores were calculated using reliability analysis. A higher value for the correlation is more desirable (DeVellis, 2017) and has the following designations: low (< .4), moderate (.5–.7), and high (> .7) correlations (Hinkle et al., 1988). Alphas for each of the subscales (see Table 20) suggested good internal consistency.

Table 20

Reliability of the Search as Learning Self-Efficacy (SALSE) Scale

Construct	*n* of items	*M* and *SD*	Reliability
Motivational SE	6	76.69 ± 13.47	α = .887
Affective SE	8	71.29 ± 15.26	α = .854
Cognitive SE	25	67.75 ± 17.26	α = .940
C.1 Schema training	7	75.86 ± 15.74	α = .855
C.2 Planning	3	56.45 ± 24.20	α = .834
C.3 Monitoring	12	62.07 ± 22.15	α = .920
C.4 Evaluation	3	69.57 ± 21.17	α = .795
Selection SE	11	61.21 ± 24.97	α = .912
SALSE	50		α = .95

Note. SE = self-efficacy. The table outlines statistics for the pre- and post-test using all 32 observations and the 50 items in the deployed SALSE scale from Phase 2.

DeVellis (2017) recommended alphas above .70, but alphas over .90 should flag the researcher to shorten the scale. This suggests that the number of items for monitoring and selection could be reduced in future analysis with a larger sample (DeVellis, 2017; Gorrell et al., 2011).

Interitem Correlations

An initial exploration of the data was conducted to examine means, standard deviations, and item-total correlations of SALSE subscale items for the 32 cases. The purpose of item-scale correlations is to check whether individual items correlate with remaining items and helps the researcher determine the effects of retaining or removing individual items. Item means close to the midpoint (50) were considered desirable, as the range of possible scores are from 0 to 100. Means too near to either extreme (0 or 100) may have low variances and contribute to a reduction in interitem correlation. I took a more conservative approach to removing items to avoid eliminating too many items during this initial exploratory phase.

Motivational Processes

Cronbach's alpha for the six items was good at .887. The item means variance was 42.92. The item with the lowest corrected item-correlation of .571 was Item 5, "Understand the basic concepts from the information I find online." Removing this item maintained the alpha at .887 and reduced the item means variance to 31.17. Table 21 represents the 5-item scale of motivational self-efficacy.

Table 21

Motivation Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
1	Learn on my own if I try.	83.22	14.509	0.707	0.589	0.870
2	Even if the work is hard, I can learn it.	77.00	17.753	0.704	0.646	0.868
3	Figure how to do the most difficult tasks.	68.22	17.342	0.734	0.661	0.861
4	Master the skills needed to learn independently.	72.69	18.317	0.849	0.763	0.833
6	Understand complex concepts from the information I find online.	73.66	19.418	0.667	0.593	0.879

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Affective Processes

Cronbach's alpha for the eight items was good at .854. The item means variance was 219.88. Item 8, "Feel gratified when I accomplish what I set out to do," had a low item-total correlation of .383 and was removed. Removing this item increased the alpha of the scale to .858 and lowered the item means variance slightly to 209.30. I then removed Item 9, "Rejoice in my successes," due to a low corrected item-total correlation of .345. The alpha increased to .873 with a moderate decline in the item means variance to 203.40. I then removed Item 7, "Express joy when good things happen," to me which had a low corrected item-total correlation of .318. This increased the alpha to .901 and reduced the item means variance to 160.00. Table 22 represents the final 5-item affective scale of self-efficacy.

Table 22

Affect Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
10	Express enjoyment freely when learning.	84.66	16.732	0.629	0.514	0.907
11	Keep from feeling dejected when I do not understand what I'm learning.	58.06	27.838	0.731	0.743	0.89
12	Keep from getting discouraged by strong criticism.	59.34	24.531	0.815	0.826	0.865
13	Reduce how upset I feel when underappreciated.	51.5	23.887	0.833	0.769	0.861
14	Keep from getting discouraged in the face of difficulties.	61.97	22.075	0.816	0.864	0.867

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Cognitive Processes

Schema Training. Cronbach's alpha for the seven items was good at .855. It had an item means variance of 88.02. Item 15, "Find alternate sources of information if I am having a hard time understanding information online," had a low corrected item-total correlation of .422 and was removed. This change increased the alpha to .859 and increased the item means variance to 104.53. Table 23 represents the final 6-item cognitive schema training self-efficacy scale.

Table 23

Schema Training Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
16	Use different search approach depending on the particular goal I have.	82.53	17.572	0.581	0.405	0.848
17	Choose words or phrases that tell a web search engine what I am looking for.	85.94	13.325	0.487	0.438	0.863
18	Use strategies (e.g., mind maps) to help me understand the information I find when searching online.	59.53	29.793	0.752	0.659	0.822
19	Decide on the type of information I need to complete a learning task.	68.5	28.997	0.826	0.828	0.801
20	Identify the type of information I need for my learning tasks.	73.5	21.437	0.749	0.731	0.817
21	Use the information I find online to generate new words/terms.	83	15.571	0.649	0.561	0.842

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Planning. Cronbach's alpha for the three items was good at .834. It had an item means variance of 127.34. No items were removed as three items are better for measuring a construct and the removal of the lowest item would have increased the alpha to .922 (DeVellis, 2017). Table 24 represents the final 3-item cognitive planning self-efficacy scale.

Table 24

Planning Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
22	Create a search plan before I look for information online.	50.84	29.828	0.87	0.809	0.575
23	Articulate my goal before I begin looking for information online.	69.44	26.247	0.522	0.396	0.922
24	Predict possible problems that might occur with my search.	49.06	27.625	0.722	0.753	0.742

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Monitoring. Cronbach's alpha for the 12 items was excessive at .920. It had an item means variance of 147.24. Removed item 35, "Ask peers for help using popular blogging sites [e.g., Medium] when I'm learning something," because the corrected item-total correlation was .499. Removing this item had minimal impact on the alpha (.921) but reduced the item means variance to 118.84. Table 25 represents the final 11-item cognitive monitoring self-efficacy scale.

Table 25

Monitoring Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
25	Stop and check my progress on a learning task when searching online.	57.16	30.288	0.585	0.818	0.919
26	Keep track of my progress when I am searching for information online.	58.69	32.328	0.567	0.808	0.920
27	Adjust my search terms if I am not making progress.	86.22	12.579	0.673	0.732	0.920
28	Find an expert to help me with something I'm learning.	70.03	28.158	0.703	0.740	0.913
29	Email experts within my network for help with something I'm learning.	65.25	31.608	0.850	0.853	0.906
30	Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning.	58.13	33.92	0.818	0.905	0.907
31	Reach out to experts in my community (e.g., slack, LinkedIn) for help with something I'm learning.	65.63	32.254	0.814	0.848	0.908
32	Reach out to experts using my personal network (e.g., text messaging) for help with something I'm learning.	67.13	32.098	0.578	0.700	0.920
33	Find a group of friends or peers that can help me	74.78	27.448	0.793	0.845	0.910

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
	with something I'm learning.					
34	Find help by posting to web forums when I'm learning something.	52.75	32.647	0.719	0.764	0.913
36	Ask peers questions on community websites (e.g., Reddit) when I'm learning something.	46.91	32.676	0.623	0.769	0.917

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Evaluation. Cronbach's alpha for the three items was good at .795. This subscale had an item means variance of 47.29. No items were removed as three items are better for measuring a construct. Table 26 represents the 3-item cognitive evaluation self-efficacy scale.

Table 26

Evaluation Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
37	Evaluate my searches as I look for information online.	69.41	26.533	0.651	0.534	0.709
38	Assess how much I'm learning during a search.	62.78	28.711	0.807	0.651	0.52
39	Judge how well the information I find matches my learning needs.	76.53	19.153	0.524	0.362	0.84

Note. *N* = 32. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Selection Processes

Cronbach's alpha for the 11 items was excessive at .912. It had an item means variance of 177.44. Item 40, "Use a web search engine to find the information I need," was removed because of its low corrected item-total correlation of .116. Removing Item 40 did not change the alpha (.921) but reduced the item means variance to 99.12. Table 27 represents the 10-item selection process self-efficacy scale.

Table 27

Selection Items Statistics

Item #	Question item	*M*	*SD*	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
41	Find information in a specialized digital library (e.g., ACM Digital Library).	46.41	36.113	0.622	0.562	0.917
42	Use truncation techniques to broaden my search.	62.97	35.355	0.621	0.829	0.917
43	Limit my searches using quotes.	65.97	37.95	0.751	0.709	0.91
44	Limit my searches by publish date.	67.63	34.639	0.841	0.902	0.905
45	Limit my searches by location.	65.28	36.251	0.799	0.92	0.907
46	Limit my searches by type of information.	70.06	34.709	0.708	0.7	0.913
47	Limit my searches by price	62.19	37.233	0.699	0.879	0.913
48	Exclude specific sites from my searches.	42.13	32.138	0.672	0.765	0.915
49	Use the advanced features of a web search engine (e.g., allintitle:).	50.63	38.324	0.686	0.709	0.914
50	Use Boolean logic (e.g., AND, OR, NOT) to refine my searches.	50.53	34.27	0.625	0.75	0.917

Note. *N* = 32. ACM = Association for Computing Machinery. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Summary

The interitem correlations were examined to reduce the number of potential items in the scale. The process of examining the intertotal correlation resulted in a reduction of seven items total, leaving a remainder of 43 question items that may be useful when reevaluating the scale for future use. Table 28 shows the number of question items and the subscale's Cronbach's alpha before and after the scale optimization process.

Table 28

SALSE Scale Optimization

	Before item removal		After item removal	
Psychological process of self-efficacy	*n* items	Cronbach Alpha	*n* items	Cronbach Alpha
Motivational	6	.887	5	.887
Affective	8	.854	5	.901
Cognitive schema training	7	.855	6	.859
Cognitive planning	3	.834	3	.834
Cognitive monitoring	12	.920	11	.921
Cognitive evaluation	3	.795	3	.795
Selection	11	.912	10	.912
Total	50		43	

Note. $N = 32$. This table displays the scale optimization from the item-total correlation analysis. It uses all 32 observations from the pre- and post-scale measures.

Correlation of Subscales

The subscales were recalculated by summing the revised set of items and dividing by the total number of items for each subscale in SPSS. All subscales were positively correlated ($p > .05$) with exception to the Motivation subscale, which was not correlated with Schema Training, Planning, Evaluation, or Selection; the Affective subscale was not correlated with Evaluation or Selection; and Monitoring was not correlated with Selection. Additionally, there were some low correlations ($r < .4$) and moderate correlations (r is between .4 and .6), yet many were highly correlated ($r > .6$). Highly correlated items suggest some overlap between question items and may not return distinct results upon performance of a factor analysis (DeVellis, 2017). See Table 29 for the correlation matrix. However, as this is an initial exploratory analysis of the scale. Future work with a larger development sample and a more robust analysis (i.e., factor analysis) may give a clearer picture of the scale composition.

Table 29

Correlation Matrix of Revised Subscales

	M	*SD*	Motivation	Affective	C1. Schema Training	C2. Planning	C3. Monitoring	C4. Evaluation
Motivation	74.96	14.56	–					
Affective	63.11	19.72	**.539****	–				
C1. Schema training	75.50	16.88	0.33	**.606****	–			
C2. Planning	56.45	24.20	0.109	**.381***	**.662****	–		
C3. Monitoring	63.88	22.58	**.631****	**.431***	**.625****	**.446***	–	
C4. Evaluation	69.57	21.17	0.248	0.349	**.721****	**.610****	**.578****	–
Selection	58.38	27.33	0.035	0.278	**.506****	**.591****	0.158	**.457****

Note. $N = 32$. Subscale correlations were analysed using all 32 observations from the pre- and post-scale measures.
* $p < .05$
** $p < .001$

4.3 Discussion

Self-efficacy plays an important role in learning by supporting persistence and depth of learning. DeVellis (2017) provided guidance for understanding the scale development process, and Bandura (2006) provided an understanding of how to develop a self-efficacy scale.

Developing a scale is a rigorous and collaborative process that is both art and science. I worked with experts and my supervisor to evaluate the constructs represented in the scale and the merit of individual items. DeVellis's (2017) recommended developing scales using a phased approach in which one first understands the domain, generates an item pool, selects a format of measurement, reviews the constructs and items with experts, and evaluates the items after administering the scale to a development sample, concluding with optimizing the scale for length. Self-efficacy is a rich and diverse construct that is context dependent; one person's capabilities in one area does not necessarily reflect their capabilities in another. Additionally, self-efficacy commonly examines only one psychological process (e.g., cognition) to narrow the focus of the study. However, this scale included all four psychological processes to better understand the experience of learning using search. Based on the expert review, I found that other constructs such as perceived benefit, anticipated outcomes, confidence in one's knowledge, social processes, and survival may be important to consider when constructing a self-efficacy scale. I weighed the benefits and drawbacks of the feedback from the expert review and revised the question items as well as reconsidered alternative validated scales while adhering to the study's research objectives.

The key takeaway from the scale development process was that most existing self-efficacy scales focus on measuring a single psychological process, rather than all four psychological processes that make up Bandura's theory of self-efficacy. The goal of the current research was to include motivational, affective, cognitive, and selection processes to gain a richer understanding learners' self-efficacy. A limitation of this work is that the scale was not validated with an appropriately sized development sample. Significant work remains ahead before this scale can be reliably used in future studies.

4.4 Chapter Summary

In Phase 1, the goal was to answer the first research question RQ1.1: How can a working adults' sense of self-efficacy be measured when learning using search? The research was guided by DeVellis's (2017) scale development process guidelines and Bandura's (1977) theory of self-efficacy. I used Bandura's four psychological processes as the theoretical basis for the scale, which supported the identification of previously validated scales to build the new SALSE scale. An expert review was conducted to gather feedback on the rating scale, higher level constructs, and individual items. Most feedback focused on expanding the constructs and updating the definition of selection processes with little consensus on the feedback of individual items. Two researchers discussed the expert feedback and collaborated on the review of question items for the scale. The expert review process resulted in a refined 50-item scale to measure the four psychological processes of self-efficacy. A reliability analysis was conducted using data from 16 participants pre- and post-study responses to SALSE (32 cases), followed by an item-total correlation analysis that reduced the scale from a 50-item to a 43-item scale. The new 43-item revised scale (Appendix D.1) was then used to calculate the difference between the pre- and post-study responses, which was later used to segment the qualitative interview data for analysis.

Chapter 5: Understanding the Role of Self-Efficacy in Searching to Learn

A convergent mixed-method study was used to compare and discuss changes in early-career UX researcher's self-efficacy using both quantitative data from a developed self-report SALSE scale (see Phase 1) and qualitative data gathered from data-prompted interviews collected as part of a diary study. The SALSE scale was used to calculate the individual change in self-efficacy at the outset of participants beginning the learning diary (pre) and the end of the diary collection period (post), followed by data-prompted interviews. The central research question guiding Phase 2 was "What is the role of self-efficacy when working adults learn using search engines?" Three subquestions were explored:

RQ1.2: Is there a significant change in self-efficacy over the course of 5 days when working adults maintain a learning diary while they learn using search?

RQ1.3: What is the nature of the self-efficacious experiences when working adults learn using search?

RQ1.4: What are the changes in working learners' self-efficacious experiences when learning using search?

5.1 Participants and Learning Goals

The target population for this study was early-career UX professionals between the ages of 19 and 65. Participants were recruited from informal digital UX community groups using a snowball sampling method—a preferred method for diary studies because the loose relationship between participant and researcher acts as motivation to participate (Conway & Briner, 2002; D. H. Zimmerman & Wieder, 1977). The researcher assumed 12 participants would be sufficient in this study to reach sufficient information power (Braun & Clarke, 2021; Malterud et al., 2016) and predicted a 48% drop-out rate. However, I was able to recruit and retain 16 of 26 participants (drop-out rate of 38%). Two participants dropped out shortly after the prescreen, six participants did not complete the surveys and the interview, and two participants identified as students during the interview. The student data were excluded as students were not part of the target population. The current analysis draws from the 16 participants who met the eligibility criteria, completed both pre- and post-study SALSE scales, participated in the learning diary, and completed the interview.

Participants with less than 3 years of experience were recruited because emerging professionals may have lower levels of domain knowledge and lack extensive awareness of resources, which may influence the depth and availability of content they are able to access. This recruitment strategy made it less likely for participants to have mastery over topics related to UX and constrains transferability of findings to early-career working professionals. However, despite using years of experience in a UX professional role as a means of recruiting people with developing expertise, there was a range of perceived expertise from the participants in this study. Participants self-identified as beginners (n = 10), intermediate (n = 4), and expert (n = 2) in the field of UX.

This study was age-inclusive, recruiting participants between the ages of 19 and 65 (M = 30.19, SD = 6.31). Age inclusivity is important because beginning a new career can occur at any age, and this study purposefully reflected the age diversity of people entering the UX field. The sample was educated, reporting some college (n = 1), bachelor’s degree (n = 9), or postgraduate degree (n = 6) education. Almost all participants were females (n = 15) who resided in North America (n = 12), but there was some representation from other geographical regions, such as Asia and Pacific (n = 2), Europe and Middle East (n = 1), and Latin America (n = 1). Most participants were employed in UX full-time (n = 10) or part-time (n = 3), and three participants were currently seeking employment in UX (n = 3).

Participants answered questions regarding their current knowledge of the self-selected topic they would be searching. I categorised the topics, which included general best practices (n = 5), research methods (n = 7), design approaches (n = 2), and web development (n = 2; see Table 30). These topics demonstrate the kinds of information UX professionals are seeking. Participants were also asked to identify one distal goal at the beginning of the study (N = 16) as well as one proximal goal for each diary entry (N = 66). Distal goals occur in the future and are represented as the applied learning goal; they demonstrate what participants wanted to achieve out of their search after a week. Proximal goals are search goals that either describe a specific plan or purpose for searching; they demonstrate what participants wanted to learn from a specific search session. Table 30 presents the list of topics alongside the participants' self-selected distal goals, accompanied by examples of the proximal goals (i.e., responses to "what prompted your search" in the diary) and search keywords. The search keywords from selected diary entries demonstrate how participants formulated their search queries in pursuit of the proximal and distal goals.

Table 30

Topics, Distal and Proximal Goals, and Search Keyword Examples

	Survey	Example snippets from daily diaries	
Topic	Distal goal	Proximal goal	Search keywords
Best practices	Personalization of apps to improve quality of work	NA	NN group UX Maturity\ How to evolve ux maturity\ how to integrate UX into culture\ Cross functional collaboration in UX
	Develop a deep understanding of ethical design practices	Learn how to design for "sticky" interfaces	how, design, repeat, software, experience, return, habit forming, sticky
	Identify design patterns and trends to create a wireframe	Dive deeper into trends from previous search.	glassmorphism, 3D illustrations ux
	Prepare for job interview	Uncover concepts from previous searches they were unfamiliar with	Material design, Presenting case studies
	Prepare for job opportunities	Agency contacted about a UX role	Recruitment Trends 2021
Research methods	Write a brief	Colleague shared articles	panel bias
	Write an article about conducting and analyzing user interviews	Doing user interviews tomorrow	"Friendly word for user interface" "user interface" "how to talk about an interface" "interface: synonimes"
	Conduct a usability test this week	Resolve an issue that arose at work regarding how to perform an A/B test	Doing A/B testing design the right way
	Construct a questionnaire	Lack of knowledge	Questionnaires, research, design, ux, methodology
	Prepare for user interviews	Collaborate with product teams	When an engineer says, “Hey, I don’t like this design,” what do you do?
	Learn about qualitative research in UX	Finish to-do list of things to learn	ux research, qualitative, focus groups

	Usability testing an app	Told myself I would learn about it	AB testing
Design approaches	Learn Figma for a new position	Learn about Figma plug-ins to make it easier	figma shortcuts, figma tips, figma plugins
	User journey map deliverable for a client	Remind myself what the user journey maps are for	“journey maps”
Web development	Design and code an app	Know more about coding	UX/UI, basic, coding, language, HTML, coding, basics, free easiest to learn, popular, code editor, HTML
	Create a website	Find other development tools to use.	Developer tool Drupal desktop

Note. The topics were designated by the researcher and are subject to individual interpretation. The distal goals were set at the beginning of the week within a survey format and were rewritten by the researcher. The example proximal and search goals were completed every time the participant completed a diary and are corresponding pairs. The proximal goals were rewritten for context and clarity, and the search keywords are an exact copy from the diary (not the search engine).

5.2 Learning Diary

The purpose of this section is to set the context for the reflexive thematic analysis of the data-prompted interviews. Data collected through the learning diaries were synthesised for each participant in an experience sampling dashboard (see example in Appendix C.6) and acted as memory prompts for participants during the data-prompted interviews. This section reports on the data collected through the participant’s learning diaries. Although this analysis focuses less on the diary data and more on participants’ reflection of their diaries (Section 5.3), the diaries do provide important contextual information with respect to three key areas: (a) number of diary entries, (b) the progression metrics toward goals, and (c) emotional responses.

The number of diary entries completed presents some insight into the investment made into the learning process over the course of a week and reveals how many entries were included as part of the discussion during the data-prompted interviews. A summary of diary entries is presented in Table 31. In total there were 66 diary entries recorded by the 16 participants that were used as memory prompts to guide discussion during the data-prompted interviews. On average, participants completed 4.125 diary entries each and Day 5 of the study had the highest number of diary entries submitted. Day 6 was added to accommodate multiple time zones and any requests for an extension from the participants (see Table 31).

Table 31

Count of Diary Entries

	Diary entries per participant			Total diary entries received per day					
	M	Min	Max	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Diary entries	4.125	3	5	9	11	11	12	16	7

Note. *N* = 66. Min = minimum; Max = maximum.

During the data-prompted interviews, participants reflected on their diary entry responses to the quantitative scaled questions (0 to 100) on their perceptions of learning, mental effort, and goal progress. The discussions during the interviews often asked participants to talk about the trajectory of their experience and to focus on outliers in their responses to gain a better understanding of their experiences. The overall means, standard deviations, and daily mean scores for these measures across all participants are shown in Table 32. The main purpose of these variables was self-referential: to present participants with an opportunity to reflect on the questions prior to the data-prompted interviews. I plotted individual responses to the questions and used them as an entry point to discuss the SAL process during the interview. In addition, the summary data in Table 32 provide evidence of broader trends towards increases in perceived learning, mental effort, and goal progress across the study, with some fluctuations over the course of the week.

Table 32

Learning Diary Scaled Variables

Variable	*M*	*SD*	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Perception of learning	67.63	18.95	61.14	79.20	73.22	61.67	68.67	76.57
Mental effort	51.06	17.70	49.22	44.91	39.09	61.33	58.20	54.00
Goal progress	61.13	17.19	47.14	58.00	64.36	57.25	69.00	67.71

Note. This table details the learning diaries statistics for the scaled variables. The scale used was from 0 to 100.

The learning diary included questions related to the emotions experienced by participants, which provided the basis for further reflection during the data-prompted interviews. Participants had the option to select multiple emotions from a list of 10 emotions and add emotions not included in the list provided. Participants reported a total of 101 emotions in the learning diary, which were then categorised using the affective circumplex model. This model plots emotions on two dimensions: valence and activation. Valence is the continuum between positive and negative. Activation is the extent of physiological arousal and sits on a continuum between activation and deactivation. In addition to a predefined list of 10 emotions, participants also had the option of self-reporting emotions that were not listed. They added the following terms: surprise, interest, motivation, stress, frustration, overwhelmed, agitation, informed, and neutral. I examined the likelihood of the strength of physiological arousal and the valence to categorise them into the existing affective circumplex model. “Surprise,” “interest,” and “motivation ”were placed in the activated-positive category; “informed ”and “neutral ”were classified as deactivated positive; “stressed,” “frustrated,” and “agitated ”were labelled activated negative; and “overwhelmed ”was added to the deactivated negative quadrant.

Across all diary entries, most participants’ emotional experiences were reported as being positive either in an activated state (*n* = 44; e.g., excited, happy, elated) or a deactivated state (*n*

= 34; e.g., calm, relaxed). There were a few instances in which deactivated negative emotions (e.g., tired, exhausted, sad, overwhelmed) were reported (*n* = 13), and even fewer instances of activated negative emotions (e.g., tense, angry; *n* = 10). See Table 33 for the daily counts of reported emotions. Apart from the predominance of positive emotions, no clear trends emerge from this data as to the emotional state of participants over the course of the study.

Table 33

Count of Emotions by Day

Affective circumplex model	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Total
Activated positive	8	11	7	5	11	2	44
Deactivated positive	5	5	10	4	5	5	34
Activated negative	1	1	0	4	3	1	10
Deactivated negative	5	0	1	1	5	1	13
Totals	19	17	18	14	24	9	101

Note. This table shows the count of emotions experienced by participants categorised by the affective circumplex model (Pekrun & Linnenbrink-Garcia, 2012). Participants could select multiple emotions per diary entry. There are 101 total emotion counts across 6 days.

Several additional data points from the diaries were used as probes for reflection in the interviews. The last section of the diary reported on whether the participants' goals had changed, if they had experienced any challenges, and if they had reached out to anyone for support. Half of the participants experienced at least one goal change throughout the week (*n* = 8). Reasons for the change were due to shifting priorities at work, a gain in knowledge that changed their overarching goal, or needing to pursue a less difficult goal. A total of 22 challenges were experienced across all 66 diary entries. Most participants (*n* = 10) reported having had between one and four challenges per week. Of the challenges reported, participants described the following: identifying the right content, learning the material, and being distracted at home. Half of the participants (n = 8) reached out once during the week and contacted people they knew, such as friends and coworkers, and one participant reported using a social media network to find answers to technical questions.

In summary, data from the diaries provide some information on learning experiences of participants over the course of the study and provided the raw material for the data summaries used as memory prompts during the interviews. The diary data suggest that, over the 5 days of the study, participants were in a generally positive emotional state and on a path learning, increasing their mental effort and progress towards their goals. However, they also experienced intermittent negative emotions, set-backs, and goal-redirection, and, in some cases, they reached out to others for support or guidance. These general trends were explored in much greater detail in the interviews and are fleshed out through participants' perspectives and the reflexive thematic analysis the interview data.

