The Impact of Strategy Instruction on Source-Based Writing

by

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ABSTRACT

This study examines the effects of providing persuasive writing and reading comprehension strategy training on source-based essay writing. Strategy training was administered through the use of the Writing Pal and the Interactive Strategy Trainer for Active Reading and Thinking (iSTART). The impact of both individual (writing or reading) and blended strategy training on source-based writing was investigated. A total of 261 participants completed the study; after removing incomplete and second language participants the source-based writing and system performance was assessed for 175 participants ($n_{no\ instruction}$ = 48, n_{iSTART} =41, $n_{Writing\ Pal}$ =41, $n_{blended}$ =45).

Results indicated that participants who received blended strategy training produced higher quality source-based essays than participants who received only reading comprehension, writing strategy training, or no training. Furthermore, participants who received only reading comprehension or writing strategy training did not produce higher quality source-based essays than participants in the no-training control group. Time on task was investigated as a potential explanation for the results. Neither total time on task nor practice time were predictive of group differences on source-based essay scores. Analyses further suggested that the impact of strategy training does not differ as a function of prior abilities; however, training does seem to impact the relation between prior abilities and source-based essay scores. Specifically, prior writing ability was unrelated to performance for those who received writing training (i.e., Writing Pal and blended conditions), and prior reading ability was unrelated to performance for those received the full dosage of iSTART training. Overall, the findings suggest that when taught in conjunction with one another, reading comprehension and writing strategy

training transfers to source-based writing, providing a positive impact on score. Potential changes to the Writing Pal and iSTART to more closely align training with source-based writing are discussed as methods of further increasing the impact of training on source-based writing.

DEDICATION

This dissertation is dedicated to all of those who have made it possible for me to get here. Special thanks to Tara, Lea, and Michael for always believing in me, and telling me frequently. Without your love and support none of this would have been possible.

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To be successful in today's society, individuals need to be literate (Statistics Canada and Organisation for Economic Co-operation and Development, 2005). Literacy skills are essential for an individual to navigate the vast amounts of information they encounter on a daily basis. Literacy skills are used across all aspects of life including texting, sending emails, paying bills, and writing out instructions. Many of the activities needed to fulfill our basic needs require at least a minimal level of literacy. Despite the centrality of literacy to success in life both within everyday activities and academic and work environments (Geiser & Studley, 2001; Kellogg & Raulerson, 2007; Light, 2001; Powell, 2009; Sharp, 2007), an astounding number of adolescents are leaving high school with only a minimal level of proficiency.

The 2011 National Assessment of Educational Progress (NAEP) report revealed that 21% of high school seniors fail to meet basic proficiency standards in writing. Furthermore, an additional 52% only meet the standard for basic proficiency. Of the remaining 27% of students, only 3% score well enough to be considered advanced writers. The 2013 NAEP report on reading indicates that proficiencies in reading follow a similar, albeit slightly more optimistic, trend with 64% of high school seniors scoring at or below basic proficiency (27% below basic, 37% at basic), with 5% of the remaining 36% of students scoring in the advanced proficiency category. These trends have been found across all groups, with the outlook for impoverished, minority, and English language learners even worse (see Table 1 for writing and Table 2 for reading). Steps need to be taken to understand the ways in which students read and write, as well as how to help increase proficiency in ways that will most deeply impact individuals' ability to

succeed. Working toward this objective, the current study focuses primarily on providing means to enhance writing instruction by investigating the impact of strategy instruction on source-based writing. Specifically, this study examines the differential effects of providing students with instruction and practice in comprehension strategies, writing strategies, or a combination of both comprehension and writing strategies.

Table 1. *National Assessment for Educational Progress Writing Results by Demographic Group*

	Below Basic	At Basic	Proficient	Advanced
National (Public)	22	53	22	3
Students qualifying for free or reduced lunch	36	53	11	1
Caucasian	14	53	28	4
African American	40	51	8	0
Hispanic	36	53	10	1
English Language Learners	80	18	1	0

Table 2. *National Assessment for Educational Progress Reading Results by Demographic Group*

	Below Basic	At Basic	Proficient	Advanced
National (Public)	27	37	31	5
Students qualifying for free or reduced lunch	38	40	20	2
Caucasian	17	36	39	7
African American	45	40	14	1
Hispanic	37	40	21	2
English Language Learners	80	18	2	0

Background Literature on Writing

Deficits in writing ability impact not only future academic endeavors, but also future job success. Over 90% of professionals acknowledge that writing is an essential part of their everyday work life (Light, 2001). Furthermore, across disciplines, both job holders and those in charge of hiring and promotion cite writing skills as critical for not only being offered a job, but also for advancement within a given career (National

Commission on Writing, 2003; 2004; Porter, 1997; Sharp, 2007). In addition, writing skills are now commonly assessed for entry into higher education suggesting that remediation should be targeted at high school and early college students (e.g., SAT, GRE).

