Teachers' Self-Directed Online Learning Strategies and Experiences: A Longitudinal Study

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Abstract
This study examines the strategies used by teachers during a series of self-directed online learning (SDOL) experiences. Over a period of four months, the authors met with 12 practicing elementary teachers three separate times. During the meetings, the teacher participants informally used the internet for their professional learning in literacy. Their online navigations were captured using screen-recording software. Immediately following their navigations, a virtual revisit think aloud was conducted where participants verbalized their thoughts aloud while viewing a screen-recording of their navigation. Semi-structured interviews with each participant were conducted following the three meetings. Data were analyzed both qualitatively and quantitatively. Findings relate to the cognitive and behavioral strategies in which participants engaged during their SDOL experiences.

Keywords: teacher professional learning, self-directed learning, online learning

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Teachers are increasingly turning to online environments for their professional learning (Parsons et al., 2019). Their use of online platforms makes sense since online environments provide teachers with spaces where they can engage with a multitude of teaching material and collaborate globally to gain insight into educational issues and best practices (Macià & García, 2016). Informal online learning opportunities are particularly conducive to teachers' schedules, allowing for flexibility with respect to time and geographical location. While a plethora of research has documented how teachers engage in formal online learning (Lantz-Andersson et al., 2018), less is known about teachers' self-directed online learning (SDOL)—teachers' decision-making processes and learning behaviors that occur during informal online navigations (Beach et al., 2021a). Moreover, limited research has documented teachers' SDOL over time. Given the impact professional learning can have on a teacher's beliefs and practices (de Vries et al., 2014), it is critically important to the teaching profession to understand how and why teachers select and use online resources and websites to inform their professional learning.

To best understand the *how* and *why* of teachers' SDOL, it is essential to use methods that capture teachers' cognitive processes and behavioral patterns as they occur. As such, this study used the virtual revisit think aloud to examine the strategies used by elementary teachers during a series of SDOL experiences. This work builds on a pilot study (Beach et al., 2021b) and presents a comprehensive picture of elementary teachers' online learning experiences and strategy use over a sustained period. Understanding the strategies used by elementary teachers during SDOL facilitates better decisions about and increased quality of informal online learning opportunities for teachers. Our findings also confirm that the virtual revisit think aloud can provide moment-to-moment data about online learners' strategies and behaviors during SDOL.

We begin this article with a review of the related literature on teacher professional learning. We then provide a discussion of self-directed learning, the theoretical framework for this study. The article continues with an overview of the methodology, including a more detailed discussion of our main data source, the virtual revisit think aloud. This is followed by the results and a discussion of the findings.

Review of the Related Literature

Like their students, teachers should be given access to a variety of learning opportunities. Providing teachers with choice in their learning can lead to increased engagement and a greater possibility of knowledge application (Campbell et al., 2017). Approaches to teacher professional learning can fall on a continuum. On one end of the continuum, more formal opportunities like distance education courses, are often guided by a facilitator and usually revolve around a community of teachers who all share a common goal (Jurasaite-Harbison & Rex, 2010). These types of learning approaches are often "top-down professional development endeavors, initiated by schools, districts and government agencies" (Lantz-Andersson et al., 2018, p. 304). At the opposite end of the continuum are informal approaches to learning, like a hallway conversation initiated by a colleague who has a particular question about a topic of interest. These types of learning opportunities can be described as bottom-up approaches (Lantz-Andersson et al., 2018) and are unique to each teacher; learning opportunities are personalized since the individual seeks out information with a particular goal in mind (Callanan et al., 2011).

Regardless of where an approach might fall on the professional learning continuum, opportunities for learning should incorporate research-based content, and be collaborative and job-embedded (Darling-Hammond & Richardson, 2009). Learning should also be supported,

sustained, and self-directed (Darling-Hammond & Richardson, 2009). When these key elements are taken into consideration, there is a greater likelihood that teachers will become engaged in their learning and incorporate new information into their instructional planning, ultimately leading to increased student achievement (Trust & Prestridge, 2021). For instance, Owen (2015) found that collaboration between colleagues during a professional learning community provided opportunities for co-planning, co-teaching, and co-assessment, and an increase in teacher support. Exploration of new teaching practices and reflective dialogue were also reported.

Similarly, in a study that involved peer coaching during context-embedded professional learning experiences, Bruce et al. (2010) found that collaboration over a sustained period of time led to increased confidence in participants' abilities to support their students and take greater risks in their instruction. The authors suggest that sustained, collaborative, and classroom-embedded professional learning opportunities support effective professional learning and lead to student achievement gains as well as gains in teaching quality (Bruce et al., 2010). Moreover, Alshaikhi (2020) found that teachers showed a high preference for self-directed learning (SDL) over more traditional forms of professional development. The SDL in which Alshaiki's participants engaged was both collaborative and individualistic. Alshaikhi (2020) noted that their participants felt driven to self-direct their learning since this approach provided an immediate response to their needs.

In online environments, teachers have many varied opportunities for learning and professional growth (Elliott, 2017). Many studies have examined the key elements listed above in the context of online environments. For instance, Colwell and Hutchison (2018) examined how a Twitter-based professional learning network offered preservice teachers a collaborative space where they were able to develop their understanding and perceptions of disciplinary literacy. The authors describe this informal online learning space as a type of professional learning that provides teachers with ongoing opportunities to discuss and share resources efficiently and with a network of educators that transcends teachers' local community (Colwell & Hutchison, 2018). Online sharing platforms, like Twitter, can allow teachers to gather and share advice, links, relevant resources, and timely news. By following other educators on social media platforms who all share common interests, teachers can find resources, learn about new approaches, and inquire about educational issues in a relatively short timeframe (Colwell & Hutchison, 2018).