5.3 Analysis and Results

This section reports on the quantitative analysis of the SALSE scale to determine participants' pre to poststudy diary study change in self-efficacy and qualitative analysis of the data-prompted interviews. There were three subquestions guiding this analysis: Is there a significant change in self-efficacy over the course of 5 days when working adults maintain a learning diary while they learn using search? (RQ1.2); What is the nature of the self-efficacious experiences when working adults learn using search? (RQ1.3); and What are the changes in working learners' self-efficacious experiences when learning using search? (RQ1.4). See Chapter 3, Figure 7 for a review of the study procedure. The analysis process drew from two datasets: the responses to the SALSE scale and the data-prompted interviews (both in Section 5.3).

Identifying Changes in Self-Efficacy Using the SALSE Scale

The revised 43-item SALSE scale (Chapter 4) was used to explore RQ1.2, whether there was a significant change in self-efficacy over the course of 5 days when working adults maintained a learning diary while they learned using search.

This study used repeated measures to examine the change in self-efficacy. By focusing on the change of self-efficacy I could attend to individual differences and identify the supports and barriers needed to support learning using search. I also recognised people have a variety of starting points in self-efficacy, and that everyone's starting point may differ across the four psychological processes. An increase in self-efficacy is plausible when using metacognitive prompts in the diary as people may pay attention to their searching habits, thereby improving their level of awareness of their own search processes. However, the literature is not clear on the relationship between self-efficacy and metacognition, particularly in understanding which construct mediates the other (Coutinho, 2009; Moos & Azevedo, 2008; 2009b) making it challenging to assume directionality. It is also plausible to see a reduction in self-efficacy because people may blame themselves when they cannot find information using a search engine (Rieh et al., 2012). Furthermore, there could have been no change in self-efficacy; SAL studies that investigate self-efficacy use a variety of study durations and measures of self-efficacy making it difficult to predict the direction of change. In short, it is challenging to know whether a change in self-efficacy would occur and, if change did occur, whether there would be self-efficacious gains or losses. Because I could not generalise the prediction across all participants, I approached the analysis without assuming directionality to align to the exploratory nature of the study.

It is for these reasons a two-tailed paired *t*-test was used to compare participants' pre- and post-study SALSE responses. The data met all assumptions for a paired *t*-test: the dependent variable was measured on a continuous scale, the independent variable consisted of a matched pair, there were no significant outliers, and the Shapiro-Wilks test revealed a normal distribution for all subscales (ps > .110; Field, 2020). Table 34 shows the means, standard deviations, and within-subjects effects of pre- and post-task self-efficacy, including effect sizes, to show the actual change between pre- and post-study diary responses.

To clarify the use of effect sizes, it is important to note that the p-value significance is the probability of getting a test statistic at least as large as the one observed, if the null hypothesis is true (Field, 2020). However, Field (2020) explained a nonsignificant result does not mean the null hypothesis is true; it reports the effect is not big enough to be found. A criticism of p-values is that they do not indicate how important something is, whereas effect size measures the magnitude of change in a variable. This analysis is a matched pair analysis, for which Khan (2020) recommended Cohen's d. For Cohen's d a small effect size is around .2, a medium effect size is around .5, and a large effect size is around .8 (Field, 2020). An effect size of 1 would be equal to the standard deviation (Dankel et al., 2018).

Table 34

Pre- and Post-Measurement Differences in the Psychological Processes of Self-Efficacy

	$M \pm SD$ (pre)	$M + SD$ (post)	Paired t-test	Effect size
Motivational SE	73.84 $\pm$ 15.05	76.08 $\pm$ 14.48	$t(15) = 1.21$, $p = .25$	$d = .30$
Affective SE	62.31 $\pm$ 20.44	63.90 $\pm$ 19.61	$t(15) = 0.44$, $p = .67$	$d = .11$
Cognitive SE	68.39 $\pm$ 17.67	64.97 $\pm$ 18.76	$t(15) = 1.98$, $p = .06$	$d = .50$
C.1 Schema Training	78.17 $\pm$ 14.60	72.83 $\pm$ 18.99	$t(15) = 2.15$, $p = .048$*	$d = .54$
C.2 Planning	56.54 $\pm$ 26.16	26.35 $\pm$ 22.94	$t(15) = 0.06$, $p = .96$	$d = .01$
C.3 Monitoring	66.78 $\pm$ 20.79	60.98 $\pm$ 24.56	$t(15) = 2.01$, $p = .06$	$d = .50$
C.4 Evaluation	66.63 $\pm$ 23.52	72.52 $\pm$ 18.83	$t(15) = 1.75$, $p = .10$	$d = .44$
Selection SE	59.86 $\pm$ 26.70	56.89 $\pm$ 28.74	$t(15) = 1.29$, $p = .22$	$d = .32$

Note. SE = self-efficacy. This table provides the means and standard deviations for the pre- and post-scale measures of the psychological processes as well as the paired *t*-test results and Cohen's *d* effect sizes using the revised 43-item scale. Cohen's *d* values are interpreted to be small (0.2), medium (0.5), and large (0.8).
$^*p < .05$.

There was a significant reduction in the cognitive subscale, Schema Training, between pre ($M = 78.17$, $SD = 14.60$) and poststudy administration of SALSE ($M = 72.83$, $SD = 18.99$), $t(15) = 2.15$, $p = .048$*, $d = .54$. The monitoring subscale was approaching statistical significance and had a medium effect size, but there were no changes between pre ($M = 66.78$, $SD = 20.79$) and postsurvey responses ($M = 60.98$, $SD = 24.56$), $t(15) = 2.01$, $p = .06$, $d = .50$, though monitoring was an inherent aspect of the diary study. Additionally, although I did not see statistically significant changes in the other subscales, I noted that participants' mean scores were higher for the poststudy Motivational, Affective, And Evaluation subscales, and lower for the poststudy Selection and Cognitive (except evaluation) subscales. The whole Cognitive scale is approaching significance ($p = .06$) and has a medium effect size ($d = .50$). As a result, the overall cognitive self-efficacy scores were used in lieu of the Schema Training, Planning, Monitoring, and Evaluation subscales to accommodate the broader qualitative work.

The SALSE scale asked participants to rate their answers to each question from 0 to 100 prior to the start of the study and again at the end. Using Excel, I calculated the average score for each of the pre- and post-study psychological process subscales and subtracted the difference between post and premeasures to produce an individual change score for each participant. I then calculated the minimum, maximum, and median scores of the change for each of the psychological processes (see Table 35). Some participants experienced a small amount of change and others experienced a more substantial change. Examining the areas in which specific participants experienced gains and losses was used in the interpretation of the data-prompted interviews.

Table 35

Change in Self-Efficacy

Psychological process	Lowest change score (min)	Highest change score (max)	Median change score
Motivational SE	−10.80	13.20	0.90
Affective SE	−23.60	24.00	1.70
Cognitive SE	−14.27	8.14	−2.55
Selection SE	−19.10	13.00	−0.09

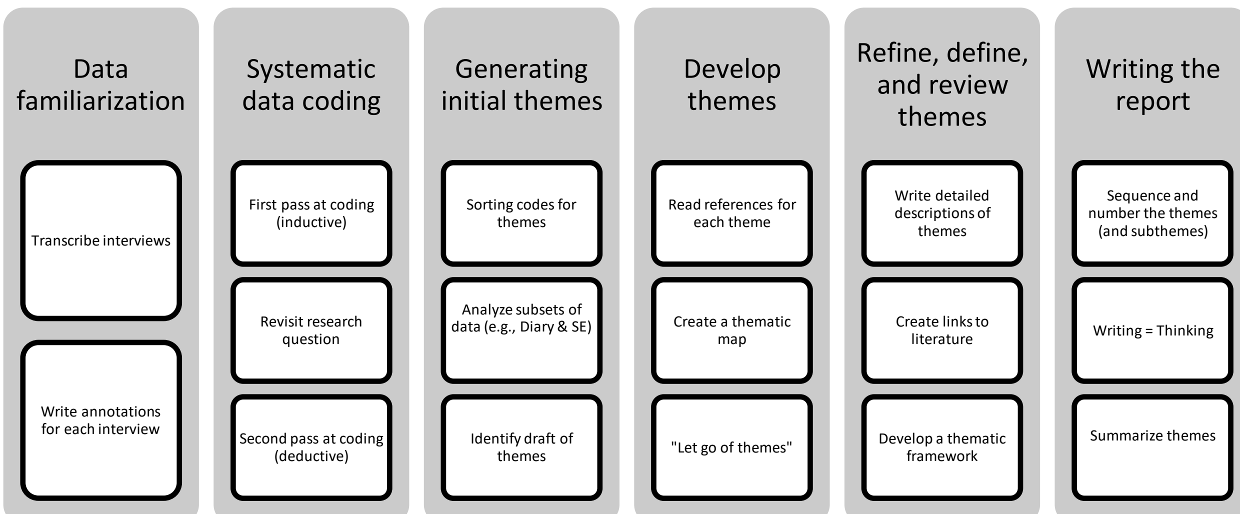
Note. SE = self-efficacy; *N* = 16. This table reports the self-efficacy scores indicating the lowest (min), highest (max), and median change in self-efficacy for each psychological process. A score of 0 indicates no change.

Data-Prompted Interview Data Analysis

The data-prompted interview data were analysed using reflexive thematic analysis (Braun & Clarke, 2006, 2021). Reflexive analysis was chosen because this process allows the researcher to identify themes and patterns in the dataset. The flexibility of reflexive analysis supports a mixed inductive and deductive approach to coding, which gave me an opportunity to identify codes and themes within the data before organizing them into the four psychological processes of self-efficacy. Although thematic analysis does not have an origin per se (Bryman, 2012), I followed Braun and Clarke's 2021 guidance on the six distinct and recursive steps to reflexive thematic analysis (see Figure 10). This grouping guided the organization of the qualitative interview data according to the results of the SALSE scale analysis described above.

Figure 10

Reflexive Thematic Analysis Process Outline



Note. This reflexive thematic analysis process diagram was created based on content within *Thematic Analysis*, by V. Braun and V. Clarke, 2021, SAGE. Copyright SAGE.

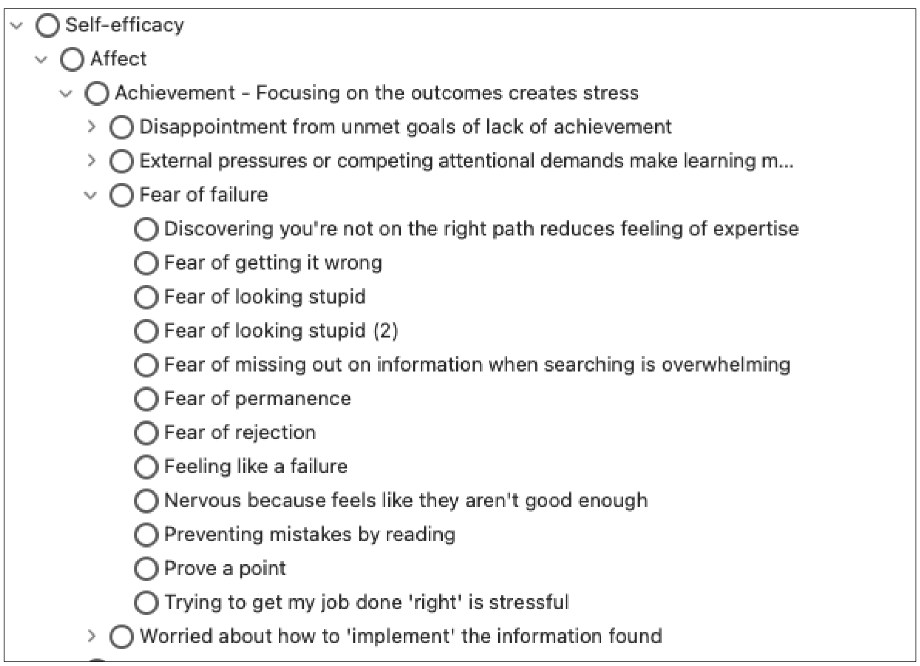
The first step involved familiarizing ourselves with the data-prompted interview data, which consisted of prolonged engagement and organizing the raw data alongside detailed field notes (Braun & Clarke, 2021; Nowell et al., 2017). I downloaded the transcribed interviews from Zoom and listened to each interview while manually cleaning the transcription data from the automated process in NVivo by fixing significant errors. When the data were accurately transcribed, I began the process of writing annotations for each of the interviews in NVivo.

The second step involved coding the data in NVivo (Release 1.6). The first pass at the coding process was inductive, whereby codes were identified as part of the sensemaking process from the interview data itself. I then moved to the deductive stage, in which I grouped codes into theoretical categories. The early list of codes was presented to the dissertation committee for feedback. This led to altering the names of codes to be less theoretical in nature and specific and representative of the meaning behind what a participant is saying (Braun & Clarke, 2021).

I returned to the second step and recoded the data in NVivo in a manner that better reflected the participants latent intent and meaning. To accomplish this, participants' quotes were rewritten as sentences and organised into groups that became codes. Codes were then organised into the four psychological processes. An example of this structure is provided in Figure 11).

Figure 11

Example of Recoding Process



Although not discussed as a specific process within reflexive thematic analysis, rewriting participants' statements into different words kept me focused on the latent meaning, making it easier to manage the data and organise codes. This practice was adapted from a qualitative analysis process developed and described by industry research Indi Young that organises interview data into thinking styles (Young, 2021). At this point, I revisited the research questions to check alignment with what I was hoping to learn from this study.

Using the scores obtained by participants on each of the SALSE scale's subscales (see Section 5.3), I coded participants who experienced a change in their self-efficacious process as a loss, no change, or gain (see Table 36). I excluded the "no change" category from the reflexive thematic analysis as research question (RQ1.4) focuses on differences resulting from the change in self-efficacy.

Table 36

Count of Participants by Psychological Process of Self-Efficacy

Psychological process	Loss	No change	Gain
Motivational SE	7	0	9
Affective SE	8	1	7
Cognitive SE	10	0	6
Selection SE	10	0	6
Total	35	1	28

Note. SE = self-efficacy; count of participants (*N* = 16) who experienced a loss, no change, or gain to each psychological process of self-efficacy.

The benefit of using NVivo was the ability to use the crosstab feature during the sorting process. By categorizing participant quotes from the thematic analysis into gains, losses, or no change in self-efficacious process, I was able to organise the codes more efficiently and get a better sense of commonalities between participants' quotes (see Figure 12 for an example).

Figure 12

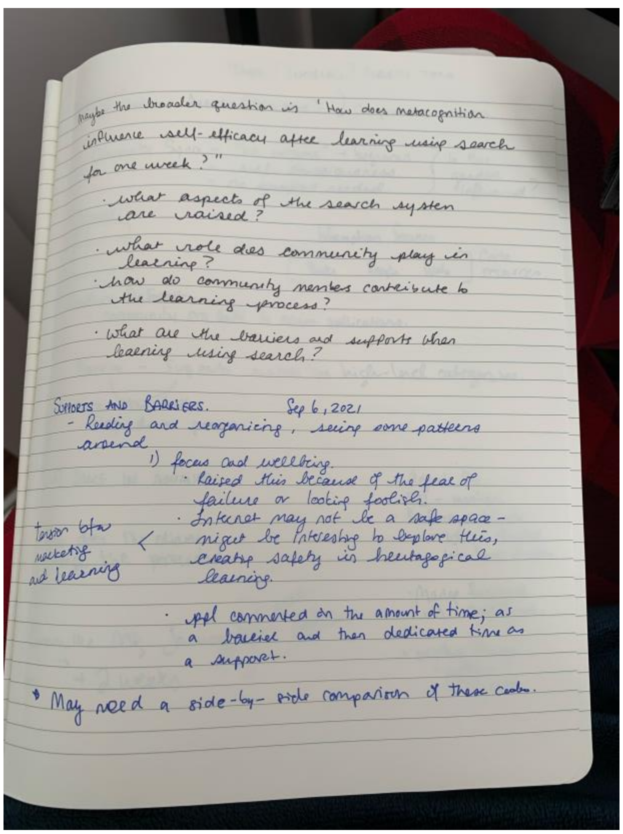
Example of the Crosstab Function of NVivo

Codes	SE_Affect = Loss (n=8)	SE_Affect = Gain (n=7)	SE_Affect = No Change (n=1)	Total (n=16)
Achievement - Focusing on the outcomes creates stress	20	10	0	30
Achievement - Satisfied at the end of the task or project	5	5	1	11
Affective reflections help to reframe the entire experience	2	4	1	7
Epistemic - confidence supported by a slower onboarding process	6	3	0	9
Epistemic - during learning confusion and uncertainty reduces confidence	20	13	7	40
Searching is not an emotional experience	4	1	0	5
Total	57	36	9	102

The third step involved generating initial themes. This process included rereading the captured participant quotes under each code and identifying a small number of themes drawn from multiple participants and supported by evidence from the dataset. Handwritten thoughts were recorded in a journal dedicated to this research project (see Figure 13).

Figure 13

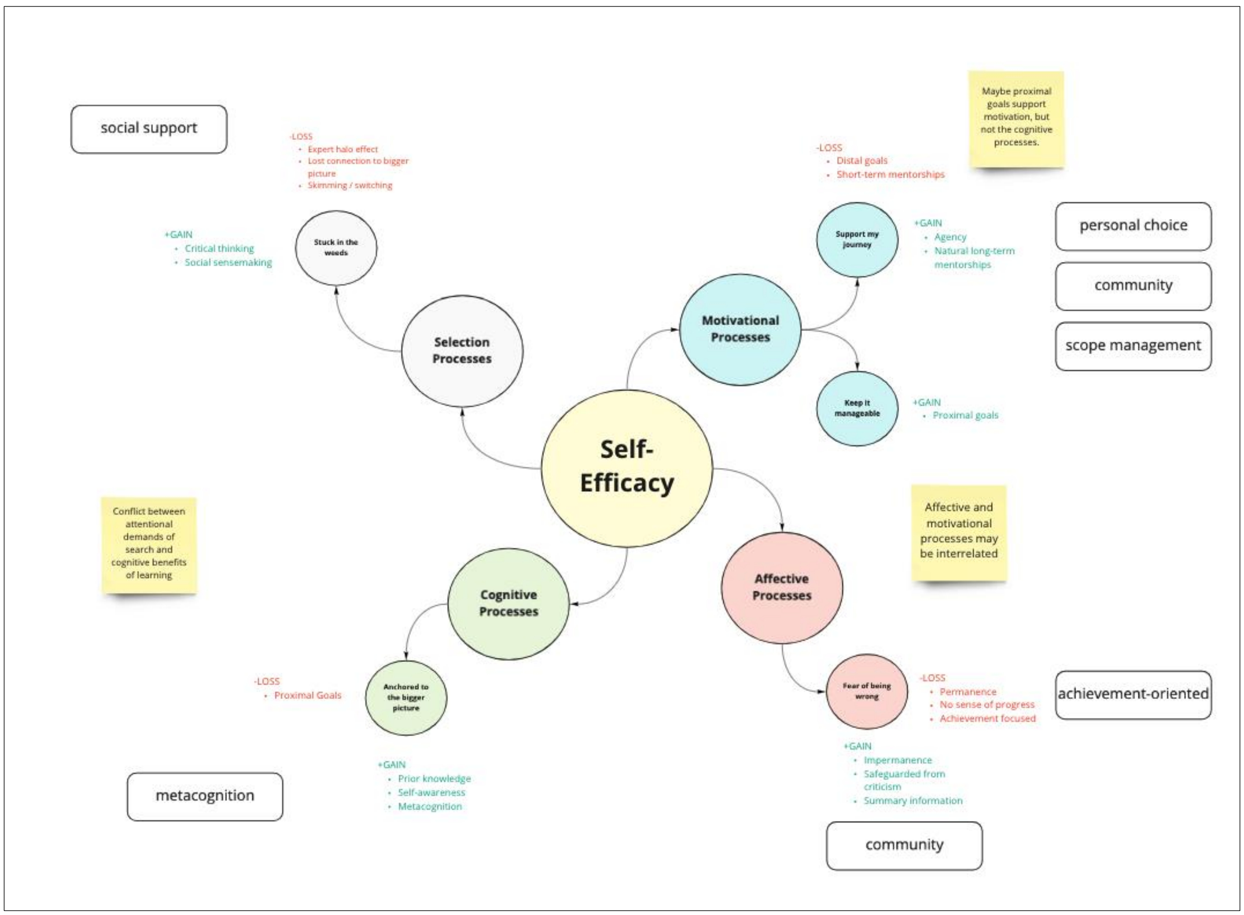
Reflexive Journal Example



The fourth step involved further development of the initial themes. A thematic map was created to anchor the themes and subthemes within the context of the four psychological processes of self-efficacy using Miro, with virtual sticky notes added when there were contradictions within the dataset or conflicts with what is known from the literature (see Figure 14). Themes were developed further in the fifth step. Descriptions of the themes were written and updates to the thematic map were made (see Section 5.3).

Figure 14

High-Level Thematic Map Using Miro



The sixth and final step was writing the report. In the case of reflexive thematic analysis, writing is thinking, and the writing process was used to understand some of the connections and tensions between the codes. This process used both illustrative and analytical approaches to first assist the researcher with understanding what participants said, and to probe deeper into why the change may be occurring. The writing process alters one's thinking about themes—with each phase moving iteratively closer to understanding the narrative. It is important to note reflexive thematic analysis is a synthesis of the total experience and references individual statements that support the patterns identified in the data. Figure 15 shows the joint display of the identified themes with representative quotes from the data-prompted interviews. These themes are discussed in more depth in Section 5.3.

High-Level Themes

Five key themes were identified in the data and represent the summary end of an iterative analysis cycle that examined the interview data grouped by gains and losses to self-efficacious processes. The themes were identified as part of the narrative process that used data extracts (i.e., participant quotes) to illustrate the experiences of the participants. Next, each theme is described at a high level; followed by a deeper examination of participants' self-reports segmented by those who gained or lost self-efficacy during the weeklong learning experience in Section 5.3.

Support My Journey. Some participants were motivated when they had sufficient agency or choice in when, what, and how they learned. But participants were also influenced by naturally occurring mentorships and relationships. These relationships allowed the time and mental space for learners to discuss their ideas. This did not necessarily mean that mentors provided cognitive support, but rather it describes a relationship of trust and belonging.

Figure 15

Joint Display of Quantitative and Qualitative Data

Note. Mixed-method results are often presented as a combination of quantitative and qualitative information. The wheel diagram, starting from the centre, displays the four psychological processes of self-efficacy subscales, gain and loss codes from the descriptive statistics of the Search as Learning Self-Efficacy (SALSE) scale, short theme titles, and the key concepts colour-coded in red for loss and green for gain.

Keep It Manageable. Identifying the problem to be solved through the information-seeking process was a significant challenge for participants who were learning using search.

When the distal goal was too big, search engines did little to support refining the problem to something manageable, resulting in a potential lack of motivation to continue. Proximal goals were not always useful; proximal search goals may have been gratifying for some participants but, in some cases, did not contribute to the distal learning goal.

Afraid of Being Wrong. This theme was pervasive throughout the interviews with participants. Most participants expressed concern of both short- and long-term consequences of sharing their beginner status and questioned their ability to learn new methods, tools, practices, or domains in a short period of time. The central fear often involved the presentation of the self to others in the near and distant future, as though one wrong remark in the digital space could ruin their career. One participant also expressed fear in taking the company's product in the wrong direction. This fear translated into a significant weight when thinking about their learning capabilities and choosing the right resources from which to learn.

Anchored to the Bigger Picture. Many participants become lost on the worldwide web. The volume of summary-level information made finding specific information more difficult. Some participants struggled with keeping track of the hierarchy of concepts and understanding the differences between opinions found online. Although reading books in a linear fashion was one strategy mentioned by a participant to better control the order of information, this solution did not appear to address the needs of the other participants who were trying to learn quickly and keep pace with a rapidly changing workplace.

Stuck in the Weeds. Some participants experienced a degree of difficulty in choosing the right resources on the web. Participants spent much of their time making credibility assessments on a very homogenous set of search results and were often distracted by search features as well as ads and marketing content. Participants who were able to overcome the search interface had existing prior knowledge of the topic and used search as a reference guide.

Mixed Analysis of the Data-Prompted Interviews

The following sections describe the themes associated with the supports (gains) and barriers (losses) experienced by participants and are organised according to motivational, affective, cognitive, and selection processes.

Motivational Self-Efficacy

Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994). Reflexive themes associated with motivational processes were "support my journey" and "stuck in the weeds."

Theme 1: Support My Journey

Some participants who made gains in motivational self-efficacy reported searching as an individual discovery process in a variety of ways. One participant explicitly stated that searching was an independent process: "I just feel like learning for me is more of a solo activity; I tried to figure out things by myself versus asking other people for help or guidance" (P023), and another participant commented that searching was an independent process because they wanted to understand something prior to reaching out to others: "When I do want to figure out something I would try to figure out myself first to the best of my ability—before I reach out to other people" (P024). The mental model of the individual information-seeking journey contradicted findings in the literature that suggested learners with a stronger sense of generalised self-efficacy often begin their information-seeking journey by asking other people or online resources for help (Cheng & Tsai, 2011; Williams & Kim, 2012). But, in terms of motivational self-efficacy, participants in this study were more hesitant to reach out to others for basic information during the early information-seeking stages.

Despite the mental model of search as an independent process, relationships played a central role while learning using search. The parameters of the research study were identified by several participants which indicates a high-level of reflexivity in the study design as well as the importance of accountability partners. A few participants commented on the study design, which may have contributed to persistence in learning. One participant said, “[The study] was helpful because usually I’m not this consistent with learning. So, having a reason to be learning was helpful” (P014). Another participant also referred to feelings of obligation to the researcher: “I didn’t skip any of the days just because I knew I always have to fill in some data” (P002). Reflexivity is an integral part of the response to a diary study as there is often a relationship that forms between the participant and the researcher (D.H. Zimmerman & Wieder, 1977).