In all these examples, there are underlying cognitive processes at play that guide and influence a teacher's decisions, beliefs, and goals during their professional learning. These cognitive processes can range from more complex and higher order processes to more procedural in nature (Horz & Schnotz, 2010). Higher order cognitive processes might involve reasoning, monitoring, and evaluating, to name a few, whereas procedural or lower order processes can refer to merely describing an event (Horz & Schnotz, 2010). The study of teachers' cognitive processes has primarily focused on the interactions between teachers' cognitive constructs and their classroom practice. For instance, Peters-Burton and Botov (2017) examined how elementary teachers engaged in a professional learning activity. They found that their participants monitored their learning in regular periods to see if their goals were being met. Monitoring learning involved skimming and scanning information for relevance and self-assessment using questions.

Additionally, in their study examining preservice teachers' cognitive processes during reading instruction, Griffith (2017) found that their participants used metacognitive decision-making strategies to reflect on their teaching growth and identity. Griffith's findings show that

these types of in-the-moment learning strategies allow teachers to draw upon their content and pedagogical knowledge to best support their students during learning activities.

Recognizing and understanding underlying cognitive processes and learning strategies is essential for professional learning to be successful, whether the professional learning is formal or informal. One type of informal learning that has become increasingly popular amongst teachers, particularly during the COVID pandemic, is SDOL (Beach et al., 2021b). SDOL stems from theories related to SDL, a complex process of independently seeking out and acquiring knowledge (Garrison, 1997). Connected to Knowles' (1975) adult learning theory and emerging from the notion that individuals often desire to understand a phenomenon, an incident, or a concept (Ponti, 2014), SDL is a highly individualized process with underlying supports in constructivism, an educational theory that emphasizes knowledge and understanding as based on a learner's own experiences. When involved in SDL, the learner constructs and reconstructs knowledge based on their own interpretations of information (Simons, 2000). SDL is a self-initiated process of learning, fosters personal autonomy, and promotes greater learner control; learners are free from external control and constraint (Caffarella, 1993). According to Trotter (2006), teachers are self-directed learners when they choose educational topics that directly relate to their individual practice and classroom context.

Several processes are involved during SDL including self-management, self-monitoring, and motivation (Garrison, 1997). Self-management focusses on task control and the ability to be metacognitively aware; the learner is intentional and aware of their task-oriented goals. The focus is on what the learner *does* during the learning process and the strategies they enact to accomplish a particular task. Managing a task during the learning process is dependent upon several variables (Garrison, 1997), including proficiency (the learner's abilities and skills), resources (the support and assistance in the given learning environment), and interdependence (the learner's integrity and choice). Additionally, it is through reflection and critical awareness that a learner is metacognitive and able to effectively self-manage their learning; an internal dialogue occurs during the learning process in which the learner is aware of their current knowledge, how they will search for additional information, and assess their learning outcomes. In an online environment that is geared towards self-directed learners, such as a professional development website (e.g., www.readingrockets.org), a teacher might manage their learning by selecting a tutorial video that can help them effectively use a new learning tool (proficiency), using filters during a search (resources), and initially navigating a website that provides them with multiple forms of media from which to learn (interdependence).

Self-monitoring involves planning and modifying our learning as the process progresses (Garrison, 1997). Garrison (1997) posits that it is through critical reflection and collaborative confirmation in which self-monitoring occurs and, as a result, knowledge is constructed. Self-monitoring is indeed a self-regulated process in which the learner observes, judges, and reacts to the activities (Bandura, 1986). Like self-management, the learner's responsibility for their own learning involves the ability to use strategies conducive to the learning environment. When a teacher navigates a website to find information related to their literacy program, for example, they might monitor their learning by considering the various selections from a list of hyperlinks (observing), forming an opinion about the title of a relevant link (judging), and then clicking on and reading the article or lesson in full in order to determine how it can be integrated into their current literacy program (reacting).

Finally, Garrison (1997) suggests "motivation plays a very significant role in the initiation and maintenance of effort toward learning and the achievement of cognitive goals" (p. 26). Two types of motivation are highlighted in Garrison's (1997) model: entering motivation and task motivation. A learner is motivated to enter a new learning situation when they perceive it as valuable and connected to a personal goal. Being motivated and deciding to enter an online learning environment is often interest-driven and, for a practicing teacher, more likely to occur when the content is connected to their classroom context. A teacher's decision to continue perusing a website is dependent on their task motivation. As Garrison (1997) states, "to direct and sustain motivation [teachers] must become active learners" (p. 28). They must actively decide whether the information is meaningful and, based on this, whether it is worthwhile to continue using a selected site. Motivation has been connected to greater learner control, which implies that the learner is the one who considers the content, approach, and value to the learning experience (Caffarella, 1993). With greater learner control individual needs are more likely to be met in teachers' quest for pedagogical knowledge and instructional materials.

Online environments are conducive to SDL as they provide opportunities for learners to interact with technologies in personally meaningful ways (Moore, 2016). Teachers' SDL is often intertwined with their instruction. When they are involved in the constructs of SDL (self-management, self-monitoring, and motivation), their learning will likely influence and, ideally, support their teaching practice (Putnam & Borko, 2000). Through their ability to self-direct their learning in online environments, teachers have a greater chance of selecting appropriate and related information and constructing knowledge that can have a direct effect on their teaching practice, and ultimately on student learning.

Evidence from research in teacher learning over the past 30 years shows that professional development can lead to improvements in instructional practices and student learning (e.g., Borko, 2004). As Borko discussed in her seminal 2004 paper:

> For teachers, learning occurs in many different aspects of their practice, including their classrooms, their school communities, and professional development courses or workshops. It can occur in a brief hallway conversation with a colleague, or after school when counseling a troubled child. (p. 6)

To understand teacher learning we must study it within these multiple contexts, considering both the individual teacher-learners and the context in which they are participants. In our study, teachers individually self-directed their learning in the context of online environments. To capture teachers' thought processes about their teaching practices and learning strategies, we used the virtual revisit think aloud. As a result, we have gained greater insight into teachers' self-directed learning as it occurs in online environments. Generating this data can contribute to better decisions about and increased quality of informal online learning opportunities for teachers. The following research questions guided this study:

1. What cognitive and behavioral strategies do elementary teachers engage in during a series of SDOL sessions?
2. Are there any changes in elementary teachers' cognitive and behavioral strategies over a series of SDOL sessions?