The researcher as an accountability partner is important to note; however, despite the presence of an accountability partner, participants reported they did not receive help from others in their learning diary on most days (see Section 5.2). However, when these same participants were asked about social support during the data-prompted interviews, they were easily able to describe and elaborate upon the interpersonal relationships that supported their learning process. In most cases, participants discussed a mentor, “an experienced employee in a position of power who provides support, direction and feedback regarding career development” (Day & Allen, 2004, p. 73).

When motivational process scores increased, some participants commented on the ongoing nature of their learning connections. Mentorships were commonly discussed as being sourced from a professional pool (e.g., career coaches, managers, coworkers): “I share [my learning] with people I work with and get their feedback to see if I'm on the right track" (P001) or socially selected groups (e.g., professional groups): "I would randomly add people on LinkedIn and actually made two friends this way. They're senior UX designers and they didn't mind at all" (P002).

When motivational process scores declined, some participants commented on the degree to which they engaged with mentor(s). One participant reported not having access to a mentor: "I enjoyed getting the information [from search], but I do think I might have benefitted from having an outside mentor or advisor" (P015). Another participant reported receiving one-off pieces of advice from multiple sources: "Everyone I spoke with personally was very helpful in providing resources" (P009). A few participants had weekly meetings with online mentors through a web application. For example, one participant commented, "I think it's been four or five months now, and we've been meeting every week and he helped me prepare or even answer any questions or doubts I have" (P020).

Individual study results may show negative associations between mentoring and career outcomes (Day & Allen, 2004). However, a meta-analysis of studies on this topic demonstrated a positive relationship between workplace mentoring and career outcomes (Eby et al., 2008). Eby et al. (2008) posited that internal malleable factors such as protégé's attitudes and external (less malleable) factors such as cognitive ability, race, and gender may play a role in moderating career outcomes. There are also a wide variety of mentoring types, such as informal, formal, peer, communities of practice, developmental networks, and virtual mentoring (Hansman, 2020). I originally made a broad assumption about mentorships being solely situated within the context of a digital community of practice (e.g., Slack). The interview data suggest otherwise; that nuances to mentorships may not have been adequately captured a priori through the study scales or interview questions. Broadly speaking, one way in which to understand the differences between mentorship types may be related to how the relationship was established: naturally or forced.

Naturally occurring relationships (e.g., managers, peers) were reported when participants made gains in motivation. One explanation may be the relationships that novices developed within their professional and social networks occurred naturally over time and may have been bound by unconditional regard from the mentor (Hansman, 2020; Van Dam et al., 2018; Wouters et al., 2018). Natural mentorship relationships are commonly studied in the context of youth outcomes (Kaferly et al., 2020; Van Dam et al., 2018), but have high applicability in the workplace and show a similar need for acceptance (Kram & Isabella, 1985): “I need to find a mentor or just to know that that person exists. So, once I get started, and if I fail then they will be somebody who I can approach and who will help me.” (P011). One participant noted they appreciated encouraging statements from their mentors, such as “Go on, you’re on the right track; make some small tweaks here and small tweaks there and you’re fine; it’s a nice idea go ahead; let’s see what’s going to happen; I’m curious; I like your idea.” (P018).

Forced mentorships (e.g., one-offs or through apps) showed a reduction in their motivational process scores over 5 days. One-off mentorships are those in which a person seeks sporadic (or single instance) advice from someone in their discipline. One example of a web application mentorship platform specific to UX professionals is ADPList (www.adplist.org). Forced or revolving mentorships may not have the same relational dynamics as naturally-occurring mentorships because, although expertise and guidance may be extremely useful, they may not, on their own, positively motivate individuals to sustain their learning practice (Day & Allen, 2004). Participants who decreased in their motivational process scores primarily discussed the intellectual function of mentors: “She wanted us to look for infographics image every week that we found useful or appealing in some way and then share it and explain why we shared it” (P003). They also spoke to finding a network of people with whom they were not emotionally connected to ask questions: “I haven’t found a network that I think is really helpful for me in terms of my learning process. I do ask questions, but I don’t consider them as a group for learning or a community that walked with me through the path of knowledge” (P008).

In summary, motivational processes may be supported by naturally occurring mentorships that are sourced from professional and social network pools. But mentorships are nuanced—meaning that simply providing intellectual guidance is insufficient for improving motivational processes of self-efficacy when learning using search. Being accepted by your mentor in the face of failure and knowing one has the unconditional regard of one’s mentors may support motivational processes of self-efficacy in early-career UX professionals learning on the job using search.

Theme 2: Keep It Manageable

One of the other ways in which motivational processes may be supported is by keeping the tasks manageable. Learning-based search tasks are human-initiated goals that draw upon real-world activities (Francom & Gardner, 2014) that are accomplished through effective interactions with information systems (Liu & Belkin, 2008; Wildemuth et al., 2014). Participants who specified their proximal search tasks may have made gains in their motivational process scores because the tasks were manageable and solvable within a smaller set of searches. Some participants discussed a variety of strategies and orientations to support the sense of manageability. One participant commented on scope as a means of achieving a sense of progress: “Because [the tasks] were easy or smaller or I could solve them. Focusing on [the small] ones, I get that good feeling that I can do some things. It’s just this big task that feels unfulfilling” (P018). Another participant remarked on using the learning goal to support managing the scope of the search: “I think, as a result [of] narrowing that goal, making it smaller and having a shorter time frame of the goal helps to frame what you’re searching for. And why you’re searching” (P014). And another participant reported having a strong distal goal and became immersed in the process of learning by uncovering new topics:

> I had a plan in my head of what I shall look into. But the more I search, the more concepts come up and I’m like, “Okay, I should take a note of that.” And then I research more because I don’t understand, or I’ve never done it, or don’t feel comfortable. So, the more I read, the more things come up. (P002)

Identifying proximal learning goals may improve motivational processes because this act narrows down the scope of the project, parceling out the broader learning goals and making it easy to sift through large volumes of content (Eppler & Mengis, 2004). Learning environments focus on building resilience toward achieving distal goals—creating a practice of delayed gratification (Bembenutty, 2022). Proximal goals are a strategy used in support of distal goal achievement and are considered to improve self-efficacy (Pajares & Schunk, 2001; Pintrich, 2000). However, proximal goal achievement may sometimes improve motivational processes for reasons other than learning. Hillis and colleagues (2013) describe Google’s web search as being

> marked by a temporal framework constituted in immediate gratification of desire. Online search displays information within moments of being sought and that, by the same logic of immediacy, also can disappear instantly back into the index, or cloud, from whence it came. What Google’s model of search proposes is, then, not accretion of knowledge but the immediacy and ephemerality of information retrieval. (p. 72)

And despite previous literature advocating for strategies such as chunking goals into manageable tasks, these smaller proximal goals may also be viewed as briefly gratifying distractions (Schunk & Greene, 2018). If web searching is instantly gratifying, perhaps finding information is associated with the reward centres of the brain. Dopamine, a chemical in the brain, is largely associated with motivation (Parker et al., 2019), and is often framed in the media as an addiction (Aagaard, 2021). However, in discussing social media use, Aagaard (2021) claims there is little scientific evidence in support of the idea of dopamine addiction to technology and argues instead that humans developed bad habits (not addictions) around technology use (Aagaard, 2021).

The structure of the study design, in this case, with its goal definitions, learning diary, and data-prompted interviews may represent a habit of learning. Motivational process scores increased for a few participants who noted the diary supported keeping them on track with their learning. One participant noted the diary helped to structure information in their head: “Before I found myself searching something and then I’ll forget. But because I was doing the diary, it’s kind of like, I structured it better in my head” (P002). Another commented on the idea of the diary supporting them in achieving their distal goal: “The diary kept me on track, so before the whole diary study started, I did have an idea of what I want to gain out of it” (P024). This points to some indications of metacognitive habit supporting the learning process. But this was not true across all participants who completed the full study. Two participants who experienced a decrease in their motivational processes of self-efficacy also commented on the same perceived helpfulness of tracking progress in a diary. For example, one participant said, “I think just having those [diary] assessments helped me to think about the progress I was making. And for better or for worse it kept me going instead of just sitting and watching the same videos over and over." (P015).

Because the learning diary did not universally support gains in motivational processes across all participants, research needs to look instead to the search process and what may be occurring during the learning process. Perhaps the immediacy of search is akin to a reward-based system for some learners. There are some interesting parallels between information seeking and the results from a recent neurological study. Parker et al., (2019) exposed mice to a positive reward feedback loop (i.e., Pavlovian conditioning) and gradually withdrew the reward over time. They found that a neuron (i.e., nociceptin) that in considered to be akin to frustration or demotivation, became active when the mice in the experiment stopped seeking rewards; the mice essentially gave up (Parker et al., 2019). Kuhlthau's (1991) Information-seeking process model describes the frustration, confusion, and doubt that arises during the exploratory phases of a search (about midway through the journey). When the feeling of frustration arises during a search, some information seekers may mistake the gratifying feeling of finding immediate answers with progress toward their distal goal. This raises an interesting question as to why motivational processes improved when participants referred to their proximal search goals during the data-prompted interviews. Is there a chemical response in the brain to finding information online or is there a missing connection between motivation and habit that supports motivational processes?

It is worth remembering that the study design included a feedback session on the distal goal, in which the participants were directed to set their own learning and applied goals and given the opportunity to revise them in the presurvey. The learning diary included prompts intended to help searchers reflect on their SAL experience—supporting the process of setting daily search goals. Although the combination of distal and proximal goals were an explicit part of the study design, I did not examine the specificity or difficulty of the self-set goal, which has been shown to have an influence on daily study performance in formal education settings (B. J. Zimmerman, 2008).

In summary, motivational self-efficacy is complex. Proximal goals were associated with participants who experienced an increase in motivational processes. Gains made in motivational processes may have been related to mechanisms that supported an individual's sense of agency and the manageability of the learning scope. Despite the perceived individual nature of learning using search, one of the more remarkable findings was that motivational gains may be influenced by the human relationships that support each individual learning journey.

Affective Self-Efficacy

Affective processes refer to the ability to "build coping skills and instill beliefs that one can exercise control over potential threats" (Bandura, 1994, p. 6). The themes associated with affective processes is "afraid of being wrong."

Theme 3: Afraid of Being Wrong

When affective process scores increased, some participants commented they felt confident they met their self-determined standards: "Each time I knew what a method was, I felt immense relief because it's so much more simple [than I thought]" (P010). One the ways in which participants described meeting standards was through the strategies they used when learning using search. The most common strategies employed were metacognitive in nature. Some learners asked themselves questions during the learning process: "I think when I learned something I am quickly also thinking about, 'How can I apply it and get that practical experience?'" (P024). Others created their own criteria beforehand to evaluate content: "This was a topic I wasn't so much familiar with and... I had to form my own criteria" (P003). Finally, some participants used others' lived experiences to inform their learning and practice: "Reading up on other people's experience when they reflect on [their work], helped prevent me from making a lot of mistakes" (P002).

When affective process scores declined, some participants remarked on the struggles they felt when searching, for example, "Towards the end, once I was able to get something accomplished or learn something new, I was a little more optimistic or positive" (P015). The participant engaged in a reframing process, in which they reflected on the negative experiences and reframed it in a more positive manner (Lambert et al., 2009). Positive feelings are common at the end of a learning period (Mielniczuk & Laguna, 2020; Villavicencio & Bernardo, 2016), and during the process of learning many participants discussed a variety of fears and expressed concerns about future (unintended) consequences as well:

> Maybe I've done this whole [search] wrong. And you start to overthink or get worried about what you haven't done yet; you've only actually done part of what you thought you needed to do. It can get a little overwhelming. (P009)

The fear of failure was identified as a common theme among participants who self-reported a reduction in their affective processes of self-efficacy (e.g., keep from getting discouraged in the face of difficulties). Others have observed a fear of failure when learners are focused on achievement outcomes in formal education contexts (Covington, 1984). This study suggests that, for UX learners, the fear of failure encompassed short and long-term fears and permeated both online and offline information seeking. The information seeking literature often refers to a cognitive-affective state that describe feelings of uncertainty that "commonly cause affective symptoms of anxiety and lack of confidence" (Kuhlthau, 1993, p. 347). Kuhlthau et al.

(2008) found that learners in classroom environments experienced negative emotions midway through a project, followed by a sense of relief or positive feelings at the end. Superficially, the struggle of learning looks similar, but the fear of failure is not a purely cognitive state with symptoms; it is a "a tendency to appraise threat and feel anxious during situations that involve the possibility of failing" (Conroy et al., 2007, p. 239). Although anxiety is a common thread between uncertainty and failure, fear of failure shifts the learner's attention from the cognitive work during the process of learning to mitigating the interpretation of a potential negative future based solely on an assessment of what one knows today (Carver, 2003).

Fear of failure for participants may have been due to feelings related to a lack of knowledge saturation. Knowledge saturation is akin to self-judgements of learning in education and data-saturation concepts in qualitative research, in which the person assesses the extent to which the knowledge they gathered meets their needs. Information science research refers to stopping behaviours, a set of heuristics people use to determine whether they have found sufficient information to answer their question (e.g., Dostert, 2011; Toms & Freund, 2009). However, for participants who experienced a reduction in affective processes, web search engines may not provide sufficient information to solve a learning problem in the speed needed to acquire knowledge, leaving participants feeling lost and uncertain. One participant said, "I mean at the end… I was a little sad I didn't go further than I had hoped. I didn't accomplish as much as I wanted" (P015). Another participant reported, "I feel like it's very easy to get lost and… I need to learn to be specific at the very beginning" (P017).

Information overload has been related to the use of technology—suggesting that job skills, information literacy skills, and age may contribute to feelings of being overwhelmed within the digital information landscape (Benselin & Ragsdell, 2016). But other perspectives frame this phenomenon as work overload, suggesting it is not the information itself that is causing being overwhelmed but the increased demands on workplace information engagement (e.g., emails; Allen & Wilson, 2003; Bawden & Robinson, 2009).

In this study, participants started to experience frustration when they tried to translate summary-level information (e.g., definitions and processes) found on the web into the actionable steps required to perform their job function or purpose. For example, one participant commented, "Reading what a focus group was wasn't overwhelming, but the fact that I would be conducting them and navigating the discussion is what was overwhelming" (P009).

Searching for in-depth or step-by-step scaffolds for complex work online may result in more negative epistemic emotions (i.e., emotions related to the cognitive task or processing of information) resulting in fears involving long-term consequences: if the search does not produce the right set of information, then the job function will not be performed properly, and then some imagined consequence is realised. As one participant noted, "People are going to be building [products based] upon [my research]. And I would hate, for it to be an unstable foundation" (P005).

The contradiction between the (nonsignificant) self-reported increase in affective processes in the SALSE scale and the presence of fear of failure when learning using search is an interesting finding. The contradiction may point to the differences in goals between human searchers and the goals of the search system when looking for information using search. Search systems may inadvertently create the environmental conditions for negative affect by prioritizing similar results that contain summary information and obfuscate the process of filtering out search results deemed not useful. Proponents for more feature-rich search engines claim the lack of refinement tools (e.g., filter) reduces user agency and prevents searchers from carrying out complex tasks using web search engines, which may result in withdrawing from the search altogether (Savolainen, 2007; Tucker & Edwards, 2021).

Web search engine limitations may negatively impact learners who need to learn quickly on the job, effectively shutting down their learning when the next step in the information-seeking process is too challenging. Some participants reported expressions of relief during search. For example, one participant noted, “even if it wasn’t exactly what I was searching for I knew it was a starting point. And I was excited because, I’m like, ‘Wow I found something’” (P014). But this sense of relief is not necessarily an indicator of a positive end state. Pekrun and Linnenbrink-Garcia (2012) claimed that relief is a performance-avoidant emotion in which the person rests on a continuum between relief and anxiety.

Affective processes were also impacted outside of the search system. Some participants who experienced reduction in their affective processes expressed fears of asking questions in public spaces. The intersection of fear of failure and community settings shifts the anxiety from the internal self and toward other possible outcomes, such as how others may perceive one’s own learning questions and outcomes. For example, one participant commented,

> It’s hard to ask for help, because you never know if it’s a dumb question or if it’s something that you should just know, or if it’s something that you should be learning by yourself. . . . Let’s say in the future I am applying for a job, and then the recruiters go and get my portfolio and they’re like, “Oh, this person asked a dumb question.” (P014)

One potential concept that may describe this experience is socially prescribed perfectionism, which suggests people with a fear of failing may worry about interpersonal consequences or may believe others have set excessively high standards for them (Conroy et al., 2007). Participants may view their digital communities as largely unsupportive, which may not set the stage for individual resilience (Ledesma, 2014), and they may fear a negative evaluation of their skills leading to avoidant behaviours (Zeidner, 2014). The felt permanence of self-generated content on the web shifted the participants toward outcomes that were not within their control, preferring instead to opt-out of large digital communities they perceived as a threat.

In summary, this analysis suggests that affective self-efficacy gains were made when participants met their own standards. However, participants felt affectively supported online in few places. The web-based digital environments provided little respite for the participants and may be perceived as an unsafe learning space. Affective self-efficacy declined when participants had a significant fear of being wrong, which may have been due to a sense of incompleteness of their learning process or a sense of permanence of negative outcomes (e.g., a mistake today impacts future employment opportunities if it is permanently recorded online). One possible explanation is the persistence of mental models of learning based on achievement outcomes, as a residual effect of the educational system in North American elementary and high schools focused on grades as evidence for entrance into university (Clinedinst, 2019). The attentional preference of achievement-related motivations and behaviours experienced during school may be perpetuated when entering the workplace. Alternatively, workplaces may emphasise the value of performance over process. Working learners may default to standardised performance metrics to communicate their value to the organization and to cope with the ambiguity of what success looks like in research and design.

Cognitive Self-Efficacy

Cognitive processes involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. The theme associated with cognitive processes is “anchor me to the bigger picture.”

Theme 4: Anchor Me to the Bigger Picture

Cognitive process scores increased when some participants had an anchor or a frame of reference to the bigger picture. Typically in information science cognitive self-efficacy is considered as it relates to the search strategies people use to find the information they want (Gorrell et al., 2009; Uman, 2011; Wang, 2013), but gains in cognitive process scores in this context were more learning focused. Participants who showed gains in cognitive process scores discussed having prior knowledge on the topic: “[Previous research knowledge] helped me navigate what resources are reliable, and what resources are not” (P023), having a degree of self-awareness about their phase in the learning process: “The end goal is to be well versed; I don’t think I’m there, but I’m definitely at the beginning stage” (P010), or used the metacognitive strategy of the diary to keep them anchored to a distal goal: “There are many other things that come and go or change priorities during the week, but [the diary] kept me anchored to the most important goal” (P018).

The act of maintaining a diary impacted participants’ cognitive processes when evaluating their learning. One participant commented,

> [The diary] definitely made me think more about what I was doing. Instead of just aimlessly searching and you know reading a sentence or two and saying, “Okay, good enough” it made me think more about, Why am I searching this? And would I be able to talk about this later? Is this going to stick in my brain when I’m doing like my next journey map or my next focus group? (P009)

The purpose-driven questioning of “why am I searching” is a less common focus in the searching as learning (SAL) literature. Many web-based information credibility assessments focus on the content itself (Vakkari & Hakala, 2000) or cursory information (i.e., metadata) such as the authors, the publication date, a contact number, and other factors (Rieh & Danielson, 2007). To make matters more complex, there are group differences in the way that people make content selections and evaluations. People with some domain knowledge, expertise, or prior topic knowledge tend to first peruse more formal sources (e.g., scientific journals) whereas novices tend to rely on overviews (e.g., blog posts; Brand-Gruwel et al., 2009). In this context, cognitive evaluation was self-reflective, thinking more deeply about the "why," and whether the participants learned the information sufficiently to proceed.

When cognitive process scores declined, some participants commented on the increase in attentional focus on search queries. One participant remarked on the intentionality of their search: "You become more intentional. I generally don't search for things so intentionally" (P020). Commonly proximal goals are considered to enhance self-efficacy (Pajares & Schunk, 2001; Pintrich, 2000). One possible explanation may be that the content found or made available to participants through a web search engine made it more difficult for them to move beyond summary-level information, thereby reducing their cognitive processes of self-efficacy. One participant remarked,

> You start banging up against the same information over and over again it's just regurgitated in various forms or article, and you know that's not the definitive answer... the buck doesn't stop there, there is stuff beyond it, but it's just being controlled (P005).

P005 reasons that web search engines control what information is "findable." Another participant considered the summary-level information was due to the algorithm: "I don't know what the algorithm is. Is it just other people who are asking kind of the same [question]?" (P011). These comments reveal the challenges participants experienced operating within the complexity and opacity of search engine algorithms—and raise issue with the web search engine's ask to operate under a form of "blind faith."

An alternative possible explanation is that cognitive self-efficacy is related to the complexity of the business and social problems that UX professionals are meant to solve, from designing tools for use in space (Hillenius, 2016) to the new future of work (Teevan et al., 2021). Individual learners may be unable to maintain the pace of acquiring sufficient information to learn complex skills and knowledge on the fly in a search environment: "It's never-ending; I feel there's so much to learn" (P020), and "You thought you knew something, and then the more you learn about it, the more, you know, that you don't know" (P001).

In summary, the analysis identified that participants' cognitive processes were improved when their searches were consistently anchored to the bigger picture. The bigger picture was supported by having prior knowledge, being self-aware of their beginner status of the topic or employing metacognitive strategies that keep their attention on the distal goal. However, cognitive self-efficacy declined when participants focused too narrowly, such as on proximal search goals. The abundance of information found on the web and the inability to achieve depth of learning with the available content may suggest typical cognitive strategies (e.g., diaries and notetaking) did not help develop a person's cognitive self-efficacy.

Selection Self-Efficacy

Selection processes refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). A stronger sense of self-efficacy may be related to the breadth of options one might consider (Bandura, 1994). Searchers have enormous choice in not only the web search engines they select, but also their content. The theme associated with selection processes is "stuck in the weeds."

Theme 5: Stuck in the Weeds

Typical web users make content credibility assessments using six common factors: objectivity and accuracy, source reputation, top-level domain, timeliness, aesthetics, and accessibility (Rieh & Danielson, 2007). Selection processes both improved and declined for participants who used source reputation as a credibility heuristic—trusting well-established websites or community experts who had expressly written learning content. One participant commented on the trust of known websites: “I have my websites and some places I trust, and I usually go directly there” (P008). Another participant commented on credibility of information based on the company’s reputation and role in the discipline: “I always go to read some stuff on like Neilson Norman Group because they are the founders of UX. I don’t question as much of what I read from them because [it has] a proper weight to it” (P002). Another participant reported on specific websites that contributed to their learning in the past: “I find Curiosity Tank really reliable to navigate my learning needs for UX research” (P023).

Learning tasks are often complex and have a high degree of uncertainty. Under these conditions searchers may see an increased need to gather many general-purpose sources that address the specific domain or problem-solving information area (Byström & Järvelin, 1995) or increase their reliance on people as primary sources (Byström, 2002). When participants seek learning content, their reliance on familiarity or name recognition may reduce their overall uncertainty and increase their overall confidence in their choice of content.

Participants who made gains in selection processes commented on being cautious about the information they found online. One participant commented on feeling skeptical of the website, regardless of perceived status of the content’s origins: “I know that it’s a website a lot of designers use and it’s a community-based website, but that’s not to say they’re always going to provide credible information" (P014). One participant also expressed how the information was presented; favouring content that discussed a topic from multiple perspectives:

> I still took some of the information or the opinions into account, but I already decided to go with trying to learn some coding language, so the opinions [that were] "You don't need to know anything [about coding], don't even bother"—I took that with a grain of salt. (P015)

The critical nature of learning using search may mean that learners need to do an extra layer of work to discover the right content. This aligns with a study that compared web and digital library searching and found that web searchers expended more effort assessing credibility (Rieh et al., 2012). Although this may be generally applied, there is a degree of nuance to the finding. For example, when one participant commented on how they evaluated the content on the page, they talked about its implicit features: "The tone of the article—if it was more of an instructive article and felt that it was sharing more information and came from kind of an educated place" (P015).

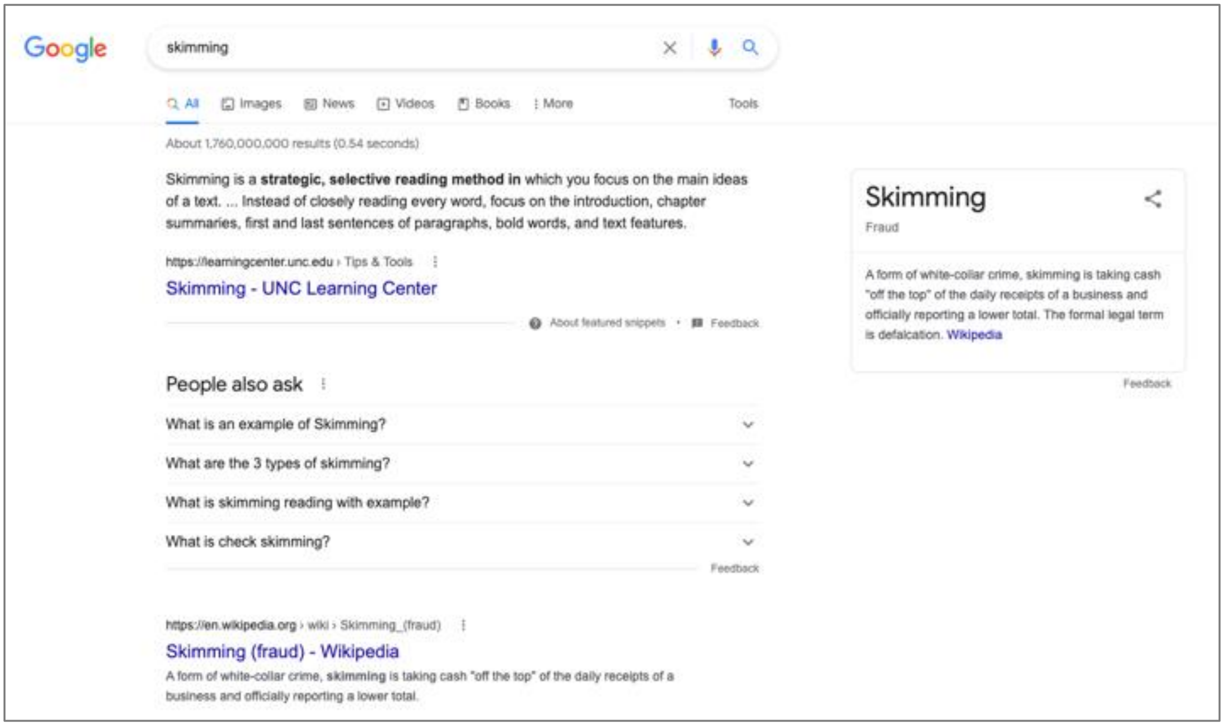
Selection process scores decreased when participants expressed some difficulty in searching. One participant struggled to identify where to go for answers: "I feel the design field is so subjective… there's so much information that I don't know which is the best resource" (P020), and other participants spent some time assessing content credibility using specific cues. For example, one participant reported the usefulness of hyperlinked citations in assessing credibility: "they will often attach a hyperlink to another article, so it's also useful in that way" (P017). Other participants reported evaluating the content based on explicit marketing-related design cues, such as calls-to-action: "[blogs] always have a CTA [call-to-action] to sell you something at the end.” (P001) and stock photos: “I don’t need to see seven photos of a group of people sitting in an office together” (P009).

The visual features participants noticed, such as coloured hyperlinks, calls-to-action, and stock photos imply many of the credibility cues are skimmed. But herein lies a risk. Skimming behaviours may lead to oversimplification of the information and a limited understanding of the content (Duggan & Payne, 2006). One study that investigated differences between skimming and reading on Wikipedia found no comprehension differences (Fitzsimmons et al., 2020). However, the study was set within a closed lab environment with predefined tasks, suggesting that skimming may be sufficient in situations wherein there is a set of credible and curated resources in the context of a well-defined task. In real-world searches different visual cues, such as hyperlinks, calls-to-action, and stock photos, reduced participants’ confidence in the content and introduced doubt as to whether they had selected the right search strategies. For example, one participant reported, “You start to overthink or get worried about what you haven’t [searched for] yet” (P009).

Selection process scores also decreased when participants were faced with credibility assessments on the SERP, which may have slowed their understanding of what content lay behind the result snippets. Skimming is a common strategy when looking for information online (Lowrance & Lea Moulaison, 2014). To find the right content participants resorted to skimming the SERP, “I skim things a lot more to try to find anything that’s relevant” (P001) or changing the search engine altogether: “I looked into YouTube so the content that I’ll get will be videos” (P017). Search engines companies support skimming behaviours by bolding the search query terms in the snippet and applying design principles to the SERP that use white space and headers that aid searchers in differentiating between and identifying the appropriate search results (see Figure 16 for an illustration).

Figure 16

Image of Google Search Engine Results Page for the Search Query Term "Skimming"



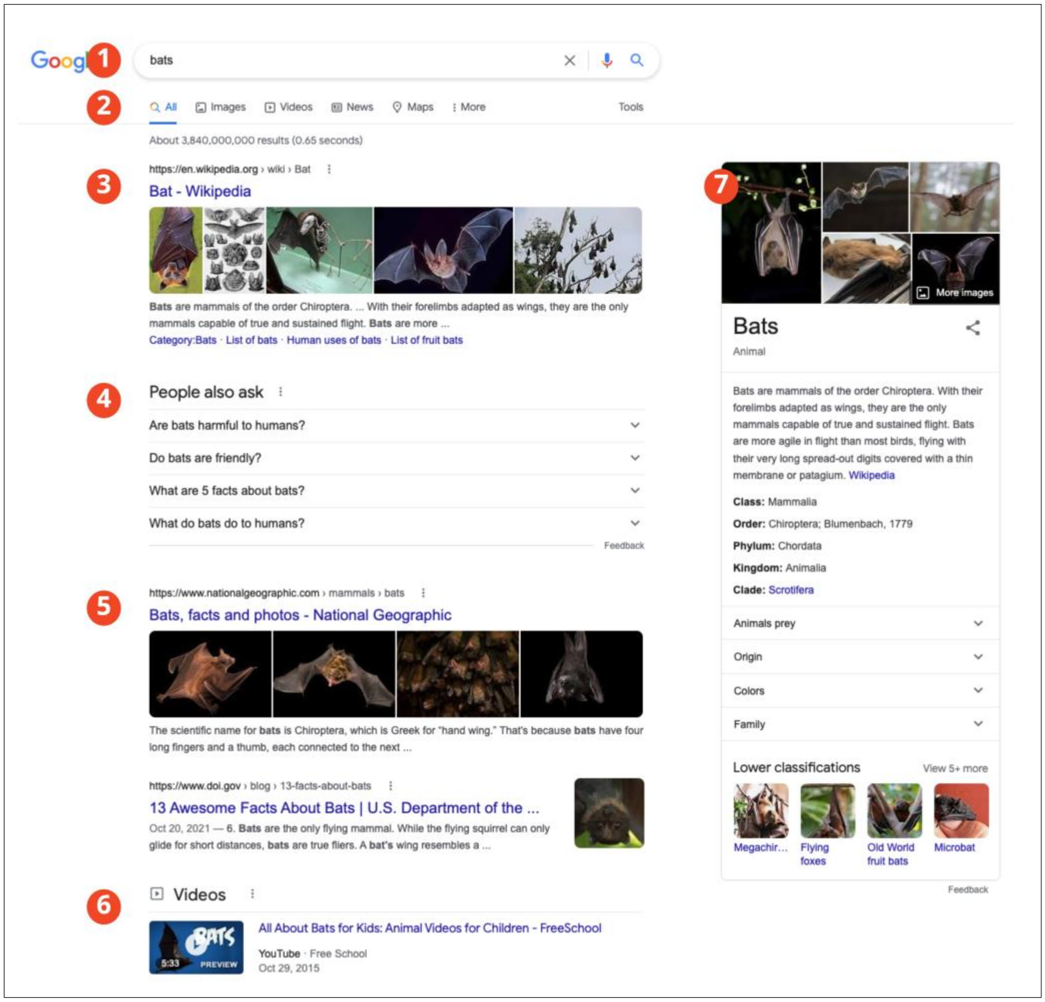
However, skimming may be detrimental to improving selection processes on the SERP. One participant reported the abundance of promoted content on the SERP: "Sometimes I'd be Googling something, and it would just be two pages of ads—I'm glad it discloses that those are ads, but that's a lot" (P005).

Despite high knowledge of marketing-related cues that help searcher's differentiate between ads and content online (Goldstein, 2021), Kattenbeck & Elsweiler (2019) found many implicit heuristics that searcher's may use when assessing the credibility of a search result. These included source reputation and top-level domain (similar to the heuristics found in Rieh and Danielson (2007)), but also the perception and motivation of the domain, language used, personal attitudes, assumptions about the linked content, and whether the snippet represented a balanced or multiperspective view (Kattenbeck & Elsweiler, 2019). The amount of effort required by the searcher and the visual clutter of the web may have made too many attentional demands on participants using search engines to learn, inadvertently switching their mental attention to the results, and distracting them from the bigger picture. For example, one participant remarked, “I make my way out of the valley of despair when I am able to connect the dots between different concepts or like different pieces of work from different people and try to kind of understand the bigger picture” (P001).

Selection processes scores decreased when some participants viewed some of the extraneous information on the SERP as a distraction. After a search query is made, the SERP dynamically displays a variety of webparts (a widget that contains a certain set of functions or features) related to the query (see Figure 17 for an example of a SERP).

Figure 17

Example of a Search Engine Results Page



Note. This figure shows a variety of webparts for the search term "bat." The Google web search results page displays "1" search bar, "2" filters, "3" top result, "4" people also ask, "5" top results, "6" videos, and "7" knowledge panel.

From the participants' perspective, the displayed information was perceived as an embedded, contextualised set of results related to their original query. In this case the serendipity of related results distracted some participants from their original search intent by leading them down other potential paths of interest that were unrelated to their initial search intent. One commented, "It distracts me sometimes if I see that it's relevant [to the overarching topic]. I'll be reading about it and I'll sometimes I would click on the link and read some more" (P011). These distractions undermined some participants' selection processes by stopping the search process altogether: "If I'm overwhelmed, I'll just want to not engage" (P001); or by creating confusion during the source selection process: "You're just going to be lost on the Internet; going from one place to the other because Google give you 1,001 responses" (P006).

Selection process scores increased when some participants reported using non-web resources, such as books: "Libraries are my first place to look. I would invest time reading the entire book and then move on to the online resources" (P023). This may indicate that using search engines for learning were useful once the information was somewhat internally organised and understood by the learner, making nonlinear learning using search engines easier after there was an established foundation of knowledge and context. This perspective aligns with prior work that discusses using search engines to alleviate gaps in knowledge (Belkin, 1980; Dervin, 1998; Marchionini, 2006), but search engines may not necessarily support learners who are unfamiliar with the topic at hand. Recent studies have shown that novices who learn using search may have greater learning gains when they are less familiar with the topic. However, these studies presented a closed corpus of information and asked study participants to search for predefined problems across a Wiki (Yu et al., 2018) and digital library (O'Brien et al., 2022).

Selection process scores also increased when participants found value in information that was related to their original search query—a concept discussed in the research of serendipity (McCay-Peet & Toms, 2017). For example, one participant commented, "It was kind of nice when I searched for 'UX interview tips' and [the search engine] gave me suggestions with links to other sources like, 'whiteboarding exercises'" (P002).

A potential explanation may be that learners used strategies to persist through what Dewey (1910) refers to as a state of "mental unrest" (p. 4). The notion of uncertainty and confusion are not new to the information-seeking process and have been modelled in a variety of contexts, such as through classroom and everyday life lenses (Dervin, 1998; Kuhlthau, 1991; Savolainen, 1995). These models focus on the internal processes of the learner. Some participants in this study commented on engaging in social processes during sensemaking after finding information online. The social nature of the exchange was not necessarily intellectual; the conversational partner did not need to inhabit the same mental context. For example, a few participants commented that anyone can be a form of social support, from family, “He didn’t really understand anything I was saying. I was able to kind of get that [information] out and talk through it and say, ‘Hey, this is what I think I learned’—it’s pretty cool.” (P015) to peers: “Sometimes it’s good to have support just because the topic is a bit unfamiliar, or I’d like to share the information that I’ve learned to see if that makes sense to other people too” (P003).

In summary, the attentional demand of credibility assessments during search may detach novices from the broader learning context. The worldwide web connected content together using hyperlinks that does not govern nor expose the connections between ideas. This idea is loosely supported by Kopak and colleagues (2010), who argued for scaffolding information, such as genre, linking, and annotation when navigating a predominantly semantic information space, like the web. This idea has also been discussed by C. L. Smith and Rieh (2019) when articulating the need for exposure of bibliographic (e.g., author name, author affiliation) and inferential (e.g., author’s other works, genre, citations) knowledge contexts during the search process. Void of anchors, some novices may direct all their attention to explicit evaluation criteria, making it more difficult for them to focus on learning. This may have resulted in some learners continually becoming too invested in the evaluation process, thereby reducing their chances of seeing a useful return on their investment of time and effort. Repeated exposure to a poor return on their investment may have create a negative mental model of search and reduced their confidence in making good learning content choices online. Improvements made to a searcher's confidence in their ability to search the web for information may stem from social sensemaking, suggesting that searchers who were able to discuss or share their learning process may make better query reformulations during their next search session. This aligns with sensemaking theory—a human process in which people actively make sense of the information they find in an iterative and ongoing way (Dervin, 1998)—and presents a potential explanation as to how query reformulation evolves outside the search system.

5.4 Chapter Summary

In this chapter I investigated the role of self-efficacy when working adults learn using search, specifically focusing on the gains and losses of the four psychological processes experienced by learners. The analysis drew upon the interview data with respect to the individual psychological processes (motivation, affect, cognition, selection), segmented by the SALSE scale, which was used to categorise the qualitative data into gains and losses. A high-level summary of the gains and losses described in the narrative are listed in Table 37.

Table 37

High-Level Results From Thematic Analysis

Self-efficacy process	Theme	Support (gain)	Barrier (loss)
Motivational	Support my journey	When learners self-select their learning goals, they want to feel supported in the process of learning. Motivational self-efficacy may be improved when mentorships are naturally occurring, such as with managers, peers, and coaches and when the mentor has unconditional regard for the protégé.	Forced connections with mentors may decrease motivational self-efficacy for UX professionals until there is sufficient trust and regard established between mentor and protégé.
	Keep it manageable	Proximal search goals and tasks may support motivational processes for working learners; however, this contradicts the findings within cognitive processes. Having proximal search goals may improve motivational processes when there may be waning commitment to the distal goal or when the feedback from the proximal goal is not informative.	No barriers were mentioned with regards to scoping projects; although it is related to the theme, "anchor me to the bigger picture."
Affective	Afraid of being wrong	Self-determined standards may support the gain in affective processes.	The fear of being wrong is an affective barrier that may hinder improvements in self-efficacy when working adults learn using search engines. It may be an unintended carryover of an achievement-focused orientation developed through education or perception of poor internet safety.
Cognitive	Anchor me to the bigger picture	Being anchored to the bigger picture is a cognitive support that improves cognitive self-efficacy over time. When learning new topics, participants discussed the	Being too narrowly focused on search goals may lose the learner's connection to the bigger picture.

Self-efficacy process	Theme	Support (gain)	Barrier (loss)
		benefits of prior knowledge, had some degree of self-awareness of being in a beginner state, or engage in metacognitive activities.	
Selection	Stuck in the weeds	Participants who had sufficient prior knowledge or received social-emotional support when making sense of the information found online improved their selection processes over the course of 5 days.	Repeated credibility assessments shift the attentional focus too narrowly to the search query. This may mean that participants who learn using search may struggle to anchor their learning within the broader context.

In response to the central research question, “What is the role of self-efficacy when working adults learn using search,” the reflexive thematic analysis showed that self-efficacy in SAL is multifaceted, and the experience of learning using search extends well beyond the boundaries of the search box. By examining the four psychological processes of self-efficacy together I identified that (for this group) web search engines privilege those with foundational knowledge, who are self-aware of their beginner status, and have existing, naturally formed mentorships that support their learning process. This analysis also showed the importance of autonomy and the ability to self-determine the standards of learning in building self-efficacy in this context.

I asked, “Is there a significant change in self-efficacy over the course of 5 days when working adults maintain a learning diary while they learn using search?” (RQ1.2). In comparing the pre- and post-study diary responses to the SALSE scale, I found a significant reduction in the cognitive subscale, Schema Training, which relates to methods for finding information (using keywords, strategies, graphic organisers) and information checking behaviours (Gorrell et al., 2009). Results also showed a nonsignificant increase in mean scores across motivational and affective processes, and cognitive evaluation subscales as well as a nonsignificant reduction in mean scores for cognitive planning, monitoring, and selection subscales.

To address subquestion RQ1.3, “What is the nature of the self-efficacious experiences when working adults learn using search?”, this research program identified five key themes that spanned the four psychological processes: “support my journey” and “keep it manageable” (motivational processes); “afraid of being wrong” (affective processes); “anchored to the bigger picture” (cognitive processes); and “stuck in the weeds” (selection processes). The selected themes were described based on changes participants’ self-efficacious process as determined the SALSE survey.

Subquestion RQ1.4 asked: “What are the changes in working learners’ self-efficacious experiences when learning using search?” Applying the lens of self-determined learning to SAL and unpacking self-efficacy in an informal learning context provided a holistic view of the learning experience using search that looked beyond the search query. Some participants perceived learning using search as a deeply individual process, despite being discussed in terms of social processes during the interviews. Some participants experienced an increase and others a decrease in one or more of their self-efficacious processes over the 5-day study. The deep connections between search and the broader learning ecology are interesting, as barriers both inside and outside of the boundaries of the search box can interfere with the learning process.

Three significant threads within the reflexive themes suggest areas upon which to focus on future work. One significant thread was the understated importance of specific kinds of relationships in the learning using search process. Social relationships influenced whether learners felt safe in digital communities, felt supported throughout their cognitive development, and may even have improved search queries and tactics over time through sensemaking activities outside of the search environment. Another significant thread is related to the learning tasks and supporting both proximal and distal goal tracking as well as helping learners to understand where they are within a knowledge space (e.g., research methods) through wayfinding support so they understand the bigger picture. This may reflect a need for learners to see the connection more easily between their search query and the larger landscape of information. The last significant thread is related to the content and system. Clutter in the search environment may need to be removed, limiting marketing-related cues and reducing the amount of repetitive, summary-level content in search results. This may involve focusing attention on open-access content creation that provides more variety of depth and types of information that goes beyond definitions (e.g., methods and process-based videos) as well as curating specific libraries of UX professional information that are easily accessible online.

Chapter 6: Discussion

6.1 Overview

Working adults face an ongoing need to reskill throughout their career, but search engines are misaligned with the needs of the UX professionals featured in this research who were turning to the web to find information to help them learn on the job. This research examined the concept of self-efficacy by first developing a self-report measure of self-efficacy rooted in self-determined learning theory, followed by a mixed-method study that used the SALSE scale from Phase 1 to understand changes in the self-efficacious experiences of the participants as expressed during data-prompted interviews. The central research question was: What is the role of self-efficacy when working adults learn using search? The outcome of this research is a broader understanding of self-efficacy and the potential failure of current web search engines as tools for fostering persistent, in-depth learning.

This chapter discusses the understanding developed over the course of the research program. Section 6.2, measurements in SAL, discusses the creation of the self-efficacy scale in Phase 1 and interprets the preliminary findings from the development sample from Phase 2. The changes in the self-efficacy scores (Section 6.3) and the nature of self-efficacy (Section 6.4) are examined. The key takeaways on each of these are discussed in Section 6.2, 6.3, and 6.4.

6.2 Measuring and Evaluating Self-Efficacy

Phase 1 asked, “How is a working adults’ sense of self-efficacy measured when learning using search?” (RQ1.1). Self-efficacy was a purposeful choice of measurement based on alignment with the heutagogical learning paradigm because of its links to persistence and effort in learning (Bandura, 1994; Hase & Kenyon, 2000). Learning is typically measured according to the degree to which an external expert decides that a person has learned. Traditional learning measures follow a summative (i.e., final grade) or formative (i.e., feedback) approach (Shephard, 2009), although there is growing interest in ipsative (self-comparison) assessments (Hughes, 2011; Lok et al., 2016). SAL studies commonly use proxies for learning (e.g., scores/grades) that focus on products of knowledge or measures of search ability (e.g., Collins-Thompson et al., 2016; Jansen et al., 2009; Knight et al., 2017; Moraes et al., 2017; O'Brien et al., 2022; Wilson & Wilson, 2013). A variety of methods have been devised to assess learning from multiple-choice quizzes, written summaries, and so on, with each of these methods producing an output that is determined by an expert (e.g., Collins-Thompson et al., 2016; Jansen et al., 2009; Knight et al., 2017; Moraes et al., 2017; O'Brien et al., 2022; Wilson & Wilson, 2013).

The researcher did not use formal learning measures in this dissertation because self-determined learning is self-referential and guided by what a person does, thinks, feels, and chooses (Hase & Kenyon, 2000). Products of learning are a representation of a temporary state of knowledge and can continuously be improved upon given the time and desire. The point of self-determined learning is to understand how to support learning over time and ensure working adults are gaining an appropriate diversity of knowledge from their experiences, interactions, and information. For this reason, learning in this study was viewed as a highly personalised assessment in which learners' own perceptions of learning was more important than external experts' assessments. It is important to note that not all knowledge domains focus on diversity; within stable knowledge domains in which information does not frequently change or is not subject to multiple interpretations, correctness may matter. However, if the future is unknown and learners need to develop critical thinking and creativity to address future problems in a changing knowledge domain, determining the correctness of an answer is insufficient as a sole measure of learning. Recruiting pairs of participants (e.g., researcher and a corporate client, manager, or in-situ peer) to evaluate the applied learning goal output was not a feasible option. In some cases, corporations are subject to nondisclosure agreements and the aforementioned people may not be experts in UX. In lieu of feedback loops, other characteristics and attributes of learning can be examined and designed for, such as self-efficacy.

Prior research on self-efficacy in SAL has focused on search expertise or ability. SAL research investigates self-efficacy using skills or processes, as illustrated in Kurbanoglu’s (2006) Information Literacy Self Efficacy scale and Bailey’s (2017) Search Ability scale. Yet the foundation for SAL set by Kuhlthau’s (1991) information-seeking process model attends to the whole learner, including the affective dimensions of search. Information literacy and search ability are important and valuable facets for understanding SAL, but they represent only a portion of the perceived self-efficacious capabilities needed in the context of learning using search. This dissertation examined Bandura’s original works and developed a scale to measure all four psychological processes of self-efficacy (motivational, affective, cognitive, and selection) when working adults learn using search (Bandura, 1994).

DeVellis’s (2017) development process guided the development of the SALSE scale. Most notably, the feedback from the expert review study demonstrated the multitude of ways in which self-efficacy may be conceptualised by experts. It provided insights into a variety of alternative constructs (e.g., anticipated outcomes) that may be related to the intersection of learning and self-efficacy. Additionally, written feedback on the items proved valuable for reflecting on the interpretation of the constructs. For example, one expert advocated for inclusion of social processes, which they felt was absent in the original conception of the scale. Social processes, although not an explicit psychological process noted in Bandura’s (1977) theory of self-efficacy, was also a significant theme during the data-prompted interviews that highlighted the kinds of social supports (e.g., naturally occurring mentorships) that support learning using search.

Additionally, before the expert review I selected the Emotional Self-Efficacy scale (Kirk et al., 2008) that measured one's ability to identify one's emotions, but following the expert review, I shifted to a scale that encompassed the regulation of emotions (Caprara et al., 2008) because it better aligned with Bandura's (1977) definition of affective processes. The key takeaway from the expert review process was the importance of capturing more than one psychological process in the study of self-efficacy. An awareness of all the potential processes that influence or alter the experience of learning using search helps to illustrate the intersections between and contradictions within the psychological processes of self-efficacy that occur along the learning journey. By improving understanding of self-efficacy and the differences between psychological processes, studies can be fine-tuned to focus on how self-efficacy is changed (if at all) by learning interactions with search systems.

In Phase 2, the SALSE scale was tested with a small development sample and showed potential for face validity, reliability, and construct validity. In Phase 1, face validity was investigated during the expert review. In Phase 2, reliability was calculated using Cronbach's alpha, and construct validity was investigated using statistical correlations. Criterion validity, which requires a large development sample and other validation scales to predict the criterion of importance, was not investigated in the current study. However, the SALSE scale shows promise as a measure of self-efficacy in SAL. Throughout the rigorous process of scale creation, I showed that self-efficacy is a multidimensional construct. Creating a validated scale of self-efficacy that collects data across all four psychological processes may lead to better understanding of how self-efficacy changes over time in a SAL context, which in turn can help identify ways to support learning using search.

6.3 Explaining Changes in Self-Efficacy

Measuring self-efficacy within a heutagogical paradigm suggests the inclusion of multiple psychological processes. Equally important is the evaluation of the changes in self-efficacy over time. Self-determined learning is a self-referential learning process, focused on continuous improvement (Hase & Kenyon, 2000); to think about self-efficacy as an isolated measure of learning is inadequate. The Phase 2 mixed-methods study captured fluctuations in self-efficacy over the course of 5 days, suggesting personal agency and duration in study design may be useful for explaining and supporting search as self-determined learning.

RQ1.2 asked if there was a significant change in self-efficacy over the course of 5 days when UX professionals maintained a learning diary while they learned using search. The purpose of this research question was to identify the extent to which self-efficacious processes were either supported or not supported when learning using search. The diary used to monitor participants' search sessions was constructed using Flavell's (1979) theory of metacognition; however, it was unclear whether metacognition would mediate self-efficacy or if self-efficacy would mediate metacognition (Coutinho, 2009; Moos & Azevedo 2008, 2009b). I therefore did not include any directionality to the research question (1.2), keeping it exploratory and open.

Drawing upon the refined 43-item SALSE scale developed in Phase 1, a paired *t*-test was run to analyse changes in self-efficacy over the course of the 5-day period. I found no significant changes in participants' pre- and post-study motivational, affective, cognitive, and selection processes according to the SALSE subscales. The one exception to this was the cognitive subscale, Schema Training, which involves people's mental models of search systems and the methods they use to find information (Gorell, 2009). A mental model is "a searcher's mental representation of how a search system works" (Thomas et al., 2020, p. 2). Mental models help people simplify complexity and describe, explain, and predict the system state (Rouse & Morris, 1986). A significant decline in schema training may indicate that the mental models of searchers in this study were inaccurate because of the hidden complexity behind each search.

This finding is not new: previous studies have found that web searchers are missing key elements in the information search and retrieval process (e.g., Mlilo & Thatcher, 2011; Thomas et al., 2020). Mlilo and Thatcher (2011) used 17 previously identified web features to determine whether participants' (*N* = 80) mental models of web search engines improved, compared to the findings of previous research published in 2000. They found that although some improvements were made in terms of understanding the web as a database and choosing keywords and phrases to search, participants struggled with understanding algorithms and how terms or phrases are matched to documents (Mlilo & Thatcher, 2011). Thomas and colleagues (2020) conducted a mixed-methods study in 2020 that investigated the mental model of web search engines using a combination of surveys (*N* = 400) and interviews (*N* = 11). They identified five elements that needed further explanation to complete a searcher's mental model of web search: paid ranking, filtering, recency, diversity, and credibility (Thomas et al., 2020). During the data-prompted interviews in the current study, some participants reported difficulty in finding the information they needed to accomplish their proximal and distal goals due to the lack of diversity in search results; participants reported a sense of repetition in the content during their searches, making it difficult for them to find a different opinion or to compare found information.