Methods

Research Design

This study employed a multiple method research design that included both qualitative and quantitative approaches. A multiple methods design was selected to gain an in-depth understanding of teachers' thought processes and web-based behaviors during a series of SDOL sessions. The qualitative component involved a general inductive approach to analysis (Thomas, 2006): through an open-coding technique, think aloud and interview transcripts were analyzed through a series of repeated readings. The quantitative component involved descriptive statistics, specifically frequencies and percentages of the participants' observed strategies and behaviors within and across the three SDOL sessions.

Our main data source was the virtual revisit think aloud, an alternative type of think aloud that generates data on teachers' cognitive processes and decision-making strategies *while* teachers engage in online learning (Beach & Willows, 2017a). Think aloud methods have been used across research domains to explore the ongoing cognitive processes that occur during a task performance (Ericsson & Simon, 1984; 1993). Over the past several decades, researchers have incorporated various types of think alouds into their research, with the concurrent and retrospective think alouds as the most common approaches (Kuusela & Paul, 2000). The concurrent think aloud requires participants to verbalize their thoughts aloud while they simultaneously complete a task.

The retrospective think aloud, on the other hand, requires participants to think aloud after a task has been completed. While these two types of think alouds have been widely used, they both have serious limitations. For instance, cognitive load increases during the concurrent think aloud since the participant is asked to complete a task while at the same time verbalize their thoughts. This can have a negative impact on how the participant completes the task as well as the act of thinking aloud (Beach & Willows, 2017a). While the retrospective think aloud avoids this conflict, much of the data during the task is lost or omitted during the retrospective think aloud since the participant must recall their decisions after the task has been completed and usually without any aids (Beach & Willows, 2017a). The virtual revisit think aloud avoids the limitations of the concurrent and retrospective think aloud by using a screen-capture recording of participants' navigations. The screen-capture recording is viewed by participants immediately following their navigation. Participants verbalize their thoughts while viewing their actions and behaviors. As a result of the aid of their screen-recording, participants recall their navigational decisions and why they made them.

Participants

Twelve practicing elementary teachers from Ontario, Canada volunteered to participate in this study. All participants provided informed consent prior to their participation. Table 1 presents participants' demographic characteristics.

Table 1
Demographic Characteristics

Characteristic		Frequency ($N = 12$) *n* (%)
Teaching Experience		
	1–5 years	7 (58%)
	6–10 years	5 (42%)
Age Range		
	25–29	6 (50%)
	30–34	3 (25%)
	35–39	3 (25%)
	40+	0
Current Grade		
	Kindergarten (JK/SK)	5 (42%)
	Primary (Grades 1–3)	2 (17%)
	Junior (Grades 4–8)	4 (33%)
	Multi-grade range	1 (8%)
Type of School		
	Public	8 (67%)
	Private/Independent	3 (25%)
	Unknown	1 (8%)

Websites

Prior to each session, participants were provided with the URLs of two literacy-oriented PD websites: *The Balanced Literacy Diet: Putting Research into Practice in the Classroom* (www.LitDiet.org) and *Reading Rockets: Launching Young Readers* (www.readingrockets.org). We selected these websites as starting points for the SDOL sessions for consistency across participants and because of their popularity among elementary teachers, research-informed content, and freely accessible resources. Participants were free to navigate these websites, select hyperlinks to additional sites, or use sites with which they were familiar.

Procedure

Participants met for three monthly one-on-one SDOL sessions with a member of the research team. All sessions were remote using Zoom and took place between November 2020 and February 2021. Participants completed a short online questionnaire prior to their first meeting. Questionnaire items related to demographic information (see Table 1). Each session followed a sequence of events and lasted approximately 45 minutes. First, the session began with the participant sharing their professional goal as it related to their current literacy practice (see Table 2 for types of goals). Next, the participant completed a 20-minute open-ended task to use the internet as they normally do when seeking information related to their teaching practice. An open-ended task was used to reflect as naturally as possible, how the participants use the internet for their professional learning in literacy. For instance, during an open-ended task, participants were free to peruse websites of interest, click on additional links, and view videos and photographs (additional behaviors are discussed in the results). Specifically, the researcher stated the following prior to the participant's navigation:

> We are interested in teachers' online behaviours and thought processes as they engage in self-directed online learning experiences in the context of literacy education. We have provided you with two literacy-oriented websites. You may use these websites or any other website that you would like to as it relates to your teaching practice in literacy. You will have 20 minutes. Feel free to take notes using a word document. As you navigate online, your actions will be recorded using a screen-capture recording program.

Participants shared their screen via Zoom and began their navigations. Their behaviors were captured using Camtasia Studio, a screen recording computer software program developed by TechSmith.

Immediately following participants' 20-minute navigation, the recording of their navigation was shared with them via Zoom and the virtual revisit think aloud was conducted: as participants viewed their online choices virtually, they verbalized their thoughts aloud. Participants were specifically given the following information:

> We are interested in what you were thinking about during your online navigation. In order to do this, I am going to ask you to think aloud while you view a recording of your navigation. What I mean by think aloud is that I want you to tell me everything that you were thinking from the time you began navigating the website until the end of your navigation. I would like you to talk aloud constantly. I don't want you to try to plan out what you say or try to explain to me what you are saying. Just act as if you are alone in the room speaking to yourself. It is most important that you keep talking. While you talk I will be recording your think aloud using a digital recorder.

To avoid disruptions during the think aloud, prompts and interventions were kept to a minimum (Jaspers, 2009). Participants were only prompted if they fell silent for 30 seconds. None of the participants required prompting during any of the SDOL sessions. In addition, the screen-recording continued to run and was not paused during participants' think aloud. Following the last SDOL session, a semi-structured interview was conducted.