Gaps in mental models are not the fault of the searchers. Gorrell and colleagues (2009) described learning to search as a form of blind training—people begin searching online without knowing why and when to use a specific strategy (e.g., quotation marks; Osman & Hannafin, 1992). This may be because web search engines are currently incapable of making sense of complex learning queries due to the current limits of artificial intelligence (McAfee & Brynjolfsson, 2017; Wooldridge, 2021); alternatively, searchers' education about web search engines may be insufficient, incorrect, or absent.

The significant decline in schema training over the course of a week may have occurred because participants adjusted their mental model of search and become more aware of their search ability when faced with carrying out a learning task that required detailed knowledge of how to search. For example, one participant's distal goal was to develop a deep understanding of ethical design practices with a proximal goal of understanding how to design a "sticky" interface. The participant used keywords such as *how*, *design*, *repeat*, *software*, *experience*, *return*, *habit forming*, and *sticky* to search for how to design an ethically sticky interface. If search engines were environments that supported self-determined learning, UX professionals would have improved their search outcomes simply by searching more.

6.4 Nature of Self-Efficacious Processes in SAL

Using the 43-item instrument development in Phase 1, I examined qualitative interview data based on participants' gains and losses in self-efficacious processes. The study design used a mixed-methods approach to investigate self-efficacy and two qualitative subquestions: "What is the nature of the self-efficacious experiences when working adults learn using search?" (RQ1.3), and "What are the changes in working adults self-efficacious experiences when learning using search?" (RQ1.4). See also Section 6.2 for discussion of RQ1.2.

To address RQ1.3, analysis of the data-prompted interviews resulted in five themes mapped to the four psychological processes of self-efficacy (Bandura, 1994): "support my journey” and “keep it manageable” (motivation), “anchored to the bigger picture” (cognitive), “afraid of being wrong” (affective), and “stuck in the weeds” (selection).

“Support my journey” refers to encouragements to persist in learning, such as through individual agency and productive mentorships. “Keep it manageable” relates to identifying the scope of the problem, reducing learning goals into searchable chunks. “Anchored to the bigger picture” pertains to issues with tracking proximal search goals to broader distal goals. “Afraid of being wrong” represents the issues early-career UX professionals experience in overcoming a fear of failure and the sense of permanence around their state of not knowing. Lastly, “stuck in the weeds” refers to challenges of credibility and source identification on both the SERP and individual web content pages.

Based on the above themes, the analysis focused on potential explanations for the changes in self-efficacy using the outputs from the data-prompted interviews to explore RQ1.4. SAL studies investigating self-efficacy have examined search ability (Bailey, 2017; Brennan et al., 2016; Kelly, 2010), the self-concept of searchers based on their search habits (e.g., scattered, settling, shrewd; Willson & Given, 2014), false beliefs about being a good searcher (Agosti et al., 2010; Feldman, 2012), satisficing or stopping behaviours when the information appears good enough (Elsweiler et al., 2011), who asks for help early in the information-seeking process (Williams & Kim, 2012), and the high cognitive load experienced during query formulation when learning using search (Gwizdka, 2010).

This study expands on this prior work by examining self-efficacy in the larger digital learning ecology wherein web search engines play a single part. A digital learning ecology is “an integrated conceptualization of learning as a complex phenomenon that bridges formal, non-formal, and informal learning experiences” (Sangrà et al., 2019, p. 1615). The current design of search interfaces and algorithms may have privileged participants who used their prior knowledge, had existing positive and trusted mentorships, and kept track of a distal goal. Web search engines for this group may act as a mediator between an external form of memory (i.e., web content) and the searcher. Participants who experienced a loss of self-efficacy struggled with assessing credibility of information and sources, sifting through volumes of homogenous summary-level information, and finding/accessing people with whom to share their intellectual takeaways and challenges.

Prior research indicates that self-efficacy can be developed through a growth mindset (Burnette et al., 2020; Dweck, 2007), influences mastery goal setting (Alhadabi & Karpinski, 2020; Honicke et al., 2020), supports positive learning emotions (Mielniczuk & Laguna, 2020; Putwain et al., 2013; Villavicencio & Bernardo, 2016), and improves in a positive environment (Chang & Jacobs, 2012; Kelley et al., 2020; Lalloo et al., 2020). Based on the findings related to RQ1.3 and RQ1.4, this research identified three design areas that may be important during learning searches and are not yet included in web search systems. The following sections explain the findings in the context of designing for affective regulation, agency, and diversity.

Affective Regulation

Working adults in this study needed to feel supported by the people around them and participants reported the role social relationships play in developing self-efficacy when learning using search. Heutagogical literature frames social relationships within the context of a community of practice (Hase & Kenyon, 2000); a self-organised community comprised of people who are working towards a shared understanding of the field (Lave & Wenger, 1991; Stebbins, 1992; Wenger, 1999). UX community groups by and large exist in both online and offline spaces (e.g., User Experience Professionals Association, User Experience Research and

Strategy, Ethnographic Praxis in Industry Community, Qualitative Research Consultants Association, Rosenfeld Media), but the participants in this study were reluctant to engage with these communities. Both motivational and affective process scores on the SALSE scale increased from pre- to post-study (nonsignificant), but qualitatively the participants reported negative self-perceptions regarding their current knowledge state. Working adults in this study reported going outside of search engines and made use of their social network to make sense of what they knew.

Study participants feared engaging with online UX communities and developing a permanent reputation of not knowing. Although affective self-efficacy commonly refers to self-regulation of emotions (Bandura, 1994), this analysis points to external self-efficacious factors, such as mentors, that support the regulation of affective self-efficacy while learning using search. As early-career UX professionals navigate learning, self-efficacy may be supported by increasing access to mentors who ameliorate the fear of failure (Conroy et al., 2007) and respond to mentees with unconditional regard (Hansman, 2020; Van Dam et al., 2018; Wouters et al., 2018). Focusing on the interpersonal connection over intellectual resources may prevent avoidant learning behaviours, such as discontinuing to search for new information (Zeidner, 2014) and may be a critical component for improving search outcomes and self-efficacy (Chang & Jacobs, 2012; Kelley et al., 2020; Lalloo et al., 2020). Two potential avenues to explore are (a) whether the need for psychological safety in digital environments can be addressed and (b) how to change the learners' views on what it means to fail.

With respect to constructing psychologically safe environments, one possibility is to consider technology not as an entirely objective source of information or truth, but as an agent that provides an emotionally supportive feedback loop on ideas. Humans use known social mores when interacting with machines (Reeves & Nass, 2003) and web search engines facilitate the conversation between human and machines (Dervin, 1998). But, machines have not yet advanced sufficiently to understand human queries without humans putting in some degree of effort to formulate search queries (Gwizdka, 2010; Rosset et al., 2020; Salle et al., 2021; Taylor, 1968; Wooldridge, 2021). When machines are not in the appropriate stage of development to fully participate in a sensemaking dialogue, humans turn to other humans.

Library and information science research has examined the role of librarians during the search process and found some information seekers turned to librarians to articulate an information need (Nilsen et al., 2019; Papy, 2008). Librarians are expert searchers who mediate the relationship between information sources and searchers. However, although librarians may address emotional states during information seeking (Nilsen et al., 2019), the lack of proximity and limited access in the workplace may not wholly reflect the ongoing affective self-efficacy needs some UX professionals gain through their immediate mentors and networks. Social networks are commonly considered to facilitate knowledge sharing within organizations (Nahapiet & Ghoshal, 1998). Social network usage was also supported in this study as most participants relied on their own interpersonal connections and individual web searches. However, participants did not report interactions with librarians from a public library or with librarians internally within the organization. There may be few opportunities with which to engage affectively with expert searchers given the fast pace, informality, and broad scope of learning experienced by UX professionals. UX professionals may also have predetermined barriers at work regarding with whom they can speak; some work-related projects are subject to nondisclosure agreements and answers may need to be turned around quickly, which limits the available humans with whom to discuss project issues.

If specialised experts, such as librarians, are unable to support the development of learning using search, another potential avenue is a digital social network. Blaschke and Hase (2016) discussed the use of social media in the heutagogical literature as a means by which working learners can create and share content, explore new ideas and topics, aggregate information or knowledge, and connect with others who share their interests. But Blaschke and Hase considered digital networks in a primarily public sense, in which people openly share questions and ideas using social media websites and tools. In this study, some participants felt ill-at-ease online as a person new to the field; there was an internal expectation to know the answers to basic questions, and they experienced fear when posing questions within digital communities. These early-career UX professionals were reluctant to reach out to others, and when they did, they were more likely to tap into their existing social network of naturally occurring mentorships and relationships.

If online spaces are perceived as unsafe, machines lack the conversational sophistication to take on the role of mentorship, and search experts are not able to continuously support the affective needs of working learners at scale, then a different perspective is needed on what it means to be a learner and to fail. In this study, learning using search was perceived as an independent, socially risky activity that elicited a fear of failure. This raises the question, is failure such a bad thing?

In education research, productive failure describes when learners are given free rein to attempt to solve a complex problem containing multiple solutions without scaffolds (Kapur & Bielaczyc, 2012). Productive failure refers to solving a problem that is challenging without being exceptionally frustrating. If the problem is too easy or too frustrating, the learner will simply solve the problem with minimal learning or walk away. Productive failure resembles the original guidance in scaffolding theory, in which learners are given scaffolds only after they have been given a chance to solve the problem themselves (Wood et al., 1976). Productive failure is also present in self-efficacy theory, as Bandura notes: "If people only experience easy successes, they come to expect quick results and are easily discouraged by setbacks and failures" (Bandura, 2012, p. 13). Well-designed systems that incorporate productive failure do so by understanding the learner's prior knowledge and building upon it (Kapur, 2016). Realigning the perception of failure to be an additive process of building new knowledge (versus missing the mark) and socializing the idea that different people know different things may create a new sociocultural perspective on what it means to be a UX beginner and to accept not knowing as a temporary and integral part of what it means to learn.

Agency

Working adults in this study needed to anchor themselves to the bigger picture, and participants who improved in their cognitive self-efficacy set their own standards or criteria of learning and engaged in metacognitive strategies that grounded them to their distal goal. Self-determined learning is an agentic paradigm that focuses on the internal state of the learner instead of on specifics tasks and outcomes (Hase & Kenyon, 2000). However, learners in this study struggled with two elements related to learning tasks during the search process: goal setting and wayfinding.

Participants in the study autonomously selected one distal goal at the beginning of the study and several proximal goals throughout the duration of the study; this strategy is known to support motivation (Alhadabi & Karpinski, 2020; Honicke et al., 2020; Seijts & Latham, 2001). However, participants' agency was hindered during searches as they tried to fit their informational needs into the search engine. Participants who showed a reduction in their cognitive self-efficacy discussed a sense of feeling lost online and reported an increase in focus on the search queries; it was a challenge for some participants to stay aligned with their distal learning goal, even with the support of daily diaries. Of note, participants who discussed their proximal goals during the data-prompted interviews also demonstrated an increase in motivational self-efficacy.

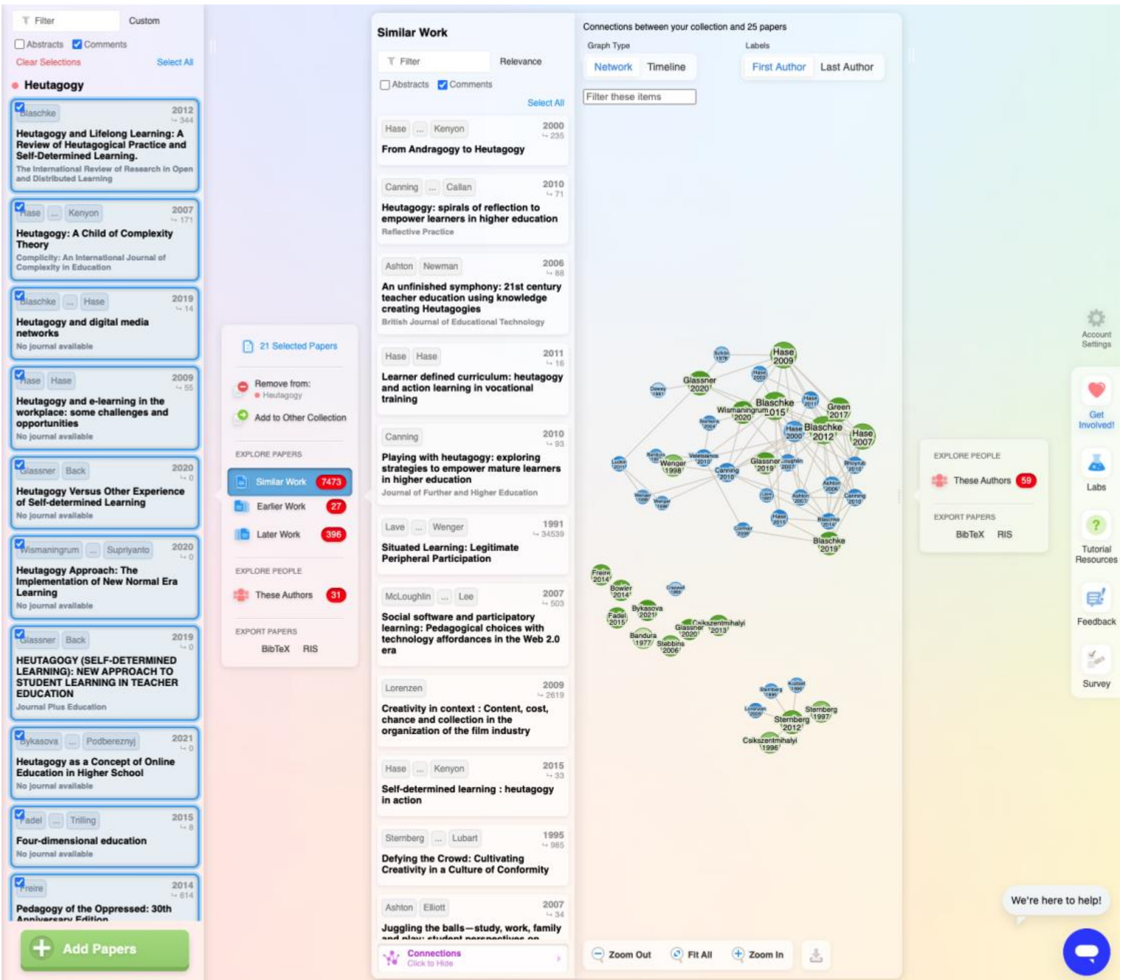
This finding presents an interesting tension between cognitive and motivational self-efficacy when people set proximal goals. There may be several reasons why this tension exists. The first is that having well-defined distal and proximal learning goals has been linked to a greater individual commitment to the learning topic (Seijts & Latham, 2001). Participants who focused on a distal learning goal while engaging in daily metacognitive (proximal search goals) activities may have found it cognitively easier to sustain their focus and used the distal goal as their primary learning guidance tool. However, their motivational self-efficacy may have been challenged because of the limitations of what content they were able to find on the web. The second potential explanation may be that feedback provided from proximal search goals alone may not have been informative (Latham & Brown, 2006; Seijts & Latham, 2001). This may suggest that the participants who improved their motivational self-efficacy through proximal search goals may not have sufficiently defined their distal goals or experienced difficulties keeping track of them. The information found through web search engines may also have presented insufficient information to enhance any subsequent search queries. Alternatively, participants may have felt gratified to have found any information at all and did not consider its application to their distal goal, or they may have struggled with a lot of summary-level information without achieving the level of depth required to facilitate their experience.

Further contributing to the sense of being lost is the challenge of wayfinding in search. Web search engines are effective at connecting information through hyperlinks but do not visually arrange or manage the information found beyond the SERP. For example, Crescenzi and colleagues (2021) created a tool, Orgbox, that enables the drag-and-drop of searched information into boxes that can be organised and labelled. The premise of the study suggests there are few cues that support a searcher's understanding of their results; web searchers cannot manipulate their results (outside of query reformulation) or dynamically arrange their results in a way that displays their search query within the context of the knowledge domain. To test the effectiveness of dynamic organization of information, the authors recruited students ($N = 24$) to participate in two experimental tasks that compared the OrgBox tool with an OrgDoc tool that was like Google Docs and was used as a baseline. They found the OrgBox supported better metacognitive monitoring (Crescenzi et al., 2021).

Some participants reported difficulty in keeping track of where information sat within the knowledge domain. The fluidity of search may be useful for just-in-time look-up and fact-finding searches, but learning a new topic may need to begin with some initial constraints. This does not necessarily imply that an expert should curate or collect information for the learner. Rather, if the system is based on self-determined learning principles, it should be easier for an individual to find and create a collection of materials from which to learn. Learners would then be more in control of the materials and benefit from serendipitous recommendations aligned to their distal goal. Serendipity is an integral part of exploratory searches, as the usefulness of the information may increase in relevancy over time (McCay-Peet & Toms, 2010). Early examples of knowledge visualizations paired with serendipity are currently restricted to specific domains. One such tool is Research Rabbit, a literature review tool that tracks citation chains within academic outputs, such as journal articles and conference papers (see Figure 18).

Figure 18

Research Rabbit User Interface (March 2022)



Note. Research Rabbit is a literature review search tool that helps identify, map, and monitor academic knowledge based on an input of a search term or another identifier such as an article title or author name. It has three key features including "similar (related) work" and backward and forward chaining to help identify potentially relevant research papers.

The wayfinding features within knowledge visualizations allow for exploration of a knowledge space, while maintaining ties to the original query. Wayfinding is often used to describe physical spaces (e.g., airports), and in information design it is used to refer to the cognitive processes people use to navigate information spaces (e.g., web; M. J. Bates, 1989;

Elsweiler et al., 2011). A few established modes support people in finding information: locate, explore, and meander (M. J. Bates, 1989; Elsweiler et al., 2011). Locate refers to simple search queries that are found easily, explore is a mode in which people find nuggets of information along the way (M. J. Bates, 1989), and meander is akin to serendipitous occasions where information is discovered (Elsweiler et al., 2011). The serendipitous nature of found articles is situated within an existing citation chain, increasing the likelihood of the information being relevant. Within visualization tools, like Research Rabbit, the ability to locate, explore, and meander permits various explicit information-seeking strategies while staying within the confines of the distal learning goal.

One of the criticisms of data visualizations may be related to the cognitive load experienced—a factor that may impact individual's sense of agency (Hopwood et al., 2022; Qu et al., 2021). In the case of data, visual depictions may reduce the cognitive load of a task in some cases (Munzner, 2000), whereas big data visualizations may increase cognitive load (Munzner, 2014). In search-specific studies, Burt and Li Liew (2012) performed an exploratory study with 12 participants and concluded that clustering results by topic alongside a presentation of search results may reduce perceived cognitive load in searchers. In another study, González-Ibáñez et al. (2017) compared a traditional search result list with a visualised result list with 20 participants They found no significant differences in cognitive load (using the NASA Task Load Index) between the two results presentations, suggesting it is possible to increase the number of search results presented to searchers without impacting their cognitive load. An important note about their study is the use of informational cues, which exposed the result's rank, date, legibility, and reputation in a legend location near the results visualization (González-Ibáñez et al., 2017). There may be specific design and visualization cues needed to create balance between the mapping and organization of the information and the cognitive load experienced by the searcher, thus visualization of information found through search may need to appropriately balance individual agency with the cognitive load of the searcher when using the tool.

Making knowledge connections explicitly may support learners who are learning using search on the job. Some supports that may be important for self-efficacious processes are chunking information into manageable pieces to avoid feeling overwhelmed (Oakley, 2018) and providing wayfinding guides through a particular domain or topic area to support cognitive processes (West & Leskovec, 2012).

Diversity

Working adults in this study often found themselves stuck in the weeds, and participants who improved in their selection self-efficacy displayed a healthy degree of skepticism when evaluating both search engine results and its linked content. Participants who declined in self-efficacy often gave content from established resources a form of blanket credibility, were distracted by marketing- and ad-related cues, or engaged in skimming behaviours that either distracted them from their distal goal or kept them too focused on finding the “right content.” The fixation on relevancy presents an additional hurdle to finding information that centres on a learner’s ability to assess the credibility of information. Although web search engines are perceived as easy to use when compared with library search systems (Rieh et al., 2012), they present searchers with challenges to assess the credibility of information (Rieh & Danielson, 2007) as it creates additional cognitive work in and outside of the SERP (i.e., information overload). The current research found that credibility assessments created additional cognitive work in and outside of the SERP as participants had to continually assess sources based on limited information. Focusing on credibility may have distracted participants from their overarching learning goal. Paired with the abundance of homogenous summary information, information unrelated to the explicit task, and marketing cues, web search engines may alleviate some of the effort of search (e.g., generating search results) but replace it with the cognitive effort of sorting through results.

Presenting a diversity of perspectives through search engine results may be essential for fostering critical thinking and supporting learners (Rieh et al., 2016). This concept aligns with one participant in the current study who felt more confident in information that included multiple viewpoints. Additionally, some participants who gained in self-efficacy over the 5-day period discussed being skeptical of sources. Skepticism toward online content appears to support confidence in source selection as learners may want to draw from multiple sources to confirm the found information. A recent study with 171 participants investigated the effects of YouTube information sources on skepticism; Jamil and Qayyum (2021) found that skepticism towards positive online comments on YouTube reduced the perception of the video's argument quality (i.e., perception of accuracy, comprehensiveness, relevance, and timeliness). And although content intended to influence purchasing behaviour may not benefit from skepticism, introducing skepticism of online content may support diversity and better reflect the multiperspective nature of knowledge.

Diversity may also be supported by including various levels of specificity and depth in content. The high volume of homogenous summary-level information on the web was a significant self-efficacious barrier for some participants in this research. Web search engines algorithms that prioritise efficiency may also support superficial (versus deep) learning (C. L. Smith & Rieh, 2019, 2020). Academic discourse focused on stopping and satisficing behaviours has suggested that searchers are too quickly satisfied with the answers they find (Dostert, 2011;

Maxwell & Azzopardi, 2018; Toms & Freund, 2009). However, some participants wanted more depth of information and gave up searching in favour of other methods, such as trial and error. For example, one participant who was learning Figma opted out of search when they could not find an answer and chose instead to experiment with the software directly.

Freund (2015) performed 13 interviews with software engineers to better understand the role of context in information seeking. Freund suggests moving beyond the generic search constraints (e.g., time, awareness, findability) and toward inclusion of contextualised document characteristics such as purpose, specificity, level of detail, situatedness (experience), and sanction (authority): "In this environment, knowing where, when, and how to find the right kind of information for a given situation is a valuable professional skill" (Freund, 2015, p. 1603). The outcomes of the current dissertation research also advocate for the diversity of search engine results, content depth (i.e., journal articles), and types of content (i.e., interactive learning resources) that may support working adults who have limited options for learning on the job. Additionally, as attentional demands and the pace of work increase, learning at depth becomes more challenging (Allen & Wilson, 2003; Bawden & Robinson, 2009). Accessing content quickly is essential, but there should be better ways to self-curate validated resources that support iterative learning processes.

Overall, by examining self-efficacy with UX professionals, I found that web search engines are a fundamental part of the broader digital learning ecology, but they do not currently meet the needs of working learners. Web search engines are designed for learners with prior knowledge, strong social networks, and existing knowledge of "good" information sources alongside the ability to access them. These factors limit the use of web search engines to a select group of people and for limited purposes and diminishes the potential equity in a platform/tool set that provides open and accessible information to all.

6.5 Chapter Summary

This research program investigated the role of self-efficacy in a group of early-career UX professionals when they learned using search. The SALSE scale was created for the explicit purpose of measuring self-efficacy and was deployed with a small development sample who maintained a search as learning diary over a 5-day period. Qualitative evidence of the self-efficacious supports and barriers participants experienced when attempting to learn using search was also gathered during the data-prompted interviews. In analyzing the SALSE scale, I found self-efficacy is a multidimensional construct that changes after a week of learning using search. I found a statistical decline in a type of cognitive self-efficacy, Schema Training, that suggests learners' confidence may be reduced when they have an inaccurate mental model of search, resulting in a mismatch between their perceived and actual abilities.

I examined the self-efficacious barriers and supports of participants based on the psychological processes and explored these findings in terms of their design implications related to affective regulation, agency, and diversity. Early-career UX professionals in this sample leveraged their immediate social networks to support their learning, and those who engaged in sensemaking with mentors and learning partners on an affective (versus a cognitive) level experienced gains in affective self-efficacy.

Self-efficacious processes may be improved by focusing on the need for human connection instead of purely intellectual exchanges when supporting early-career UX professionals. Agency is an important component when learning using search. Setting and tracking distal goals for this population sample were important for achieving a greater sense of cognitive self-efficacy. However, the effects of proximal goals were less clear. Some participants who reported on their proximal goals showed gains in motivational self-efficacy, but at the cost of cognitive self-efficacy, suggesting that searching may be merely gratifying without necessarily being productive. Cognitive self-efficacy also declined when too much attention was paid to the search query; participants reported a sense of being lost online. However, cognitive self-efficacy improved for participants who reported having prior knowledge.

Cognitive self-efficacy may be improved by self-curation of information using visualizations and progress records. Diversity of content in search results supports selection self-efficacy. Self-efficacious processes may be reduced in situations in which working learners need to assess the credibility of a large volume of homogenous summary-level information and may not always have a healthy skepticism of information found online. Credibility cues (regardless of type) did not support skimming behaviours, and participants in this sample demonstrated a decline in their selection self-efficacy over time. Self-efficacious processes need further study to better understand how to integrate the entire learning ecology into the SAL space.

Chapter 7: Conclusion

This chapter discusses the contributions of this research program, summarises the limitations of the work, and highlights areas for future research.

7.1 Contributions

Methodological Contributions

The methodological contributions to this research are the SALSE as a measurement tool for other SAL researchers and the use of a longitudinal mixed-methods study. A novel scale was developed for the assessment of self-efficacy in searching as learning processes in Phase 1 of the study program. Using DeVellis's (2017) guidelines for scale development, the SALSE scale underwent a rigorous process of development inclusive of a literature and expert review as well as some evaluation. The final SALSE scale includes 4 subscales and 43 items (see Appendix D.1; scoring information can be found in Appendix D.2). Although still in an early stage of development and requiring further validation, this scale is the first questionnaire deployed in a SAL study to use all four psychological processes of self-efficacy. It represents an important contribution to the SAL research community, in terms of its basis in a body of theory that encompasses the motivation, affective, cognitive, and selection processes of self-efficacy. Furthermore, this study is novel in its broad inclusion of self-efficacious factors and adherence to the recommendations provided by Bandura in measuring self-efficacy. The ecological validity of the SALSE scale is enhanced through collection of both quantitative and qualitative data that were captured from a population sample of working learners.

A longitudinal study that combined research methods was selected to acknowledge that learning occurs over time and to improve the rigour and ecological validity of the mixed-method study. I paired the learning paradigm (i.e., heutagogy) to the population sample (i.e., working learners), used natural tasks that were created by the participants, captured learning data in situ that were later used to guide the conversation with participants, and applied a rigorous process in the development of the self-efficacy scale.

The study design was heavily influenced by the heutagogical learning paradigm, which was purposefully selected because working learners should have agency in what, when, where, and how they want to learn. Purposeful choices were made because of the specific learning paradigm, which advocated for using self-referential measures (versus expert assessment measures, e.g., grades). Introducing self-referential measures of learning meant reconsidering how learners reflect on whether and to what extent they had learned. This led to the introduction of metacognitive prompts to better capture how someone was thinking and feeling, and what they were doing in the moments closely following their search sessions.

The data from the search as learning diary were summarised and expressed on an individualised experience sampling dashboard that was later used as a prompt during the data-prompted interview. This raised an important question of whether the diary was a metacognitive prompt, a data collection instrument, or both. In the end, I decided the diary was a metacognitive prompt that enabled reflection. The learning diary acted as a metacognitive prompt primarily because people generally do not pay attention to their searches in any meaningful way that would prompt a reflective conversation on its own, and there are few alternatives to encourage people to think about their searching over time in an ecologically valid way. The findings may have been different if the diary had not been a component to the study, but the in-situ responses from participants enhanced the quality and richness of the interviews. Similar outcomes could not have been accomplished using retrospective methods such as critical incident techniques—a method in which participants verbally reflect on a recent experience with a researcher

(Viergever, 2019). Because search has become an integral part of how information needs are resolved every day, it becomes challenging to recall details of a past search.

Role of Self-Efficacy When Learning Using Search

The results from the longitudinal mixed-method study contribute a multidimensional perspective on search technology development using nonstudent populations. Working learners' attitudes, feelings, and behaviours play an important role in the design of search-centric learning systems. By applying the self-determined learning paradigm to SAL in informal learning contexts, I captured a multidimensional view of self-efficacy that was high in ecological validity and can be applied to designing search interfaces for on-the-job learning contexts.

This dissertation posits that the following design changes may support the development of self-efficacy in working adults who are learning using search: improve affective regulation by supporting naturally occurring mentorships that address psychological safety in online spaces, develop agency through self-curation of content and wayfinding tools, and improve diversity by dehomogenizing search results.

Affective Regulation

Search is not designed to support the emotional experience when learning using search. Emotions play a significant role in learning, and many participants in the current study were worried about exposing themselves as a beginner in a digital community. They preferred to share their learning process with people with whom they felt psychologically safe. If search engines are designed for learning, the social and psychological influences of the broader learning ecology cannot be neglected. SAL researchers should consider how to integrate the learner's network of mentors and peers into the search process and explicitly address the affective needs of working learners.

Search-centric learning systems could benefit from understanding the fear of failure that is present among newcomers to a discipline and ensure new practitioners are welcome and have a secure space for asking questions. Anonymizing beginner questions to create a sense of content impermanence may help create a sense of psychological safety within communities and support the development of self-efficacy when learning using search. Furthermore, holding short how-to classes on a regular schedule that focuses on skill development, alongside more explanatory and definitional permanent learning content, may provide more in-depth training needed by the broader UX community.

Agency

Searchers may experience ineffective learning conversations with search engines with little means to change the relational dynamics between them and the search system. By applying a self-determined learning lens, search engines were viewed as limiting the individual to only query reformulation, which made it difficult for searchers to keep track of their distal goal and where they were in the knowledge space. SAL researchers should reconsider self-curated wayfinding knowledge tools that keep track of working learners' distal goals and anchor knowledge within its domain. Focusing on agentic SAL interfaces may be particularly useful within organizations focusing on upskilling and onboarding new employees. For example, UX professionals may be asked to learn organization-specific methods and analysis practices (e.g., Jobs to be Done, a specific set of methods used in identifying user roles and their related "jobs") and may benefit from having access to easily searchable and organizationally approved content.

Diversity Through Dehomogenised Search Results

For working learners to develop their capabilities when learning using search, they must be able to find information beyond the facts. SAL researchers should continue to advocate for simplifying access to basic knowledge while improving the diversity of search results to include differences in opinions, types of content (e.g., video), and depth (e.g., how to). Many participants struggled to move beyond finding summary-level information. Participants perceived basic knowledge as an important part of learning; however, many participants were too focused on evaluating the credibility of the search results and content, often resorting to skimming behaviours to check for cues (e.g., hyperlinks, ads, calls-to-action). Search-centric learning designs should avoid inclusion of advertising and only add cues that support the coconstruction of knowledge for each searcher.

7.2 Limitations

Both phases of this study were conducted during the first and second waves of the coronavirus pandemic in 2020 and 2021. During this time there were many inequities in employment, work–life balance, and dramatic shifts to the way those who remained employed worked (Yong, 2020). Mental health was also of growing concern for people of all ages (Javed et al., 2020). The methodological choices and findings from this study need to be interpreted within this context for two reasons. The first is that the choice to conduct the study remotely was done for participant and researcher health and safety. The second is that participants' mental state during the pandemic may not have been optimal, and their access to people and emotional support may have been limited; these factors may have contributed to a reduced sense of self-efficacy. The global pandemic may have also been a limitation for expert reviewers of the SALSE scale. During this same period, many doctoral-level researchers were faced with increased demands on their time between shifting to online classes and coping with at-home challenges (Flaherty, 2020). These factors may have impacted who responded to the request for participation and their preference for completing the study via email instead of being interviewed.

To mitigate some of the risks associated with collecting data via email, there was regular communication with participants and gentle reminder emails. On the one hand, working over email may have reduced the amount of feedback given. On the other hand, providing written feedback may have given participants more time to reflect and process the constructs and question items at their own pace. Future iterations should consider using a combination of methods, e.g., time to reflect followed by a debrief interview. Search expertise was not assessed as part of the identification process of experts. The focus on self-efficacy and information seeking may have influenced experts' focus of the scale items. For example, experts were asked to rate their knowledge of self-efficacious concepts, but not on knowledge of search ability. Knowledge of search abilities and techniques were incorporated as part of the review process with my advisor.

The SALSE scale development and evaluation process had several limitations. It was created because there was a sufficient gap in a holistic measure of self-efficacy within populations of self-directed learners outside of formal education settings in the SAL context. The purpose of the overall research study was largely qualitative, and a small sample size was recruited for the diary study. This resulted in fewer cases for evaluating the scale and full factor analysis of the items was not feasible. Additionally, DeVellis (2017) recommended including other measures to assess the convergent validity of scale. However, no additional scales were included in the diary study because participants were already being asked to complete several study activities including a preinterview, demographics questionnaire, two scale instruments, several learning diaries, and a final interview. It is expected that when the scale is tested with a larger population sample, it will include additional measures to differentiate self-efficacy from other similar constructs and ward against response bias.

The study had a significant skew toward those who self-identified as women. Women's self-efficacy may be hindered by perceived personal, social, or labour market-specific career barriers (Aymans et al., 2020). Women may also be more likely to show reduced occupational self-efficacy than men, whereby women may feel less competent than men when completing work tasks (Loeb et al., 2016). Other studies have shown that women may be more likely to experience improved self-efficacy with internal validation (e.g., such as completing an intellectually challenging task) compared to men, who may increase their self-efficacy through external validation (e.g., through presentations; Oberman et al., 2021). Thus, the results of the self-efficacious experiences of women who learn using search may differ to those of men: women may feel less competent when learning using search and may need to independently complete complex tasks to achieve gains in self-efficacy. Therefore, findings from this study should be weighted alongside other studies that primarily focus on women, as only one man participated in the current study.

Finally, I looked at whether participants experienced an average gain or loss in self-efficacy, but I did not consider the extent or degree of change. Some participants who were grouped together experienced numerically greater gains and losses than others, and some gains and losses may not have been captured in the self-efficacy scale responses. Future studies should consider a more refined look at differences in the degrees of change by including more participants.

The mixed-methods study explicitly asked people to engage in reflective activities using the search as learning diary. I did not make specific quantitative predictions for two reasons. The first reason is this is an exploratory study, and although self-efficacy has been studied in SAL, the focus has commonly been on search ability, which represented only a portion of the deployed scale. The second reason is that searching is not an activity people consciously reflect upon—and according to one participant in the study, it is akin to walking. There is sufficient evidence that suggests people do not engage in search-related metacognitive activities (Hsieh-Yee, 1993; Land & Greene, 2000; Vakkari et al., 2003; Wildemuth, 2004). Thus, by asking participants to reflect upon their thoughts, feelings, and behaviours when learning using search, they were able to be more reflective about their process, creating richer interview data through which to better understand self-efficacy.

7.3 Future Research

Many opportunities for additional research branch from this study. This section discusses further developing and testing the SALSE scale, exploring the impact of mentorships on learning using search, and exploring agency in the context of SAL.

Further Develop and Test the SALSE Scale With a Larger Development Sample

The SALSE scale was assessed for some types of reliability and validity with a small sample. The proposed scale does draw from previously validated scales and was created using a systematic scale development process, but further testing is needed to validate the scale. The first is to refine the scale using the results from the qualitative interview data to adjust the question items as needed. For example, one possibility is to include measures of algorithmic search literacy and take a broader approach in measuring the understanding of how search works. The next administration of SALSE should involve a sample of over 300 participants, include items related to other constructs to ensure self-efficacy is separate from those items, and perform a factor analysis to validate the dimensionality of the scale (DeVellis, 2017). These steps would support other information science researchers who want to measure self-efficacy in working learner populations when learning using search or want to understand persistence in learning when using search. This scale may also be useful to organizations who want to understand the specific areas of difficulty working adults face when learning independently. One example is Microsoft Learn (https://docs.microsoft.com/en-us/learn/), an informational learning website designed to provide guidance on Microsoft products for a variety of roles (e.g., AI engineer).

Explore Affective Regulation Through Understanding the Impact of Mentors on Learning Using Search

Having access to mentors who exhibit unconditional regard and craft a psychologically safe environment for the learner may improve motivational processes of self-efficacy and may inadvertently contribute to search ability. This study identified that not all mentor relationships contribute to self-efficacy. Future studies could investigate the relationship between different types of mentor relationships and search ability in the context of on-the-job learning. This may reconceptualise what is meant when discussing ideas, such as *social search*, which currently refers to “any approach to information search that harnesses the information access patterns of other users, whether past or present” (Brusilovsky et al., 2018, p. 214).

Explore Agency in SAL

Agency was identified in improving affective as well as motivational processes. Early-career learners who can choose their own standards, learning strategies, and scope of learning were all discussed as being essential components that helped to improve motivational self-efficacy. Self-curated interactive resources may be necessary for early-career working adults to learn using search more effectively. Participants in this study spent an enormous amount of time assessing validity and credibility of search engine results and coping with large volumes of homogenous summary-level text-based resources. These resources do not inform the learner of where they are in the knowledge space or how to further explore topics in depth (see work from Freund et al., 2016).

Furthermore, many lab-based experimental studies use predefined tasks and content, which treats agency as a confounding variable that must be eliminated. The reasoning behind these choices is to causally relate searching to learning behaviours and outcomes. Because agentic elements (e.g., feeling lost) were highlighted in this study as a significant factor of persistence in learning using search, a scoping review of agency may be useful for SAL scholarship. One approach could be to categorise studies based on the perceived control one has over the goals, resources, and tasks. The outcome of a scoping review on this topic would be to understand what effect study design choices have on findings, to create more positive search experiences for all learners. More research is needed to understand how to orient learners in an ever-evolving information landscape and to help them achieve balance between the breadth of understanding needed for critical thinking and the depth needed to immediately apply their learning on the job. Some early tools that visualise a larger knowledge space are Research Rabbit (https://www.researchrabbit.ai/) and Connected Papers (https://www.connectedpapers.com/).

7.4 Chapter Summary

This chapter explored potential contributions of this research program, summarised the limitations of the work, and highlighted areas for future research. The findings from this dissertation demonstrate that self-efficacy is a multidimensional construct that changes after a week of learning using search. Learners' self-efficacy may be supported by having positive and naturally occurring relationships that support the social sensemaking process, as well as by having clearly defined distal goals. Proximal goals are useful for chunking learning; however, when learning using search, proximal goals may increase one's motivational self-efficacy at the expense of their cognitive self-efficacy. These shifts in self-efficacious processes are not adequately understood and further study is needed to better understand how to manage the process of learning using search. Furthermore, the work of assessing credibility online may reduce self-efficacious processes of working learners who may need support in tracking where information sits in the knowledge space and weeding out unnecessary results that repeat the same summary-level information.

The limitations of the study are specific to this population sample and within the context of the pandemic. The SALSE scale needs to be validated with a larger development sample if it is to be used in other studies. Future work should include (a) further development of the SALSE scale, (b) a scoping review that evaluates participant agency in SAL studies, (c) further research into the influence of mentorship on search ability and design of wayfinding tools for search-centric learning environments, and (d) incorporating artificial intelligence and algorithmic literacy into early and higher education to help future working learners understand the fundamentals of how search works.

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Appendices

Appendix A Part 1

A.1 Recruitment Email

Subject line: Expert Opinion: Developing a self-efficacy scale when people learn using search.
My name is Amelia Cole, and I am a Ph.D. Candidate at the University of British Columbia's School of Information. I am supervised by Drs. Heather O'Brien, Luanne Sinnamon, and Jillianne Code. My dissertation focuses on understanding how people build confidence in learning using search systems; specifically understanding the change in adult learners' self-efficacy when they are engaged in independent learning. As an expert in self-efficacy, I am requesting your assistance.

As part of my study, I am looking at how self-efficacy has been measured in education, information science and psychology. I am conducting an expert review to understand more about the evaluation of self-efficacy and to adapt previous research to create a questionnaire I can use in my study.

If you agree to participate in this study, you will be emailed a consent form, as well as a word document with a brief presurvey and the proposed self-efficacy questionnaire. You will be asked to reflect on the scale and consider the value of the constructs selected as well as the scale items. You may choose to provide feedback through email or through an audio-recorded Zoom call.

Your participation in this study is voluntary and will be kept confidential. A $15 honorarium will be provided for participating. This should take 30-60 minutes of your time.

If you are available and interested in participating, please e-mail me at [email address]

Thank you,
Amelia Cole, Principal Investigator
PhD Candidate, Information Science

Dr. Heather O'Brien
Associate Professor, Information Science
University of British Columbia

A.2 Informed Consent for Part 1

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The role of engagement in metacognition within self-determination learning

Study Team:	**Principal Investigator:**	Heather O'Brien [email address]
	Co-Investigator:	Amelia W. Cole [email address]
	Advisory Committee:	Dr. Luanne Sinnamon [email address]
		Dr. Jillianne Code [email address]

Human Ethics ID: H20-02577

Introduction	Thank you for participating in this study. This work is affiliated with Amelia Cole's doctoral research at the School of Information at the University of British Columbia.
Purpose	We want to learn how metacognition influences self-efficacy when people learn using search. This expert review is designed to evaluate a proposed Search as Learning Self-Efficacy scale in informal learning contexts based on Bandura's theory of self-efficacy.
What you will be asked to do	After you have read this document, I will respond to any questions or concerns that you may have. Once you have signed this consent form, we will proceed to the study. This study consists of one expert review. The expert review will take approximately 30-60 minutes. You will be asked to complete a demographic pre-survey to understand your expertise and then you will be asked to document your feedback and reflections on selected self-efficacy constructs as well as the individual items. You may choose between sending feedback over email within the word document or to participate in a recorded Zoom call. Your participation is voluntary. You may decline to answer any questions and you may withdraw at any time without penalty.
Risks/Benefits	There are no major risks anticipated.
Compensation	You will receive $15 CAD for your time.

Confidentiality & Anonymity	If you choose a Zoom call, your confidentiality will be respected. You are encouraged to use a nickname when signing in to Zoom. All recordings will be identified by an assigned code number. While complete anonymity is more challenging through video and audio conferencing, you may also choose to keep the video and audio off when it is not required. Any information inclusive of recordings will be stored on a secure in-house server at the University of British Columbia. Your privacy is important. If you are willing, your contribution will be acknowledged in Amelia Cole's dissertation. You will have an opportunity to select whether you would like to be acknowledged by name or to remain anonymous in the expert review. No direct quotes will be used in any reporting.
Access to data	Drs. O'Brien, Sinnamon, and Code as well as Amelia Cole will have access to your data. Additionally, open access research guidelines means researchers may be required to make the raw data accessible to other academic researchers, such as journals, to validate the findings. As mentioned above, all identifiable information, such as username, will be removed and replaced with a participant ID. Open-access data may carry some risk to you as the participant and you will not be able to withdraw your data once the data is made available to the journal.
Use of data	The feedback will be used in Amelia Cole's dissertation and may be published in academic journals or conferences.
Future use of the data	No future use of this expert review recording is known at this time. However, should the data need to be re-analysed and re-used, I will contact you to explain the need and ask if you would be willing to consent to the activity.
Contacts	This study uses snowball sampling and asks you to consider other potential participants in the expert review. Potential participants must consent to have details, such as names and contact information, shared prior to Amelia Cole emailing them.

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study. I realize that my participation is voluntary and that I am free to withdraw from the study at any time.

I prefer to have communication occur over:
[ ] email
[ ] phone

Email/Phone: ____________________________________

Would you like to be acknowledged by name in the dissertation?

[ ] Yes I agree to be acknowledged by name in the dissertation.
[ ] No I prefer to remain anonymous.

[ ] If I choose a Zoom call, I consent to being video and audio recorded.

Signature: _____ ____________________________ Date: _________

Who can you contact if you have any complaints or concerns about the study?

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598

Human Ethics ID: H20-02577

A.3 Expert Review Instrument

What we're doing
We are developing a measure of self-efficacy when people learn using search in natural settings. Scales in search and information literacy focus specifically on one's feeling of confidence or competence in their skills and do not fully account for the psychological processes Bandura identified. Additionally, self-efficacy scales are commonly designed with the classroom or structured learning contexts in mind and do not account for the role of self-efficacy in learning outside formal institutional structures. Our current idea is to use Bandura's theory of self-efficacy and the four psychological processes to understand self-efficacy when people learn using search in natural settings.

As an expert in self-efficacy, we could really use your help in assessing the **face validity of a scale**.

What we would like you to do:

1) **Complete a demographic pre-survey**

2) **Review the search as learning self-efficacy scale on two levels: constructs and items.**
    a. **Constructs:** We would like you to think about self-efficacy from the original processes noted by Bandura's theory of self-efficacy. Consider asking yourself questions, such as:
        i. Do the constructs adequately capture self-efficacy in the landscape of digital learning?
        ii. Are their definitions clear?

    b. **Items:** Based on the four constructs, we have selected 45 scalar items drawn from existing scales, which are categorized based on the four processes noted in Bandura's theory of self-efficacy. While you are reviewing this scale, consider asking yourself questions, such as:
        i. Do these items align with the constructs they are meant to capture?
        ii. Are the items clearly written?
        iii. Can I recommend other items or scales that better address the constructs?

3) **Self-efficacy and search experts:** This study uses snowball sampling. If you know of someone who might be willing to provide feedback and have their permission to share their contact information, please share their information with us at the end.

Communication Options:

- If you prefer to communicate textually, with tracked changes on, please edit the document and email it back to [email address]
- If you prefer to give verbal feedback, please email (Bandura, 1994) to schedule a time with you to go over the scale via Zoom.

This scale is not precious. We welcome new ideas.
Scroll the next page to begin the review.

DEMOGRAPHIC PRE-SURVEY

Before we begin, can you please tell me a little bit about yourself?

Question	**Response**
What is your full name? (e.g., first name, last name)	
What is your current job title? (e.g., Professor)	
What is your affiliation? (e.g., University of British Columbia)	
What is your primary area of research? (e.g., self-regulation)	
How many years have you been a researcher in this area?	

This section documents your familiarity with Bandura's theory of self-efficacy and his four psychological processes. Because this study also looks at the relationship between metacognition and self-efficacy, a question about metacognition and self-regulation are included.

Rate your familiarity with:	**Substantial**	**A lot**	**Some**	**Little**	**None**
Bandura's theory of self-efficacy					
Motivational processes					
Affective processes					
Selection processes					
Cognitive processes					
Metacognition and self-efficacy					
Self-regulation and self-efficacy					

EXPERT REVIEW STUDY

Study Instructions:
Please read through the following sections. In each section instructions will be provided to help guide your review. Space for comments is provided throughout, although we do encourage you to provide feedback in any manner you choose.

===SCALE CONSTRUCTS===
We are thinking about self-efficacy based on the original processes noted by Bandura's theory of self-efficacy and the four psychological processes: motivation, affect, cognition, and selection in understanding self-efficacy in the context of learning when using search. We do not presume these four psychological processes (hereto referred as constructs) covers all areas of self-efficacy, but assume these four are important in self-determined/independent learning contexts. Please consider the definitions and provide feedback with regards to any additions or alternative ways to consider these constructs in relationship to independent learning online.

Constructs	Definition	Feedback
Motivational	*Motivational processes* refer to persistence of effort and are dependent on one's beliefs about the self (Bandura, 1994).	
Affective	*Affective processes* regulate emotion. Bandura believed that people who are able to develop controls over their emotional processes, such as feelings of stress and anxiety are more likely to take bolder steps in life	
Cognitive processes	*Cognitive processes* involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. People are commonly guided by their goals and desired outcomes; the stronger a person's belief is in their capability, the more effort they will devote to a specific cognitive task (Bandura, 1989).	
Selection processes	*Selection processes* refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). A stronger sense of self-efficacy is considered to be related to the breadth of options one might consider. It is important to note the bidirectional relationship as people do choose their environments, but environmental factors also influence self-efficacy (Bandura, 1977). This portion of the scale identifies the search system (environment) as having an impact on a person's search self-efficacy (Rieh et al., 2012).	

Any additional constructs you'd recommend?

ITEM LIST
This self-efficacy scale is designed to create a new self-efficacy scale for use in "search as learning." It was created by using Bandura's four psychological processes and scalar items were drawn from other studies and are noted as a reference in each item.

Participants will be given the following instructions to frame the study:

- **Participant Instructions**: This questionnaire focuses on how confident you feel about searching and using information online. It does not include your experience offline (not on the Internet) or experience asking a friend for information. When answering the questions, please focus on your experience in searching for and using information.
- **Prompt:** When I am learning using, I am confident that, as of now, I can do the following.
- **Likert Scale (5-point):** 1 = Never or only Rarely; 2 = Sometimes; 3 = Half of the time; 4 = Frequently; 5 = Always or Almost Always

The goal of this study is to assess the **face validity of the items and constructs** based on the process and ideas used by DeVellis (2017) and McCay-Peet (2013).

- A good item has the following characteristics:
    - sentences are unambiguous
    - language is clear and simple (vs complex)
    - sentences are short and concise (vs lengthy)
    - the statement conveys a single idea or characteristic (avoid double-barrelled questions)
    - sentences are written positively (avoid not and double negatives)

Instructions:
Please read the following items. Space is provided for you to indicate its appropriateness (i.e., include/exclude), its relevancy (low, medium, and high), its clarity (low, medium, and high) as well as a feedback area to suggest alternative wordings. Feel free to add new rows to propose new items as needed.

Bandura's Process	**Item**	**Include/ Exclude**	**Relevancy** (Low/Med/High)	**Clarity** (Low/Med/High)	**Feedback**
Motivational					
Motivational processes refer to persistence of effort and are dependent on one's beliefs about the self	1. I know I can learn on my own if I don't give up (Midgley et al., 2013).				
	2. I know that even if the work is hard, I can learn it (Midgley et al., 2013).				