Table 2

Participant Goals

Type of Goal		**Session 1 n (%)**	**Session 2 n (%)**	**Session 3 n (%)**
Student-focused				
	Targeting specific student needs	1 (8%)	2 (17%)	1 (8%)
	Home-school connection	1 (8%)	0	1 (8%)
Classroom-focused				
	Targeting grade level	2 (17%)	0	0
	Resource specific	1 (8%)	0	1 (8%)
	Assessment-focused	1 (8%)	1 (8%)	0
Literacy-focused				
	Targeting & planning for literacy skill(s)	6 (50%)	6 (50%)	5 (42%)

Pedagogy-focused				
	Seeking out broader educational information & filling in knowledge gaps	0	2 (17%)	3 (25%)
	Focusing on teaching structure	0	1 (8%)	0

Notes. An open-coding analysis, similar to the analysis described below, was conducted on participant statements related to their session goal to determine the types of goals reported by participants across the three sessions; during session 3, one participant did not state a goal.

Data Sources

Multiple sources of data were obtained for triangulation, contributing credibility to the findings by converging more than one source of information (Golafshani, 2003).

Online Questionnaire

A questionnaire was administered to participants to obtain data on a range of relevant demographic characteristics.

Virtual Revisit Think Aloud

Audio recordings captured participants' verbalizations ("thinking aloud") as they viewed their navigational recordings.

Screen-Capture Recordings

Camtasia Studio was used to record participants' computer screen during their online navigation.

Semi-Structured Interviews

A semi-structured interview followed the participants' navigations. Questions related to participants' general feelings of their SDOL sessions. Sample questions included: What were your general feelings during your navigations? What did you find challenging during the three sessions? Were there any websites/resources that stood out to you? And, Do you feel that you gained information about your literacy program during these sessions? The entire list of interview questions is included in Appendix A.

Data Analysis

We adapted the main themes and subthemes from the analysis and results of the pilot study (Beach et al., 2021b) to code this study's think aloud and interview transcripts (see Appendix B for coding scheme). Initially, the pilot study involved an inductive approach to analysis in which the data from the think alouds and interviews were reduced to themes because of repeated coding, comparisons, and categorizations (Creswell, 2007). Utterances or thought units verbalized by participants during the think alouds and interviews were coded based on a repeated reading of the transcripts. We used an open-coding technique in which the transcripts were segmented into meaningful units and then described using a word or short phrase. These descriptions were based on our interpretations of the data and related to the research questions. Coding each meaningful thought unit meant that the researchers were not limited to a set number of words. As a result, some thought units were only a few words while others consisted of entire paragraphs. Along with using the pilot study themes to code this study's transcripts, we also employed an open-coding technique to determine additional codes based on the current dataset. First, all members of the research team coded approximately 10% of this study's transcripts using the four main themes and sub-themes from the coding scheme. The researchers met to

review how they coded each thought unit. Each thought unit was discussed and reviewed. This review resulted in a 96% agreement rate. Therefore, two of the research team members divided and coded the remaining transcripts.

The quantitative data involved the screen-capture recordings. These were analyzed using a time-sampling observation analysis where participants' web-based behaviors were counted and recorded in 10-second intervals (Beach & Willows, 2017a). Specifically, while viewing the 20-minute screen recordings, members of the research team documented each web-action exhibited by participants every 10 seconds using an excel spreadsheet. Prior to this analysis, a list of actions (e.g., enters a search term) was determined based on the pilot study (see Appendix C). Themes and sub-themes across the SDOL sessions were also tallied. Frequencies are reported below.

Results

We provide a summary of the results according to the research questions, including an overview of each theme that resulted from the qualitative analysis. We include direct participant quotes to help support each theme. Results are also presented in several tables.

What Cognitive and Behavioral Strategies Do Elementary Teachers Engage in During a Series of SDOL Sessions?

Cognitive Strategies

Over a four-month period, participants demonstrated cognitive strategies that fall under four main categories: Metacognitive awareness, monitoring learning, evaluating information, and increases in self-efficacy. It is clear in Table 3 that the majority of thought units related to monitoring learning (Session 1: n = 705, 57%; Session 2: n = 608, 53%; Session 3: n = 566, 55%). Thought units related to self-efficacy were coded the least often across the three sessions (Session 1: n = 85, 7%; Session 2: n = 87, 8%; Session 3: n = 65, 6%). Table 4 further breaks down the main themes and presents the frequencies of thought units related to each sub-theme. The themes are described below. Examples of participant quotes are included to provide support for each theme.

Table 3

Frequencies and Percentages of Thought Units Coded for Each SDOL Session

Theme	Session 1 N (%)	Session 2 N (%)	Session 3 N (%)
Metacognitive Awareness	294(24)	305(27)	286(28)
Monitoring Learning	705(57)	608(53)	566(55)
Evaluating	142(12)	140(12)	110(11)
Self-Efficacy	85(7)	87(8)	65(6)
Total	1,226(100)	1,140(100)	1,027(100)

Table 4

Frequencies of Thought Units Related to the Sub-Themes Across the Three SDOL Sessions

Theme	Sub-theme	Session 1	Session 2	Session 3	Total
Metacognitive Awareness					
	Diversion	102	77	58	237
	Recounting	35	39	55	129
	Observing	97	140	125	362
	Recollecting	53	43	38	134
	Reflecting	7	6	10	23
Monitoring Learning					
	Searching & Filtering	69	45	39	153
	Skimming through	103	105	73	281
	Deep reading	6	21	11	38
	Saving information	32	34	28	94
	Connecting to practice	495	403	415	1,313
Evaluating					
	Source credibility	93	97	74	264
	Source accessibility	16	7	10	33
	Source quality	33	36	26	95
Self-Efficacy					
	Goal setting	37	31	30	98
	Personalizing	25	25	17	67
	Enhancing knowledge	19	23	17	59
	Vicarious learning	4	8	1	13

Metacognitive Awareness. Participants employed strategies related to *metacognitive awareness*—participants' awareness of their own thinking and strategy use led them to better understand their choices in relation to their goals. Participants noted moments when they became distracted or confused and how these moments influenced their navigations. For instance, during the first SDOL session one participant noted how she needed to be aware of her browsing behavior and related professional goals: "I tend to sometimes divert from what I'm doing and do something else to be distracted and go onto a billion different other things and then eventually come back to my main goal." Participants also commented on how their lack of understanding would lead them to navigate elsewhere. For instance, in reference to an unclear lesson plan one participant acknowledged: "It's also confusing, these names don't say the letter sound, it only says the name, so I found that difficult to understand so I think I just left that site."

Participants also recounted their web-based behaviors. This, in turn, allowed them to not only comment on their decisions but also *why* they made them. For instance, one participant described her decision to click on a specific tab: "I clicked classroom tips because I was looking for centers and informal assessment to see if there was anything here that was relevant to that." Similarly, a participant provided a rationale for selecting an external link: "I was curious about the communication milestones, so I eventually ended up clicking on that link." In another instance, this same participant explained: "This is me trying to expand this video because I was interested in her evaluation continuum."

Participants also noticed resources that were of professional interest to them. For instance, one participant "saw that they have a character analysis graphic organizer. So [she] thought maybe if it's complex [she] can simplify it a bit." Additionally, participants were drawn towards information that was familiar to them and that they could immediately relate to their current practice. One participant described how writing activities "caught [her] eye" as she scrolled through a list of lesson plan ideas. Participants were generally attracted to new, yet relatable information. As they navigated, they were "very intrigued" by and described how they "definitely will be going back and taking a look at these [resources] in the future." They often recollected information by returning to websites, as was the case for one participant who decided to return to one of the given sites during her second SDOL session. During her interview she recalled her navigational intentions:

> So today I decided to go back into Reading Rockets because I really like to see the research and information that they present on literacy and other resources and lesson ideas. The layout is really easy to navigate through and I had a few things in mind.

Another participant described a similar objective: "I decided to go back to the Reading Rockets and to move into the next section after phonemes, moving into some more phonics."

Monitoring Learning. Across the three sessions, participants most often *monitored their own learning*; they were observing, judging, and reacting to newly found material as it related to their professional goals and teaching practice. Specifically, a common strategy involved searching and filtering. More general searches seemed to occur at the beginning of a participant's navigation. For instance, one participant noted: "I always start my search with something very generic just because I'm curious to see what's out there." Another participant stated that "when it comes to navigating the Literacy Diet site, I tend to go grade specific." On this website, this participant found "using the recipe finder and the filter function" helpful to narrow down her search. At various time points throughout their navigation, participants also searched specific topics related to their teaching goals. For instance, one participant described how she used the search engine within a particular website to filter options related to "social-emotional development because this is a personal research interest of mine that I'm working on and seeing as an issue that is prominent in the class."

Searching topics and filtering options often led participants to skim "through what's there." By "skimming and scanning" various webpages, participants were able to observe, judge, and react to topics of potential interest and decide whether the site was worthwhile to continue perusing. For instance, one participant reflected on the recent switch to remote learning. She noted: "As I was quickly skimming through, I realized this is a lot to do with in-person teaching and I really needed to refine my search as I get more creative with how I was going to be teaching word study."

Skimming through information also led participants to make decisions about whether they might return to a specific site. For instance, a participant "did a quick scroll to see if [she] liked the way that the list was done. [She] did, so [she] saved it to come back to later and to have a more detailed look." As participants skimmed, they "quickly looked through titles," "browsed and perused to see if anything caught [their] eye," "flipped through to see if anything captivated [them]," and "looked for keywords that jumped out and looked relevant."

The process of skimming sometimes led participants to review information in greater depth. This involved a more thoughtful and deliberate reading. For instance, after finding an article about reading aloud in the primary grades, one participant noted how she "was reading about the benefits of read aloud and how it helps build knowledge." Another participant emphasized her careful reading to fully understand the content: "I was reading it very carefully to make sure I understood what this activity was asking, adapting it to suit where I thought was necessary to apply it to the situation, I wanted it in and just typing it out very carefully." Similarly, during her third session a participant described her close reading of a particular topic: "I'm reading this closely just to see what some traits or ways are they consider one to be active or an active citizen, especially for children."

Participants also saved information through bookmarking, downloading, note-taking, and printing out documents. This was especially the case when participants found direct connections between the information and their classroom contexts. For instance, one participant noted how she would delve deeper into an article later: "So I save this one on my computer. I was looking through it and then there was reading tips for parents for grade three so again, this is really good. I'll come back for this one later." Saving information appeared to directly relate to active planning during the participants' navigations. For instance, one participant remarked on an activity being described by a teacher in a demonstration video: "I like how she numbered it and used different colors to name the groups for them to understand easily in terms of that, so I think I should do that, and save that for later." Another participant began to consider how she might tweak an activity to suit her current students: "It was more so like a grade two activity, but I do love modifying. I love finding [activities that are] easier or harder and changing it up. I can get creative with that."

As participants continued their navigations and their time engaged in the SDOL sessions, they felt inspired to locate new ideas and learning experiences for their students. For instance, one participant remarked: "I'm looking for some inspiration for some media literacy activities and I started off by referencing the curriculum again." This participant continued sharing her plans related to media literacy and how she was interested in expanding her current teaching unit: "We've looked at print ads, commercials, we've talked about jingles and slogans, we've talked about target audiences, hidden messages, obvious messages and so I was looking for something to expand on that or something different." For all participants, it appeared that the SDOL sessions were beneficial to their own professional learning and instructional planning, particularly in the context of their current classroom: "So again, I was reading through to see what materials were needed for this particular lesson, how applicable or how relevant is it to what's happening in the classroom right now?"