Bandura's Process	Item	Include/ Exclude	Relevancy (Low/Med/High)	Clarity (Low/Med/High)	Feedback
(Bandura, 1994).	3. I know I can master the skills needed to learn independently using search. (Thomas et al., 2008)				
	4. I'm confident that I will understand the most complex information that I read online if I try. (Thomas et al., 2008)				
	5. I'm certain I can figure out how to organize the information I find online. (Thomas et al., 2008)				
	6. I'm confident I will be able to apply the information I find online to my work or learning goals. (Thomas et al., 2008)				
Affective processes					
Affective processes regulate emotion. Bandura believed that people who are able to develop controls over their emotional processes, such as feelings of stress and anxiety are more likely to take bolder steps in life (Bandura, 1994).	7. If I encounter difficulties, I can easily change a negative emotion to a positive emotion (Kirk et al., 2008)				
	8. Regulate my own emotions when close to reaching a learning goal (Kirk et al., 2008)				
	9. Calm down when feeling angry (Kirk et al., 2008)				
	10. Regulate my own emotions when under time pressure (Kirk et al., 2008)				
	11. Correctly identify my own negative emotions (Kirk et al., 2008)				
Cognitive processes *Cognitive processes* involve the beliefs people hold with regards to their capabilities in the acquisition, organization, and use of information. People are commonly guided by their goals and desired outcomes; the stronger a person's belief is in their capability, the more effort they will devote to a specific cognitive task (Bandura, 1989). Item List categorized based on Gorrell's taxonomy of metacognitive skills in search.					
Schema training search tasks require a person	12. Remember the information sources I find (Gorrell et al., 2009)				

Bandura's Process	Item	Include/ Exclude	Relevancy (Low/Med/High)	Clarity (Low/Med/High)	Feedback
to understand the "*known methods for finding information*" (Gorrell et al., 2009) that are manifested in the use of graphic organizers such as mind maps and to-do lists, as well as fact checking behaviours to resolve content conflicts	13. Identify the type of information I need for my learning tasks. (Gorrell et al., 2009)				
	14. Choose words that tell a search engine what I am looking for. (Gorrell et al., 2009)				
	15. Use different searching approaches depending on the particular goal I have. (Gorrell et al., 2009)				
Planning tasks assume searchers know what kind of information they need to find, which implies in the schema training, the person has already identified the information need, problem, or question they need answered	16. Plan where I am going to look for information. (Gorrell et al., 2009)				
	17. Choose which words I am going to enter in the search box. (Gorrell et al., 2009)				
	18. Plan my search strategy before I begin a learning task. (Gorrell et al., 2009)				
	19. Can decide what information is relevant and what is not. (Gorrell et al., 2009)				
	20. Adjust my search plan if I am not making progress on a learning task. (Thomas et al., 2008)				
	21. Assess whether or not a search plan is necessary for a learning task before I search. (Thomas et al., 2008)				
	22. Predict possible problems that might occur with my search. (Thomas et al., 2008)				
	23. Select a search system (e.g., web search or library search) that is best to use before I				

Bandura's Process	Item	Include/ Exclude	Relevancy (Low/Med/High)	Clarity (Low/Med/High)	Feedback
	begin a learning task. (Thomas et al., 2008)				
	24. Understand the aim of a search task before I begin searching (Thomas et al., 2008)				
Monitoring refers to the awareness of progress being made on the task as well as understanding the credibility or reliability of information found (Gorrell et al., 2009).	25. Check in on my progress when learning using search. (Thomas et al., 2008)				
	26. Stop searching from time to time to check my learning progress ((Thomas et al., 2008)				
	27. I'm confident that I will understand the basic concepts that I read online (Thomas et al., 2008)				
Evaluation refers to the ability to critically evaluate a search and the relevance of what is found as well as how to use the information.	28. Have a variety of approaches to recall what I need from my search. (Gorrell et al., 2009)				
	29. Understand what I read online. (Gorrell et al., 2009) 30. Remember what I learned (Gorrell et al., 2009)				
	31. Judge how well the information I find matches my learning needs (Gorrell et al., 2009)				
	32. Assess the effectiveness of my search keywords (Gorrell et al., 2009)				
	33. Assess how much I am learning during a search task. (Thomas et al., 2008)				
	34. Evaluate my search processes with the aim of improving them. (Thomas et al., 2008)				
Transfer refers to learning that is carried between search tasks. As search is not	35. Use procedures that have proved useful in other tasks to help me to work out what information I need now (Gorrell et al., 2009)				

Bandura's Process	Item	Include/ Exclude	Relevancy (Low/Med/High)	Clarity (Low/Med/High)	Feedback
discipline-specific, with exception to databases, it is assumed the skills in using search to learn will aid searchers when they are confronted with new databases; carrying forward the strategies used in previous search tasks (Gorrell et al., 2009).	36. Apply lessons I have learned from previous searches. (Gorrell et al., 2009)				
Selection processes					
Selection processes refer to the choices people make with regards to their environments (e.g., career choices; Bandura, 1994). A stronger sense of self-efficacy is considered to be related to the breadth of options one might consider. It is important to note the bidirectional relationship as people do choose their environments, but environmental factors also influence self-efficacy	37. Know the functions that a search engine offers. (Gorrell et al., 2009)				
	38. Limit search strategies by subject, language, and date in a search system (Serap Kurbanoglu et al., 2006)				
	39. Initiate search strategies by using keywords and Boolean logic (e.g., AND, OR, NOT; Serap Kurbanoglu et al., 2006)				
	40. Use different kinds of print sources (e.g.. books, periodicals, encyclopedias, chronologies; Serap Kurbanoglu et al., 2006)				
	41. Use electronic information sources (Serap Kurbanoglu et al., 2006)				
	42. Locate information sources in a digital library (e.g., ACM Digital Library; Serap				

Bandura's Process	Item	Include/ Exclude	Relevancy (Low/Med/High)	Clarity (Low/Med/High)	Feedback
(Bandura, 1977). This portion of the scale identifies the search system (environment) as having an impact on a person's search self-efficacy (Rieh et al., 2012).	Kurbanoglu et al., 2006)				
	43. Use different kinds or types of digital libraries (Serap Kurbanoglu et al., 2006)				
	44. Use internet search tools (such as search engines, directories; Serap Kurbanoglu et al., 2006)				
	45. Use different kinds (types) of digital libraries (Serap Kurbanoglu et al., 2006)				

Self-efficacy experts to contact
This study uses snowball sampling. If you know of anyone who would be interested in sharing feedback on this scale, please <u>acquire their permission</u> to share their contact information and note their name and email address below.

Consider contacting:

Name	
Email address	

A.4 Rewriting Items

This section describes the stages of writing and rewriting the question items (see Tables A1–A5). The original item is Stage 1, in which the items were selected from the identified scale. Stage 2 is the revision of the item for review in the expert review. Stage 3 is the final item modification, in which the researcher reviewed the statements items using the feedback from the expert review and within discussions with the principal investigator.

Table A1

Motivational Processes Statements at Each Stage of Review

Source	Original item	Revised for expert review	Final item modification
Midgley et al., 2013	I can do almost all the work in class if I don't give up.	I know I can learn on my own if I don't give up.	Learn on my own if I try.
	Even if the work is hard, I can learn it.	I know that even if the work is hard, I can learn it	Even if the work is hard, I can learn it.
	I'm certain I can figure out how to do the most difficult class work.	I'm certain I can figure out how to do the most difficult class work.	Figure how to do the most difficult tasks.
Thomas et al., 2008	I am confident of understanding the basic concepts taught in this course.	I am confident of understanding the basic concepts taught in this course.	Understand the basic concepts from information I find online.
	I know I can master the skills being taught in this course.	I know I can master the skills needed to learn independently using search.	Master the skills needed to learn independently.
	I am confident of understanding the most complex material presented by the teacher in this course.	I'm confident that I will understand the most complex information that I read online if I try.	Excluded from study
	I know I can understand the most difficult materials presented in the readings of this course.	I'm certain I can figure out how to organize the information I find online.	Excluded from study
	I am confident I can do a good job on the assignments and tests in this science class.	I'm confident I will be able to apply the information I find online to my work or learning goals.	Excluded from study

Table A2

Affective Process Statements at Each Stage of Review

Source	Original item	Revised for expert review	Final item modification
Kirk et al., 2008	If I encounter difficulties, I can easily change a negative emotion to a positive emotion.	If I encounter difficulties, I can easily change a negative emotion to a positive emotion.	Excluded from study
	Correctly identify my own negative emotions.	Correctly identify my own negative emotions.	Excluded from study
	Regulate my own emotions when close to reaching a learning goal.	Regulate my own emotions when close to reaching a learning goal.	Excluded from study
	Calm down when feeling angry.	Calm down when feeling angry.	Excluded from study
	Regulate my own emotions when under time pressure.	Regulate my own emotions when under time pressure.	Excluded from study
Caprara et al., 2008	Express joy when good things happen to you?	Not included	Express joy when good things happen to me.
	Feel gratified overachieving what you set out to do?	Not included	Feel gratified when I accomplish what I set out to do.
	Rejoice over your successes?	Not included	Rejoice in my successes.
	Express enjoyment freely at parties?	Not included	Express enjoyment freely when learning.
	Keep from getting dejected when you are lonely?	Not included	Keep from feeling dejected when I do not understand what I'm learning.
	Keep from getting discouraged by strong criticism?	Not included	Keep from getting discouraged by strong criticism.
	Reduce your upset when you don't get the appreciation you feel you deserve?	Not included	Reduce how upset I feel when underappreciated.
	Keep from getting discouraged in the face of difficulties?	Not included	Keep from getting discouraged in the face of difficulties.

Table A3

Cognitive Process Rewritten Statements at Each Stage of Review

Source	Original item	Revised for expert review	Final item modification
Gorrell et al., 2009	I have got ways to help me remember information sources I find.	Remember the information sources I find.	Find alternate sources of information if I am having a hard time understanding information online.
	I often use different searching approaches depending on the particular goal I have.	Use different searching approaches depending on the particular goal I have.	Use different search approach for different goals.
	I am good at choosing words that tell a search engine what I am looking for.	Choose which words I am going to enter in the search box.	Choose words or phrases that tell a web search engine what I am looking for.
	I have techniques that help me understand the information I find when searching.	Understand what I read online.	Use strategies (e.g., mind maps) to help me understand the information I find when searching online.
	I spend a lot of time judging how well the information I find matches my learning needs.	Judge how well the information I find matches my learning needs.	Judge how well the information I find matches my learning needs.
	I can tell whether the words I use in my searches are good ones.	Assess the effectiveness of my search keywords.	Use the information I find online to generate new words/terms.
	When I have a learning task, I usually know how to decide on the type of information I need.	Not included	Decide on the type of information I need to complete a learning task.
	I have developed ways of identifying the type of information I need for my learning tasks.	Not included	Identify the type of information I need for my learning tasks.
	I do not have any particular techniques for improving my understanding of what I find when searching.	Not included	Use the information I find online to generate new words/terms.

Source	Original item	Revised for expert review	Final item modification
Gorrell et al., 2009	I decide in advance exactly what type of information I am looking for.	Identify the type of information I need for my learning tasks.	Excluded from study
	Before beginning a web search, I work out which words I am going to enter in the search box.	Choose words that tell a search engine what I am looking for.	Excluded from study
	Before I start my search, I tend to plan where I am going to look for information.	Plan where I am going to look for information.	Excluded from study
	I have techniques that help me remember the information I find.	Remember what I learned.	Excluded from study
	I tend to work out my search strategy before I begin.	Plan my search strategy before I begin a learning task.	Excluded from study
	I tend to decide what is relevant and what is not based on criteria that emerge during the search.	Can decide what information is relevant and what is not.	Excluded from study
	I am confident that I have a good approach to recalling what I need from a search.	Have a variety of approaches to recall what I need from my search.	Excluded from study
Thomas et al., 2008	I adjust my plan for a learning task if I am not making the progress that I think I should.	Adjust my search plan if I am not making progress on a learning task.	Adjust my search plan if I am not making progress.
	I consider whether or not a plan is necessary for a learning task before I begin that task.	Assess whether or not a search plan is necessary for a learning task before I search.	Create a search plan before I look for information online.
	I try to predict possible problems that might occur with my learning.	Predict possible problems that might occur with my search.	Predict possible problems that might occur with my search.
	I try to understand clearly the aim of a task before I begin it.	Understand the aim of a search task before I begin searching.	Articulate my goal before I begin looking for information online.
	I plan to check my learning progress during a learning task.	Check in on my progress when learning using search.	Keep track of my progress when I am searching for information online.

Source	Original item	Revised for expert review	Final item modification
	I stop from time to time to check my progress on a learning task.	Stop searching from time to time to check my learning progress	Stop and check my progress on a learning task when searching online.
	I assess how much I am learning during a learning task	Assess how much I am learning during a search task.	Assess how much I'm learning during a search.
	I evaluate my learning processes with the aim of improving them.	Evaluate my search processes with the aim of improving them.	Evaluate my searches as I look for information online
Thomas et al., 2008	I consider what type of thinking is best to use before I begin a learning task.	Select a search system (e.g., web search or library search) that is best to use before I begin a learning task.	Excluded from study
	//duplicate	I'm confident that I will understand the basic concepts that I read online	Excluded from study
Cheng & Tsai, 2011		Not included	Find an expert to help me with something I'm learning
	When I have an academic problem, I will email the instructor or class assistants to make a query.	Not included	Email experts within my network for help with something I'm learning
	When I have an academic problem, I will query the instructor or class assistants on the web-based course forum or guestbook for a relevant solution.	Not included	Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning
	When I have an academic problem, I will query the instructor or class assistants by instant message software (e.g., MSN, Skype).	Not included	Reach out to experts in my community (e.g., Slack, LinkedIn) for help with something I'm learning
	When I have an academic problem, I will query the instructor or class assistants through possible online channels.	Not included	Reach out to experts using my personal network (e.g., text messaging) for help with something I'm learning

Source	Original item	Revised for expert review	Final item modification
		Not included	Find a group of friends or peers that can help me with something I'm learning
	When I have an academic problem, I will post a message on relevant web forums requesting unknown experts' help.	Not included	Find help by posting to web forums when I'm learning something.
	When I have an academic problem, I will ask for peers' help through some popular blog systems (e.g., Plurk, Twitter).	Not included	Ask peers for help using popular blogging sites (e.g., Medium) when I'm learning something.
	When I have an academic problem, I will post a query on relevant knowledge community websites (e.g., Yahoo! Knowledge).	Not included	Ask peers questions on community websites (e.g., Reddit) when I'm learning something.
	When I have an academic problem, I will find the proper websites, forums, or bulletin board system (BBS) to ask for unknown experts' help.	Not included	Excluded from study

Note. Blank cells in the column of original items indicate that items were added only after expert review.

Table A4

Selection Process Statements at Each Stage of Review

Source	Original item	Revised for expert review	Final item modification
Gorrell et al., 2009	I know how to use the functions that a search engine offers.	Know the functions that a search engine offers.	Use the advanced features of a web search engine (e.g., allintitle:).
Kurbanoglu et al., 2006	Initiate search strategies by using keywords and Boolean logic (e.g., AND, OR, NOT).	Initiate search strategies by using keywords and Boolean logic (e.g., AND, OR, NOT).	Use Boolean logic (e.g., AND, OR, NOT) to refine my searches.
	Use electronic information sources.	Use electronic information sources.	Use a web search engine to find information I need.
	Locate information sources in the library.	Locate information sources in a digital library (e.g., ACM Digital Library).	Find information in a specialized digital library (e.g., ACM Digital Library).
Kurbanoglu et al., 2006	Limit search strategies by subject, language and date.	Limit search strategies by subject, language, and date in a search system.	Excluded from study
	Use different kinds of print sources (e.g., books, periodicals, encyclopedias, chronologies).	Use different kinds of print sources (e.g., books, periodicals, encyclopedias, chronologies).	Excluded from study
	Use different kinds (types) of libraries.	Use different kinds or types of digital libraries.	Excluded from study
	Use internet search tools (such as search engines, directories, etc.).	Use internet search tools (such as search engines, directories, etc.).	Excluded from study
	duplicate	Use different kinds (types) of digital libraries.	Excluded from study
Kurbanoglu et al., 2006	Use truncation techniques to broaden my search.	Not included	Use truncation techniques to broaden my search.
	Limit my searches using quotes.	Not included	Limit my searches using quotes.
	Limit my searches by publish date.	Not included	Limit my searches by publish date.
	Limit my searches by location.	Not included	Limit my searches by location.

Source	Original item	Revised for expert review	Final item modification
	Limit my searches by type of information.	Not included	Limit my searches by type of information.
	Limit my searches by price.	Not included	Limit my searches by price.
	Exclude specific sites from my searches.	Not included	Exclude specific sites from my searches.

Note. ACM = Association for Computing Machinery.

Table A5
Final Self-Efficacy Scale

Scale	Item Text	Item #
Motivation	Learn on my own if I try.	1
	Even if the work is hard, I can learn it.	2
	Figure how to do the most difficult tasks.	3
	Master the skills needed to learn independently.	4
	Understand the basic concepts from the information I find online.	5
	Understand complex concepts from the information I find online.	6
Affect	Express joy when good things happen to me.	7
	Feel gratified when I accomplish what I set out to do.	8
	Rejoice in my successes.	9
	Express enjoyment freely when learning.	10
	Keep from feeling dejected when I do not understand what I’m learning.	11
	Keep from getting discouraged by strong criticism.	12
	Reduce how upset I feel when underappreciated.	13
	Keep from getting discouraged in the face of difficulties.	14
Cognition	Find alternate sources of information if I am having a hard time understanding information online.	15
	Use different search approach depending on the particular goal I have.	16
	Choose words or phrases that tell a web search engine what I am looking for.	17
	Use strategies (e.g., mind maps) to help me understand the information I find when searching online.	18
	Decide on the type of information I need to complete a learning task.	19
	Identify the type of information I need for my learning tasks.	20
	Use the information I find online to generate new words/terms.	21
	Create a search plan before I look for information online.	22
	Articulate my goal before I begin looking for information online.	23
	Predict possible problems that might occur with my search.	24
	Stop and check my progress on a learning task when searching online.	25
	Keep track of my progress when I am searching for information online.	26
	Adjust my search terms if I am not making progress.	27
	Find an expert to help me with something I’m learning.	28
	Email experts within my network for help with something I’m learning.	29

Scale	Item Text	Item #
	Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning.	30
	Reach out to experts in my community (e.g., Slack, LinkedIn) for help with something I'm learning.	31
	Reach out to experts using my personal network (e.g., text messaging) for help with something I'm learning.	32
	Find a group of friends or peers that can help me with something I'm learning.	33
	Find help by posting to web forums when I'm learning something.	34
	Ask peers for help using popular blogging sites (e.g., Medium) when I'm learning something.	35
	Ask peers questions on community websites (e.g., Reddit) when I'm learning something.	36
	Evaluate my searches as I look for information online.	37
	Assess how much I'm learning during a search.	38
	Judge how well the information I find matches my learning needs.	39
Selection	Use a web search engine to find the information I need.	40
	Find information in a specialized digital library (e.g., ACM Digital Library).	41
	Use truncation techniques to broaden my search.	42
	Limit my searches using quotes.	43
	Limit my searches by publish date.	44
	Limit my searches by location.	45
	Limit my searches by type of information.	46
	Limit my searches by price.	47
	Exclude specific sites from my searches.	48
	Use the advanced features of a web search engine (e.g., allintitle:).	49
	Use Boolean logic (e.g., AND, OR, NOT) to refine my searches.	50

Note. ACM = Association for Computing Machinery

Appendix B Part 2

B.1 Recruitment Poster

THE UNIVERSITY OF BRITISH COLUMBIA

iSchool
Faculty of Arts **Study**

Human Ethics ID: H20-02577

Call for participants

Want to improve your ability to learn on your own?

This study is seeking **junior user experience professionals** for a **week-long remote study.**

Dr. Heather O'Brien and Amelia Cole (graduate student) from the University of British Columbia's School of Information are conducting a study to understand how junior user experience professionals learn independently using search.

You must:
- be at least 19 years old;
- have less than 3 years professional experience in user experience;
- not be enrolled in a college or university degree program; and
- speak English fluently.

Duration: 5-day diary study and a 60-minute interview

What you're being asked to do:

1. **Learning Diary (5 mins per day x 5 days)**
   You will be asked to choose a learning topic that will frame your searches for the week. Every time you use search to find out more about your topic; you will answer a few questions in a survey format, which will take approximately five minutes a day for five days.
2. **Surveys (10 mins x 2)**
   On the first and last day of the diary study you will be asked to complete a set of surveys, which will take approximately 10 minutes to complete each.
3. **Interview (60 mins)**
   The study concludes with a 60-minute interview about your experience.

Compensation: You will receive $40.00 CAD for completing all aspects of the study.

Participating in this study will contribute to advancing learning technologies and provide insights into your own learning process as you search.

The study will be conducted remotely.

If you would like to participate or have questions, please contact miaco@mail.ubc.ca

B.2 Social Media Recruitment

UBC STUDY
Recruiting junior UX professionals (19+) not enrolled in a degree program to participate in a week-long remote study. Individuals must be fluent in English. Participants will receive $40 CAD. Email [email address] for info.

B.3 Informed Consent for Part 2

THE UNIVERSITY OF BRITISH COLUMBIA

School of Information
Irving K. Barber Learning Centre
470- 1961 East Mall
Vancouver, BC Canada V6T 1Z1

Phone 604 822 2404
Fax 604 822 6006

ischool.ubc.ca

The role of engagement in metacognition within self-determination learning

Study Team: **Principal Investigator:** Heather O'Brien [email address]
Co-Investigator: Amelia W. Cole [email address]
Advisory Committee: Dr. Luanne Sinnamon [email address]
Dr. Jillianne Code mailto:jillianne.code@ubc.ca [email address]

Human Ethics ID: H20-02577

Introduction	Thank you for participating in this study. This work is affiliated with Amelia Cole's doctoral research at the School of Information at the University of British Columbia.
Purpose	We want to learn more about how people think about their searches as they learn online. As an adult learner not affiliated with a structured degree program, the research team is specifically interested in understanding how you learn independently online using search technologies, like Google or libraries (e.g., ACM digital library).
What you will be asked to do	After you have read this document and you have signed this consent form, we will proceed to the study. This remote study consists of four parts. **Step 1**: You will begin the study by completing a brief demographic and pre-survey in Qualtrics; it should take 10 minutes. **Step 2:** You will then keep a diary in Expiwell for five days. You will be prompted daily by the researcher, but you are being asked to complete the survey every time you use a web search engine to learn about your topic. If you find yourself searching for information multiple times per day, please fill out the survey for every time you start learning about your topic. Each diary entry should take no more than 5 minutes to complete. **Step 3**: On the fifth and final day of the diary study, you will complete one additional survey in Qualtrics, which should take less than 10 minutes.

	Step 4: Participate in a 60-minute remote interview using Zoom regarding your experience of searching and learning online. Your participation is voluntary. You may decline to answer any questions and you may withdraw at any time without penalty. I will be taking notes as you speak and with your permission will also audio record your responses to help me remember everything you said.
Risks/Benefits	There are no major risks anticipated, but you will be asked to share your learning and search experiences. There are two digital tools, Expiwell (diary data) and Miro (visual collaboration tool) that stores data in USA and is subject to US Privacy laws, including the US Patriot Act. Final storage of your data will be housed in Canada on secure servers located at The University of British Columbia. Please note, you may encounter people or information online that may cause offence. You are not required to interact with any people or information you find offensive.
Compensation	There is a $40 CAD cash honorarium associated with completion of all aspects of this study and will be delivered at the end of the interview. If you are unable to complete all aspects of this study, you will still receive $3 CAD for each day you submitted a diary with a maximum of $15 CAD.
Confidentiality & Anonymity	Your confidentiality will be respected. When using Zoom, you are encouraged to use a nickname. All documentation and recordings will only be identified by an assigned code number and you will not be identified by name in any reports of the completed study. While complete anonymity is more challenging through video and audio conferencing, you may choose to keep the video and audio off when it is not required during the interview. Any information inclusive of recordings will be stored on a secure in-house server at the University of British Columbia.
Access to data	Drs. O'Brien, Sinnamon, and Code as well as Amelia Cole will have access to your data. Additionally, open access research guidelines means researchers may be required to make the raw data accessible to other academic researchers, such as journals, to validate the findings. As mentioned above, all identifiable information, such as name, email address, and username, will be removed and replaced with a participant ID. Open-access data may carry some risk to you as the participant and you will not be able to withdraw your data once the data is made available to the journal.

Use of data	The synthesized data will be used in Amelia Cole's dissertation and may be published in academic journals or conferences.
Future use of the data	No future use of this data is known at this time. However, should the data need to be re-analysed and re-used, Amelia Cole will contact you to explain the need and ask if you would be willing to consent to the activity.

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study. I realize that my participation is voluntary and that I am free to withdraw from the study at any time.

[ ] I consent to participating in the study as outlined.
[ ] I consent to the interview being video and audio recorded.

I prefer to have communication occur over:
[ ] email
[ ] phone

Email/Phone: ___________________________________

Who can you contact if you have any complaints or concerns about the study?

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598

Human Ethics ID: H20-02577

B.4 Email Communications

Interview Follow up [+1 day following interview]

Subject line: Thank you for participating in the learning study.

Hi,

I very much enjoyed our chat about your learning experiences. Your input is so valuable and necessary to forward the design of future learning tools.

A couple of quick closing items:

Action Item: Please sign the attached '<u>Receipt of Payment'</u> after you receive the cash transfer. This is very important as the University will only reimburse me if I have the receipt.

I've also attached the study debrief for your records.

Thank you so much and keep safe,
Amelia

Interview Day [Day of interview]

Subject line: Reminder: Learning study interview

Hi,

I'm really looking forward to our chat today at [time] PT about your learning experiences!

I've created a dashboard of your diary activity that we'll be working with during the interview.

You can find the dashboard here: https://miro.com/app/board/o9J_lMhuqag=/
Password: [username]2021

Chat soon,
Amelia

Last Reminder Email [Day 5]

Subject line: Final Day! Learning Study Participation

You made it! This is the last day you need to enter a learning diary!

Step 1: Remember to fill out your last learning diary today!
https://app.expiwell.com/experience/5fdcf4aae8cc0a4604f8b073

After you completed your learning diary for today, please do the following:

Step 2: This is the final set of questions asking you to reflect on your confidence in searching and using information you find online. (10 min)
https://ubc.ca1.qualtrics.com/jfe/form/SV_6VDHsqrsUqUHTpQ

Step 3: Schedule some time with me for the final interview using Calend.ly. I'll send the zoom information shortly following your selection.
https://calendly.com/learningstudy2021/learning-study

Let me know if you have any problems,
Amelia

Daily Reminder Email [Day 2, 3, 4]

Subject line: Reminder: Learning Study Participation

Hi,

A little nudge to fill out your learning diary today when you find, consider, read, or use online information that references your goal.

https://app.expiwell.com/experience/5fdcf4aae8cc0a4604f8b073

You can fill out as multiple diaries per day. And If your goal changes over the course of the week, that's ok. Just continue filling the diary with your new goal.