Evaluating Information. Participants *evaluated* information as they navigated various websites and resources; they were assessing the source credibility, accessibility, and quality of information. For instance, participants noted their attention to the source and whether the source was a credible author, an organization or field expert they could trust to provide them with accurate information. One participant stated: "And then my eye caught this university because I know they're a well-respected university, so I was curious what their teaching guide would say." Similarly, another participant noted that she "really enjoyed that these come up with university-based resources, that are going to be based on academic truth and strong foundational principles that I specifically believe in." Additionally, during her third SDOL a participant remarked: "Going down, checking again references, just want to make sure there's some sort of reliability, academic quota that's being hit, and not just going off someone's gut feeling." Participants found it helpful to "scroll through reading through what the experts have to say."

Along with source credibility, participants noted the accessibility of various websites and resources. They were most interested in material that was free of charge and membership. For instance, one participant "was quite impressed because there were a lot of free books, which is nice." Participants also noted websites' architecture, as in one participant who commented on the "well laid out websites" which she found to be "really helpful for teachers." Participants also referred to the accessibility of the content:

> And what I really love about this site particularly, is that it makes a lot of those larger concepts really digestible and then super useful for those that are really versed in it but also really great for those who don't necessarily have a lot of experience within the realm or with the vocabulary or whatever it may be.

Throughout all three SDOL sessions, participants also evaluated the quality of the websites. One participant, for instance, "just liked how everything was so wonderfully scaffolded and again looking at the list of narratives and just, you know, always showing them examples, really strong examples." They were intrigued by the possibilities of various online resources, particularly those that were of varying levels where information could be tweaked according to student interest and academic progress. For instance, one participant described how one online resource "was interactive and had a lot of possibilities in it for different activities and different levels." The quality of the literacy content on various websites was also a point of reference in terms of the participants' evaluation. For instance, one participant described:

> It's so nice that they have so much for literacy so that whenever I seem to be looking for something, I can usually find pretty quickly exactly what I'm looking for which is always nice as a teacher so you're not scrolling the internet looking for something and not being able to find it.

Increases in Self-Efficacy. Finally, participants experienced increases in *self-efficacy*; their confidence in their ability to complete a task or achieve a goal related to their literacy practices appeared to be affected by their SDOL experiences. Although this theme resulted in the least number of thought units across the three sessions, the strategies related to self-efficacy are relevant, nonetheless. These included goal setting, drawing on personal experiences, and reflecting on literacy learning. Participants also demonstrated vicarious learning in which increases in confidence for teaching literacy appeared to result from viewing a demonstration video or teaching resource.

By setting goals at the beginning of each session and noting goals throughout their navigations, participants were able to stay focused. One participant noted how she would otherwise get distracted by other topics of interest: "I was focusing on writing strategies today because last time I got side-tracked a lot." Goals were obtainable and seemed related to their students' needs and interests. For instance, one participant described her focus on two students: "One of my goals is to think about G's retention of sight words and ability to transfer knowledge." This led her to search and select material that aligned with this goal and student needs. Later in the same session, this participant stated: "And then I'm thinking about another student, a goal I have for him, he is struggling with recall of sight words." As participants navigated through the various material they often reflected on their goals: "So when I was starting, I was taking a little bit to think about my goal and trying to have something that was doable." Similarly, halfway through her second SDOL session, a participant reflected: "Then I was back to my original goal, literacy milestones in terms of things that would perhaps come to play in the classroom."

Participants also drew on personal experiences as well as their own literacy learning during their SDOL sessions. These reflections seemed to create connections to the material. For instance, as one participant viewed a demonstration video she noted: "I spend a lot of time with prekindergarten students, so I was thinking, as I watched this, about some of the stuff that I naturally do when I'm just hanging out with kids anyway." Similarly, another participant reflected on her experience observing other teachers. This seemed to provide her with a critical lens on how socio-emotional development is integrated in the classroom, a topic of personal interest: "I'm thinking about how I've seen or observed teachers in my placements or other experiences, how have they effectively taught social emotions, or have they taught it at all?"

Although there were only a relatively small number of thought units coded as vicarious learning, moments of vicarious learning may have contributed to increases in confidence for teaching literacy. For instance, while viewing a demonstration video one participant stated: "It's also funny because when I did it last year, I hadn't done it in a long time, so it was nice to watch someone else do one." Another participant was keen on understanding how a teacher articulated learning goals to her students since this was something the participant found difficult to do: "I'm looking at the learning goal to see how she articulates it because it's really hard to put down every learning goal, but actually this is a great idea." By viewing another teacher's practice, participants appeared to gain confidence in their own teaching.

Behavioral Strategies

Participants engaged in a range of web-based behaviors during the SDOL sessions (see Appendix C). Note-taking and video viewing occurred most often across the three sessions. Participants also explored information by opening webpages; they used various web features, including interactive virtual classroom tours, and they changed the course of their navigation by opening external links, using the back button, and opening new tabs.

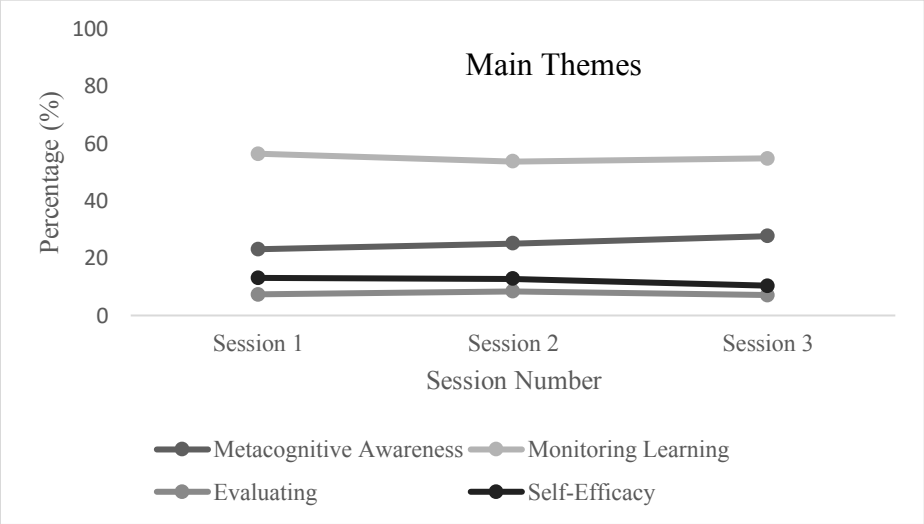
Are There Any Changes in Elementary Teachers' Cognitive and Behavioral Strategies Over a Series of SDOL Sessions?

As shown in Figure 1, the strategies related to participants' metacognitive awareness, monitoring learning, evaluating, and self-efficacy generally remained constant across the three sessions. These findings corroborate the results from the pilot study (Beach et al, 2021b); regardless of the session number, participants demonstrated strategies that were interconnected and iterative. Strategies did not appear to progress in a linear way but rather overlapped and potentially influenced each other. For instance, participants did not begin their first SDOL session with more general cognitive strategies, such as recounting or skimming through, and then move towards higher level cognitive strategies throughout their second and third SDOL sessions, such as deep reading and connecting to practice (Beach, 2017b). It is possible that the number of sessions limited any potential for change. Additionally, this study did not use an intervention and therefore, there was not a single moment to prompt any change. Future research could integrate a workshop or tutorial related to SDOL over several more SDOL sessions.

Interestingly, participants monitored their learning most often across the three sessions. This suggests that as they sought out and delved into personally meaningful topics, they made decisions about whether the material was relevant to their teaching practice; participants were acutely attentive to their personal goals (Garrison, 1997).

Figure 1

Main Themes Across Sessions



In terms of participants' SDOL behaviors, a notable finding relates to how participants increasingly took notes and saved information across the three sessions. It is possible that as the sessions continued, participants became more comfortable about the process. They may have also realized that these sessions were not only part of a research study but were also valuable learning and planning opportunities for themselves.

Discussion

Our findings corroborate our pilot study results (Beach et al., 2021b) suggesting that SDOL is a valuable source of teachers' professional learning regardless of how often it occurs. Based on our findings, it appears that SDOL fosters teachers' metacognitive awareness, ability to monitor their learning, and critically evaluate content and resources. In addition, our findings show that the teachers in our study increased their self-efficacy for teaching literacy while participating in SDOL. The strategies enacted by our participants appear to align with higher-order cognitive processes, as outlined by Horz and Schnotz (2010). Participants' ability to think about their strategies and navigational choices, for instance, provided them with ample opportunities to redirect their course of action, narrow down topics of interest, and reflect on their options during their navigations; they self-managed their learning experiences. Garrison (1997) suggests that self-management involves the cognitive management of learning and the construction of meaning through critical reflection. By employing metacognitive strategies and critically analyzing information, participants were able to build onto existing knowledge as well as construct new knowledge that was personally meaningful and tied to their instruction.

Our findings also suggest that participants monitored their learning during their navigations. Monitoring learning involves the acute attention to personal goals (Garrison, 1997). This makes it an especially useful process to enact during SDOL. The teachers in this study planned and modified their learning and instructional planning with goals in mind. Most of the participants shared literacy-focused goals before each SDOL session. This seemed to help guide and regulate their navigations to achieve an intended outcome. This finding aligns with Callanan et al.'s (2011) work, which suggests that learning opportunities become personalized when the individual has a particular goal in mind. As many of the participants demonstrated, their searches allowed them to make observations and consider potentially relevant material. Similar to Peters-Burton and Botov's (2017) participants who demonstrated strategies related to monitoring learning, our participants skimmed and scanned information for relevance while keeping their personal goals in mind. By skimming material, they also formed judgements and opinions about whether it was worthwhile to delve deeper and engage in a careful reading of the material.

Note-taking appeared to be an especially effective strategy for delving into and better understanding topics of interest. This finding aligns with prior research that has suggested notetaking supports deep comprehension (Kobayashi, 2005), particularly during online learning (Zhu et al., 2022). Note-taking provides learners with opportunities to encode information into long-term memory, aiding in the organization of incoming information (Kobayashi, 2005). It is possible that the participants in the current study were able to think more deeply about the information they documented as it related to their literacy instruction and teaching goals. While we did not follow up with participants, it is also possible that participants revisited their notes later to review their newly learned material and consider how they might integrate it into their instruction. The benefits of notetaking during SDOL should be further examined, as well as how we might be able to utilize note-taking tools within online learning platforms to facilitate teachers and other site users in employing notetaking during learning.

Along with being metacognitively aware and managing their learning, participants appeared to evaluate the information and material they viewed. Across the three sessions, participants thought critically about the source, accessibility, and quality of information. Through their unique teaching lenses, the participants in our study sifted through information while at the same time engaged in a critical evaluation of the material.

Online resources accessed by teachers to enhance their professional learning come from a range of sources, some based on solid evidence and others on opinion, experience, and incentives, and thus their quality and relevance vary. It appears that the teachers in our study were able to view and select material through a critical lens. This finding is in contrast with a previous study we conducted examining whether preservice teachers critically evaluate online sources they use for their literacy planning and instruction (Beach, 2020). Survey results indicated that the preservice teachers often selected online resources based on accessibility of material and visual appeal (Beach, 2020). These types of online resources, like Teachers Pay Teachers and Pinterest, are not monitored by credited evaluators and can often include inaccurate or misleading information. Perhaps the difference in findings is based on field experience. It could also be suggested that this difference is due to a higher social media presence in the lives of preservice teachers. More research should be done to further investigate this distinction.

Participants in our study also seemed to gain confidence in their literacy instruction. Although observed less often than the other cognitive strategies, strategies related to self-efficacy may have contributed to the participants' motivation and feelings of support. Self-efficacy for teaching literacy has been described as a teacher's self-perceptions of their competency with the activities of literacy teaching (Tschannen-Moran & Johnson, 2011).

Given the affirmations and connections the participants made to the material, it is possible that participants' confidence and motivation to continue learning about a specific topic increased during and across the SDOL sessions. Similar to Colwell and Hutchison's (2018) participants who found Twitter to be a beneficial space for learning about other teachers' practices, our participants were able to relate to teachers in online spaces and potentially felt motivated to continue their navigations.