Let me know if you have any problems,
Amelia

Intro Email [Day 1]

Subject line: Learning Study Participation

Welcome to the study!

Thank you so much for participating. This study aims to improve people's ability to learn using web search engines. In our initial meeting we talked about your goals and what you might be interested in finding out. We are interested in how people learn naturally on their own, so if your topic or goal changes, that is okay.

There are three surveys to complete at the beginning of this study. Please complete each one in order.

Step 1: You will begin the study by taking the following pre-survey. Many of the questions were already asked in the pre-interview. (10 min)
https://ubc.ca1.qualtrics.com/jfe/form/SV_0HAIwNtrTgrIYeh

Step 2: The next set of questions ask you to reflect on your confidence in searching and using information you find online. (10 min)
https://ubc.ca1.qualtrics.com/jfe/form/SV_6VDHsqrsUqUHTpQ

Step 3: Starting today and for the next five days, please complete a short 5-minute learning diary **for every search session related to your goal**. I will remind you every day to complete the diary.
https://app.expiwell.com/experience/5fdcf4aae8cc0a4604f8b073

Step 4: The final step of the process includes a 60-minute interview, which we will schedule on the fifth and final day of the learning diary entries. If you have any questions or need clarity on any of the steps, please don't hesitate to reach out to me. If you need to change the start date of the study, please let me know. I'm happy to accommodate your schedule.

The links should not be shared with anyone.

After you complete all aspects of the study, you will receive a $50 (CAD) gift card for your participation. Note, if you do not participate in the interview and If you complete at least three diary entries and both validated surveys you will receive $15.

If you have any questions, comments, or concerns about this study, please reply to this email or contact Amelia Cole at [email address]. We appreciate your time and participation.

Cheers,
Amelia
[phone number]
[email address]

B.5 Payment Receipt

The role of engagement in metacognition within self-determination learning

Study Team: *Principal Investigator (PI) – Dr. Heather O'Brien,* [email address]
Co-Investigator – Amelia W. Cole, PhD Candidate [email address]

Study Participation Incentive Receipt

I confirm that I am in receipt of $40 CAD for participating in the above titled study.

Signature: ________________________________ Date: ________________________

B.6 Study Debrief

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

School of Library, Archival & Information Studies
470 - 1961 East Mall
Vancouver, BC Canada V6T 1Z1

Phone 604 822 2404
Fax 604 822 6006
slais@interchange.ubc.ca
www.slais.ubc.ca

The role of engagement in metacognition within self-determination learning

Principal Investigator: Dr. Heather O'Brien
Co-Investigator: Amelia Cole

Study Debriefing

Purpose of this Study
Search is quickly becoming part of the how we begin to learn. Originally machine algorithms, that determine what information is seen and in what order, were believed to provide sufficient support for people to find the information they need. However, the human intent of learning was not part of the original design. As technology is incorporated into the way in which we engage in learning process, new tools are needed to encourage people to learn more deeply.

In this study, we were interested in understanding how reflections during search influences your belief in your ability to use search to learn. Reflecting on the learning process has been shown in other contexts to influence a learner's self-concept, belief in their capabilities, as well as improve learning outcomes. We looked at your beliefs based on your perception of your search skills along with the motivational, emotional, and environmental (e.g., search system) factors that you felt might influence your capability to learn using search.

How the Study Worked
You participated in a five-day period of learning using search. During these five days, you were asked to reflect on your experiences, the search queries or keywords you used, the challenges you experienced, the emotions you felt, the mental effort you put into your search, and your perceptions of learning after each search session.

Before you started your learning period, we asked you to share information about how much you knew about the topic as well as reflect on what you hoped to achieve during the five-day learning period.

Before and after the learning period, we asked you to complete two surveys that asked you to reflect on your perceived capabilities when looking for and learning from information you find online.

We concluded the study with an interview that used your diary as a prompt to guide interview questions about your feelings of competence as you engaged in learning using search.

Anticipated Outcome
While there is research that already tells us that when people reflect on their learning it improves their confidence, searching is a little different. Web search engines, like Google, often make us feel like we are better at searching than we are. And little is known about how people learn using search when they are not in a formal classroom setting.

Our goal is to improve the learning experiences of people who use search and provide recommendations that support individuals through their learning process.

If You Have Questions
If you have questions, please feel free to ask the researcher present today or use the contact information provided below to contact a member of the research team at a later time.

Contact Information
This study is conducted under the supervision of Dr. Heather O'Brien, the Principal Investigator, with Amelia Cole as the Co-Investigator.

Dr. O'Brien can be reached by phone [phone number] or email [email address]

Amelia Cole can be reached by email [email address]

More Information about the Research
If you would like to read more about Dr. O'Brien's research, please visit her website: https://heatherobrien.arts.ubc.ca/publications or visit UBC's Institutional Repository by typing "Heather O'Brien" into the search box to retrieve a list of her publications: https://open.library.ubc.ca/cIRcle/collections/facultyresearchandpublications

PLACEHOLDER (RE: FOOTNOTES)
(Johnson, 2021)

Appendix C Part 2 Instruments

C.1 Pre-Screen Interview Protocol

Hi, my name is [name]. Thank you for responding to my call for participation to this study; I really appreciate your response. This will sound a little like I'm following a script, but it is because I am. I will briefly go over the purpose of the study and what we'll be asking you to do followed by some preliminary qualifying questions.

Does that sound ok?

This study looks at how people learn when they use a web search engine to find information.

Activities that represent learning may be finding, assessing, reading, and applying information you find online. And search engines can mean a lot of different things and include web search engines, like Google, or specific search engines, like Google scholar or digital libraries, and digital product searches, like Kindle or Google books.

The study begins with a brief demographic survey and a medium-length survey asking about your confidence in search and learning. The main part of the study will ask you to fill out a 5-minute questionnaire after every web search session on your topic. The final day will include another survey and ask you to schedule time for a sixty-minute interview.

Do you have time in the next month to help out?

> **If no**, I really appreciate your time. If I have some remaining slots available after [month], do you mind if I reach back out to you?
>
> **If yes**, I have a couple of quick questions about your background and learning purpose before I can enter you into the study.

Ok, ready for the background questions? This should take 5-10 minutes.

1. What is your age? [19-65]
2. What kind of education do you have? [BA +]
3. Are you currently enrolled in a degree or certificate program? [No]
4. Are you currently working? [Retired]
5. What is your current role? [UX / Other]
   a. If other, what is your current or desired role? [user experience related roles]
6. How many years have been working in user experience? [0-3 years]

Great! Thanks for letting me know about your background. Now I'd like to speak briefly about your learning topic.

7. What kinds of things are you interested in learning? [user experience topic]
8. Why did you decide to learn this topic; for example, are you having challenges in one particular area? [reason]
9. How much do you feel you already know about this area specifically? [Not much, a little, some]

   If qualified, Thank you, so much. You are an excellent fit for this study.

10. Are you still willing to participate in the study? [Yes]

    Fantastic. We typically start the study at the beginning of each week on Mondays. What week are you available to start the study? [Schedule study start date]

    Date available: ______________________________

    And would you prefer email or text message for your diary reminders?
    [ ] email
    [ ] text message

    Email/Phone: ____________________________________

    If not qualified, Thank you so much for your time. Unfortunately, this study doesn't seem like a good fit at the moment. I am very interested in your experience, however. Would you mind if I put your name on my list for future studies?

C.2 Pre-Survey

Instructions to Participants:
The first thing we'd like you to do is to create a username.

Your privacy is important to us. Please create a 6-character username that disguises your identity, and you can easily remember for at least two weeks. We recommend the last three letters of your first and last name.

Demographic Data Coding

Table C1 lists the demographic questions to be answered in the pre-survey and shows how options were coded.

Table C1

Demographic Questions

Field Text	Field Type	Options	Choices
My username	AlphaNumeric; 6-digits;	[##AAA#]	
Demographic Information			
In what year were you born?	Numeric; 4-digits;	[yyyy]	Age: 2021 – YYYY
Where were you born?	Open text fields	[city] [country]	1 = NA (North America) 2 = EMEA (Europe and Middle East) 3 = APAC (Asia Pacific) 4 = LATAM (Latin America)
Where do you currently live?	Open text fields	[city] [country]	1 = NA (North America) 2 = EMEA (Europe and Middle East) 3 = APAC (Asia Pacific) 4 = LATAM (Latin America)

Field Text	Field Type	Options	Choices
What is your gender?	Radio buttons	Female Male Non-conforming (please describe)	0 = Male 1 = Female 2 = Non-conforming
What is the highest level of education you have completed?	Radio buttons	Did not complete high school High school graduate Some college or university, no degree Bachelor's degree Professional degree Post-graduate degree (e.g., Masters or PhD)	0 = Did not complete high school 1 = High school graduate 2 = Some college or university, no degree 3 = Bachelor's degree 4 = Professional degree 5 = Post-graduate degree (e.g., Masters or PhD)
Which of the following best describes your current employment or work status?	Radio buttons	Full-time work Part-time work Not currently working Homemaker Retired Student*	5 = Full-time work 4 = Part-time work 3 = Not currently working 2 = Homemaker 1 = Retired 0 = Student*
Are you fluent in English?	Radio buttons	Yes No	1 = Yes 0 = No

*Currently enrolled students were not eligible for the study.

C.3 Pre-Survey Prior Knowledge and Learning

Tables C2 and C3 show the field text options given to participants for past learning experiences and learning goals.

Instructions:

This questionnaire focuses on your past learning experiences and why you are learning about your topic.

Table C2

Past Learning Experiences Survey Questions

Construct	Field text	Field Type	Options	Choices
Prior knowledge	Please write a brief paragraph about what you can remember about your topic.	Open text field	[ ]	
Expertise assessment	How would you rate your current level of expertise on your topic?	Multi-select	Beginner Intermediate Expert	1 – Beginner 2 – Intermediate 3 – Expert

When answering the next two questions, think about your topic and what you'd like to accomplish overall thinking of what you'd like to accomplish this week.

Table C3

Learning Goals Survey Questions

Construct	Field text	Field Type	Options
Learning Goals	What do you want to have learned by the end of the week?	Open text field	[ ]
	How do you hope to use what you have learned? (e.g., write a book chapter, prepare for an interview, etc.)	Open text field	[ ]

C.4 SALSE Scale (50-Item)

Rating scale: Cannot do at all (0) to Certainly can do (100)

Motivation Question Items
This set of questions focuses on how confident you feel expressing emotions when learning from information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.

1. Learn on my own if I try.
2. Even if the work is hard, I can learn it.
3. Figure how to do the most difficult tasks.
4. Master the skills needed to learn independently
5. Understand the basic concepts from information I find online
6. Understand complex concepts from information I find online.

Affect Question Items
This set of questions focuses on how confident you feel expressing emotions when learning from information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.

1. Express joy when good things happen to me
2. Feel gratified when I accomplish what I set out to do
3. Rejoice in my successes
4. Express enjoyment freely when learning
5. Keep from feeling dejected when I do not understand what I'm learning
6. Keep from getting discouraged by strong criticism
7. Reduce how upset I feel when underappreciated
8. Keep from getting discouraged in the face of difficulties

Cognition Question Items
This set of questions focuses on how confident you feel learning using information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.
Schema Training

1. Find alternate sources of information if I am having a hard time understanding information online.
2. Use different search approach depending on the particular goal I have
3. Choose words or phrases that tell a web search engine what I am looking for.
4. Use strategies (e.g., mind maps) to help me understand the information I find when searching online
5. Decide on the type of information I need to complete a learning task

6. Identify the type of information I need for my learning tasks
7. Use the information I find online to generate new words/terms.

Planning

8. Create a search plan before I look for information online
9. Articulate my goal before I begin looking for information online.
10. Predict possible problems that might occur with my search

Monitoring

1. Stop and check my progress on a learning task when searching online.
2. Keep track of my progress when I am searching for information online.
3. Adjust my search terms if I am not making progress
4. Find an expert to help me with something I'm learning
5. Email experts within my network for help with something I'm learning
6. Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning
7. Reach out to experts in my community (e.g., Slack, LinkedIn) for help with something I'm learning
8. Reaching out to experts using my personal network (e.g., text messaging) for help with something I'm learning
9. Find a group of friends or peers that can help me with something I'm learning
10. Find help by posting to web forums when I'm learning something
11. Ask peers for help using popular blogging sites (e.g., Medium) when I'm learning something
12. Ask peers questions on community websites (e.g., Reddit) when I'm learning something

Evaluating

13. Evaluate my searches as I look for information online
14. Assess how much I'm learning during a search.
15. Judge how well the information I find matches my learning needs

Selection Question Items

This set of questions focuses on how confident you feel using search engines in web browsers.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.

1. Use a web search engine to find information I need
2. Use the advanced features of a web search engine (e.g., site:)
3. Use Boolean logic (e.g., AND, OR, NOT) to refine my searches
4. Find information in a specialized digital library (e.g., ACM Digital Library)
5. Limit my searches using quotes
6. Limit my searches by publish date
7. Limit my searches by location
8. Limit my searches by price
9. Use truncation techniques to broaden my search
10. Limit my searches by type of information
11. Exclude specific sites from my searches

C.5 Search as Learning Diary

Instructions:

Your learning diary is meant to capture your search and learning experiences. Every time you **end** a web search session related to your goal take a moment to reflect on your experience. The diary should take approximately 5-minutes to complete and can be completed multiple times per day.

Your username Your privacy is important to us. Please use the 6-character username you created at the beginning of the study.	AlphaNumeric; 6-digits;

Table C4 presents the theoretical map of the learning diary. The theory column denotes Flavell's (1979) theory of metacognition.

Table C4

Learning Diary Theoretical Map

Theory (Flavell, 1979)	Construct	Survey question	Field type	Options	Theoretical source
Knowledge	Mastery vs. performance	What prompted you to search for information today?	Open text	[ ]	Bandura, 1994; Pajares & Schunk, 2001
	Search knowledge	What keywords can you remember from your search?	Open text	[ ]	Gorrell et al., 2009
	Task difficulty	Did you experience any challenges during your session?	Categorical	Yes No	Wildemuth et al., 2014; Pintrich et al., 2000
		If you experienced some challenges, what were they?	Open text	[ ]	
	Learning progress	How much do you think you learned during this session?	Quantity rating scale	None (0) Little Some A lot Substantial (100)	Pintrich et al., 2000

Theory (Flavell, 1979)	Construct	Survey question	Field type	Options	Theoretical source
		Explain why you did or did not learn during your search session.	Open text	[ ]	
	Search effort	How much mental effort did you put into your search?	Quantity rating scale	None (0) Little Some (50) A lot Substantial (100)	Rieh et al., 2012; Pintrich et al., 2000
		Explain the degree of mental effort you put into your search.	Open text	[ ]	
Experience	Affect	How do you feel after your search session? Check all that apply:	Checkbox Categorical	Excited Elated Happy Relaxed Calm Exhausted Tired Sad Angry Tense Other [ ]	Pekrun & Linnenbrink-Garcia, 2012
		Explain what prompted your feelings, if any occurred.	Open text	[ ]	
		How would you rate your progress toward your goals?	Quantity rating scale	None (0) Little Some (50) A lot Substantial (100)	Pintrich et al., 2000; Dunning, 2005
Skills	Monitoring	Explain what contributed to the degree of progress you made during this session.	Open text	[ ]	
		Did your goal change at any point during the session?	Categorical	Yes No	
		If your goals changed; why did you goals change?	Open text	[ ]	

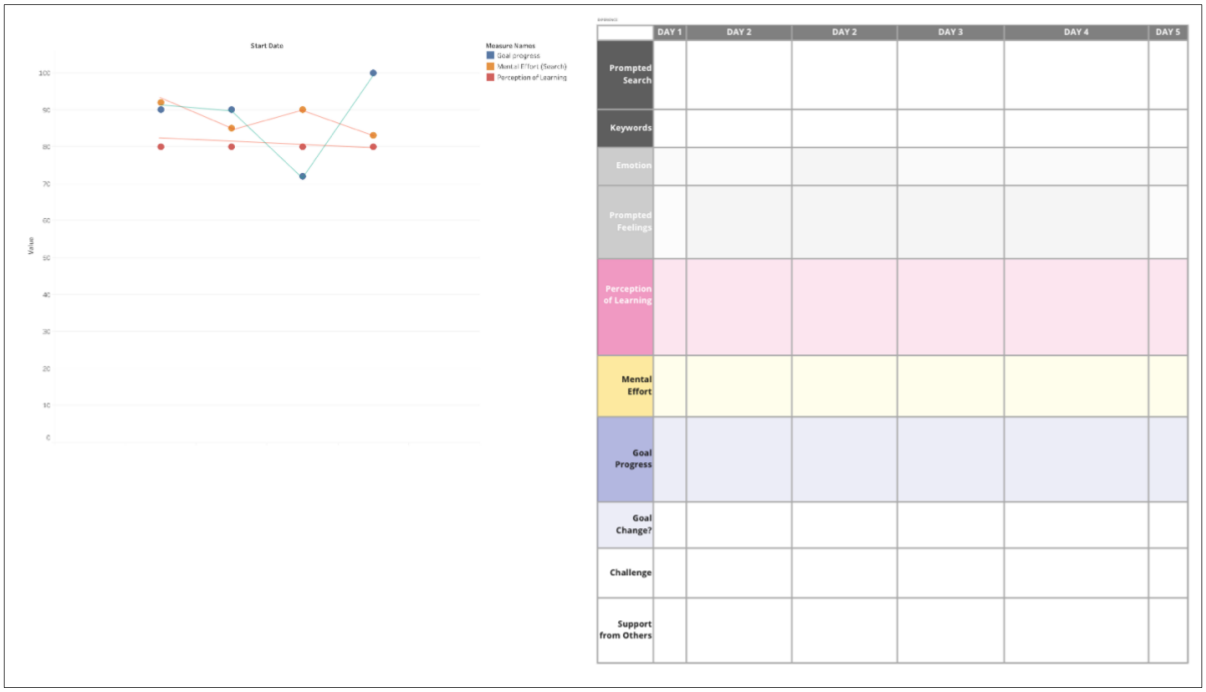
Theory (Flavell, 1979)	Construct	Survey question	Field type	Options	Theoretical source
		If you asked someone for help; who did you reach out to?	Open text		(McCord & Matusovich, 2019)

C.6 Experience Sampling Dashboard

The researcher-generated experience sampling dashboard (see Figure C1) was exported as a PDF and shared with the participant in Zoom using the screenshare features as a data prompt during interviews. The quantitative data were plotted on a chart using Tableau with the scale on the y-axis and the event-triggered learning diary (grouped by days) on the x-axis.

Figure C1

Template for the Experience Sampling Dashboard



Note. This dashboard was created by the researcher in Tableau and Miro and shared with the participant during the interview.

C.7 Interview Protocol

Participant ID: [Numeric; 4-digits]

Hello, [Name]! Nice to speak with you again.

First of all, thank you for participating in the full study. I really appreciate the time you took to participate in this process. This interview will reflect on the learning experience you had this week and we'll be talking about what you learned as well as your search process.

Based on your learning, I created a diagram that contains the kinds of activities you engaged in as well as your perception of learning and search effort. I'll be using this learning journey to guide our conversation and then ask you questions about how you would characterize your search.

Moderator's note: Request participants to turn off camera.

Do you consent to the recording?

BROAD QUESTION:

1. In general, can you tell me about your experience this week?

Cognition
I'd like to speak for a minute about what you learned.

Question

2. Tell me a little bit about what you learned this week.
3. What kinds of topics came up during your search?
4. How did your understanding of the concepts change over the course of the week?
5. What new ideas developed?
6. Did your confidence in the topic change over the course of the week? If so, what helped or hindered you?
7. Did the diary support your understanding? In what way (or how)?

Motivation
I see you met/did not meet your goals you set at the beginning of the week?

Question

8. Did you encounter any obstacles in accomplishing your goals? Why or why not?
9. What supported your accomplishment of your goals? Can you give some specific examples?
10. Did your goals shift or change over the course of the week? Why or why not?

11. Why did you (or did not) spend time learning about this topic?

If not raised in conversation

12. Did the search system affect how much effort you put into your learning?
13. Did the diary support your goals? If yes/no; in what way did they (not) support your goals?

Affect

Let's switch to talking a little about your emotions during this process

I see you reported [x,y,z] feelings occurred this week.

Question

14. Did the diary capture your emotions during your search in a way that makes sense to you? If no, did you experience other emotions while you're searching?
15. Let's talk about the search system itself
16. How did the search systems impact your emotions? (e.g., frustrated)
17. Did you have an emotional response to the interactions with the search system itself? If yes, what were they?
18. Did you have any emotions related to the content you encountered? If yes, what were they
19. Did your diary impact your emotions? If yes, how so?
20. Were there are any other influences on your feelings while you're searching?

Moderator's note: If participants express a strength of emotion: How do you manage your emotions to stay on task?

Selection

I'd like to talk about your experience with search when learning about your topic.

Question

21. Tell me a little bit about your keyword selection process over the course of the week. How did your keywords evolve over the week?
22. How did you decide which sources to select? Was that challenging about selecting sources?
23. What kinds of sources did you find most useful? What was challenging about determining their usefulness?
24. Did you run into any other challenges when searching?

Social

[Check on the document to see if they mentioned any people in the process]

Question

25. Did other people have a role in your learning over the past week? If yes, how did you communicate with them?

26. Did the search system provide any social supports? If so, how?
27. Did learning using search differ from how you typically learn? If so, how?

Wrap-up questions

28. What kind of support would you find most useful in learning while using search?
29. Anything else I didn't talk about that you feel is important if you learn using search?

Appendix D Final SALSE Scale and Scoring

D.1 SALSE Scale (43-item)

Rating scale: Cannot do at all (0) to Certainly can do (100)

Motivation Question Items
This set of questions focuses on how confident you feel expressing emotions when learning from information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.
1. Learn on my own if I try.
2. Even if the work is hard, I can learn it.
3. Figure how to do the most difficult tasks.
4. Master the skills needed to learn independently
5. Understand complex concepts from information I find online.

Affect Question Items
This set of questions focuses on how confident you feel expressing emotions when learning from information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.
1. Express enjoyment freely when learning
2. Keep from feeling dejected when I do not understand what I'm learning
3. Keep from getting discouraged by strong criticism
4. Reduce how upset I feel when underappreciated
5. Keep from getting discouraged in the face of difficulties

Cognition Question Items
This set of questions focuses on how confident you feel learning using information you find on the worldwide web.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.
Schema Training
1. Use different search approach depending on the particular goal I have
2. Choose words or phrases that tell a web search engine what I am looking for.
3. Use strategies (e.g., mind maps) to help me understand the information I find when searching online
4. Decide on the type of information I need to complete a learning task
5. Identify the type of information I need for my learning tasks
6. Use the information I find online to generate new words/terms.

Planning
1. Create a search plan before I look for information online

2. Articulate my goal before I begin looking for information online.
3. Predict possible problems that might occur with my search

Monitoring

1. Stop and check my progress on a learning task when searching online.
2. Keep track of my progress when I am searching for information online.
3. Adjust my search terms if I am not making progress
4. Find an expert to help me with something I'm learning
5. Email experts within my network for help with something I'm learning
6. Reach out to experts through social media (e.g., Twitter, Reddit) for help with something I'm learning
7. Reach out to experts in my community (e.g., Slack, LinkedIn) for help with something I'm learning
8. Reaching out to experts using my personal network (e.g., text messaging) for help with something I'm learning
9. Find a group of friends or peers that can help me with something I'm learning
10. Find help by posting to web forums when I'm learning something
11. Ask peers questions on community websites (e.g., Reddit) when I'm learning something

Evaluating

1. Evaluate my searches as I look for information online
2. Assess how much I'm learning during a search.
3. Judge how well the information I find matches my learning needs

Selection Question Items

This set of questions focuses on how confident you feel using search engines in web browsers.

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below.

1. Find information in a specialized digital library (e.g., ACM Digital Library)
2. Use truncation techniques to broaden my search
3. Limit my searches using quotes
4. Limit my searches by publish date
5. Limit my searches by location
6. Limit my searches by type of information
7. Limit my searches by price
8. Exclude specific sites from my searches
9. Use the advanced features of a web search engine (e.g., allintitle:).
10. Use Boolean logic (e.g., AND, OR, NOT) to refine my searches.

D.2 SALSE Scale Scoring

Note: These instructions were modelled after the appendices found in O'Brien et al. (2018).

Instructions for scale administrators: When administering the SALSE scale, all items should be randomized within each construct. Constructs should not be identified by their label (e.g., cognition), but each construct should have separate instructions for the participant (see Appendix

C.4). Below we provide general instructions that can be modified for the study context. A semantic differential scale is preferred asking participants to rate their experience from 0 to 100 using the following rating labels: “Cannot do at all” and “Certainly can do.”

Instructions for analysis:

1. There is no reverse scoring—all items are positively worded.
2. Scores are calculated by summing the subscale scores and dividing by the number of items.
   - Sum Motivation 1, Motivation 2… Motivation 6 and divide by 6
   - Sum Affect 1, Affect 2… Affect 8 and divide by 8
   - Sum Schema Training 1, Schema Training 2… Schema Training 7 and divide by 7
   - Sum Planning 1, Planning 2… Planning 3 and divide by 3
   - Sum Monitoring 1, Monitoring 2… Monitoring 12 and divide by 12
   - Sum Evaluation 1, Evaluation 2… Evaluation 3 and divide by 3
   - Sum Selection 1, Selection 2… Selection 11 and divide by 11
3. You may elect to sum all cognitive scores, which would involve summing the Schema Training, Planning, Monitoring, and Evaluation scores and dividing the number of items.
   - Sum all items in Schema Training, Planning, Monitoring, and Evaluation and divide by 25.
4. If participants complete the SALSE scale more than once in the same study, calculate separate scores for each administration of the scale.
5. At this time, the subscales should be calculated individually, and the scale should not be reported as a whole.