Finally, our findings provide further evidence of the benefits of using the virtual revisit think aloud to understand how and why teachers specifically, and internet users more generally, self-direct their learning in online environments. Given that participants viewed a screen-recording of their navigation immediately following the task, verbalizations included more complex reasonings. By virtually revisiting their SDOL experience, participants were able to explain their judgements and decision-making processes. The types of cognitive strategies participants employed can be considered more higher-level learning processes (Krathwohl, 2002). Rather than merely describing their behaviors or reading text on various webpages, participants provided rationales. As a result, we gained an increased understanding of their use of the internet for their professional learning.

While our findings contribute to the literature on professional learning by generating data on elementary teachers' cognitive and behavioral strategies during SDOL experiences, there are two main study limitations that should be taken into consideration when interpreting the results. First, this study used a relatively small sample size with all participants residing in the same region of Canada. While the focus of qualitative research relates to individuals' experiences, a larger sample size across regions and countries would provide more substantial evidence related to our research questions. The second limitation relates to the context of this study, literacy education at the elementary level. We call for future research that examines the SDOL experiences of teachers and instructors across subject areas and educational levels.

Conclusion

Overall, the findings from this study suggest that elementary teachers employ strategies related to metacognitive awareness, monitoring learning, and evaluating during SDOL and that these types of learning strategies are a valuable approach to informal PD for practicing elementary teachers. Additionally, SDOL appears to provide a space for elementary teachers to build their confidence and self-efficacy for teaching literacy. This appears to be the case regardless of how often SDOL occurs. These findings have implications for website developers and organizations interested in providing online professional learning opportunities for teachers. Providing access to online activities that optimize the use of SDL strategies, like notetaking, has the potential to engage teachers in their professional learning, create opportunities for knowledge construction, and contribute to teachers' instructional methods. An additional context-specific contribution relates to the participants' literacy goals. Asking participants to consider a literacy-related goal during their online navigations could have helped participants be more efficient in their online actions and search strategies. They were able to home in on their goals in relation to their learning strategies and teaching practice. If teacher educators and professional development administrators consider incorporating SDOL tasks into their coursework, discussing content-specific goals prior to such learning tasks can potentially lead to an increase in engagement and learning.

Although we did not pose a research question related to the virtual revisit think aloud, we do suggest that this method has the potential to be used across domains in education and online learning. Online teaching and learning researchers can use the virtual revisit to document participants' SDOL, regardless of the context or nature of the learning task. Understanding the strategies used by online learners, as well as why they access resources can contribute new knowledge about informal online learning and the platforms used by self-directed online learners. Moreover, accurately tracking how websites are navigated by target users can facilitate better decisions about and increased quality of SDOL opportunities.

Declarations

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

The authors assert that approval was obtained from an ethics review board (IRB) at Queen's University.

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Appendix A

Semi-Structured Interview Questions

1. What were your general feelings during your navigations?
2. What did you find challenging while over the four sessions?
3. Were there any websites/resources that stood out to you?
4. What was it about these websites/resources that made them stand out?
5. Was there anything missing that you would like to have seen/viewed?
6. Do you feel that you gained information about your literacy program during these sessions?
7. Have you incorporated or do you plan to incorporate any of the information that you found?
8. What other forms of professional learning do you regularly engage in? Would like to engage in?
9. Is there anything else you would like to share about the sessions or the think aloud exercise?

Appendix B

Coding Scheme

Code	Sub-code	Definition
Metacognitive Awareness		*Being aware of one's own thinking and strategy use*
	Diversion	Becoming distracted or confused as a result of a technical or platform issue
	Recounting	Describing web behaviour
	Observing	Noticing web features, tools, or resources
	Recollecting	Returning to familiar websites and resources
	Reflecting	Reflecting on the think aloud and learning process
Monitoring Learning		*Consciously making sense of information and requiring acute attention to personal goals*
	Searching & Filtering	Narrowing one's focus by searching and filtering
	Skimming through	Reading quickly at the surface level, noting relevance and key ideas
	Deep reading	Thoughtful and deliberate reading
	Saving information	Encoding information through bookmarking and note-taking
	Connecting to practice	Actively planning and extending ideas while considering students, current literacy practice and cross-curricular connections; immediate relevance
Evaluating		*Constructing meaning through critical reflection and managing incoming information*
	Source credibility	Awareness and consideration of the source authorship and trustworthiness
	Source accessibility	Considering the platforms efficiency and ease of use
	Source quality	Considering the degree of excellence in relation to familiar high-quality resources
Self-Efficacy		*Confidence in one's ability to complete a task or achieve a goal*
	Goal setting	Referring to a learning goal
	Personalizing	Drawing on personal experiences and feelings, and reflecting on personal teaching philosophy
	Enhancing knowledge	Reflecting on own literacy learning
	Vicarious learning	Increases in confidence for teaching literacy from viewing a demonstration video or teaching resource

Appendix C

List of Actions Used for Time-Sampling Observation Analysis & Frequencies Across Sessions

Main Category	Action	Session 1	Session 2	Session 3
Using web tools/features				
	Enters search term	20	23	33
	Selects interactive feature	3	7	8
	Uses interactive feature	8	19	57
	Selects filter option	31	13	10
Exploring information				
	Opens content page	94	55	74
	Opens page about background info.	18	15	10
	Opens home page	29	29	14
	Opens lesson plan	61	24	23
Viewing and engaging with videos				
	Starts a video	18	21	19
	Views a video	137	204	186
	Stops a video	9	5	7
	Skips in video	10	2	2
Saving information for future retrieval				
	Takes notes	211	239	299
	Saves information	1	19	26
Changing course				
	Opens external link	10	19	36
	Uses back button	50	27	50
	Opens new tab	28	32	50
	Switches tab	199	136	149
	Closes tab	41	25	44