Educators and educational policy espouse the importance of writing; however, little has been done to improve instruction in writing. In 2011, the Framework for Success in Postsecondary Writing (FSPW) was released as a joint effort by teachers and administrators to increase preparedness of students entering higher education. This framework stresses the importance of rhetorical knowledge, critical thinking, knowledge of both the writing process and the conventions of writing, along with the ability to write texts for a variety of purposes. This framework also provides methods for teachers to nurture improved writing skills and habits in their students. However, large class sizes and standardized testing increases (National Commission on Writing, 2003) have made it increasingly difficult for educators to adequately train students in writing. Writing itself takes time, as does the assessment of each piece of writing. Many teachers are overtaxed with both instructional requirements and grading. Furthermore, many teachers do not feel like they have the training necessary to teach writing (Leki, 1990; Reid, 1994; Susser, 1994; Winer, 1992). Given the lack of training and support teachers receive, in the teaching of writing it is important that researchers understand how to impact writing proficiency.

Impacting an individual's writing skills is easier said than done as writing is a complex cognitive task encompassing many different processes (Abbott & Berninger, 1993; Berninger & Swanson, 1994; Flower & Hayes, 1981; Hayes, 1996). Impacting

writing proficiency is further complicated by the degree to which reading and writing skills are interconnected (Berninger, Abbott, Abbott, Graham, & Richards, 2002; Corden, 2007; Couzijn, 1999; Parodi, 2007; Shanahan, 1984; Shanahan & Lomax, 1986). Disentangling these skills at higher levels is virtually impossible, making it difficult to obtain measures that solely tap writing skills. For example, most writing tasks completed in school are based on an assignment or prompt that the writer has to read and understand to be able to complete. When considering writing, it is imperative that a wide range of factors that impact an individual's ability to write are considered. Many models of writing exist; however, the model of writing postulated by Flower and Hayes (1981) stands out due to the treatment of writing as a dynamic process and the inclusion of additional factors affecting the writing process. This model has withstood years of empirical testing and is widely considered to be one of the most influential models of writing.

Unlike prior models, the model proposed by Flower and Hayes (1981; Hayes, 1996; 2006; Hayes & Flower, 1980) was a process model with processes hierarchically structured and the assertion that the stages of writing are not discrete as previously postulated (cf. Britton, Burgess, Martin, McLeod, & Rosen, 1975; Roham, 1965). One important aspect of the Flower and Hayes model is that it views writing as a dynamic process with writers constantly moving from one stage to another and back again. The Flower and Hayes model differentiates the writing process as three independent processes: planning, translating, and reviewing. The planning process includes the generation of ideas as well as the act of organizing ideas and setting goals for writing. Translation involves the actual act of transforming ideas into written language.

Reviewing involves both the evaluation and the revision of a piece of writing. While completing these processes, writers continually monitor both what they are doing and progress toward their overall goal. This monitoring process allows writers to decide when to switch from one part of the writing process to another.

In addition to viewing writing as a process, Flower and Hayes (1981) acknowledged the impact of both the task environment and characteristics of the writer on writing. The task environment includes the actual writing task (topic, audience, etc.) and the body of text that the individual has produced up to that time. The model also takes into account characteristics of the individual including prior knowledge and skills. Another key feature of this model is that each of the processes involved with writing (planning, translating, and reviewing) are influenced by and influence other components of the writing task. Later revisions of this model included cognitive skills, motivation, working memory, and affective components (Hayes, 1996; 2006).

The focus on strategic and metacognitive skills found in the Flower and Hayes model (1981; Hayes, 1996; Hayes & Flower, 1980) is unique when compared to other contemporary models (stage models of writing; Britton et al., 1975; Roham, 1965). This focus on skills such as strategy usage is integral because research has found that the use of strategies can impact performance on writing tasks. Furthermore, strategy usage is a teachable skill that writers can utilize across multiple types of writing. Prior research suggests that the use of strategies reduces demands on working memory and activates prior knowledge (Ericsson & Kintsch, 1995; Kellogg, 2001; McNamara & Scott, 2001), thus aiding writers in completing their task. Strategies help students to enact the steps necessary to produce a successful written product. Writing strategies can focus on any of

the three different phases of writing (i.e., prewriting, drafting, and revision) and are taught and used both independently and in the context of a complete written product. Writing strategies as discussed here are defined as actions and behaviors that writers consciously perform in an effort in improve their writing and to aid in their completion of the task (Petric & Czarl, 2003).

Components important to writing. There are many components important to the writing process. These components include, or support the aforementioned processes important to writing. Components include both strategies and aspects of the individual known to impact writing performance. Critical components focused on by researchers have included: self-regulatory strategies, prewriting, drafting, revising, self-efficacy, motivation, and prior knowledge. The following sections discuss each of these components.

Self-regulatory strategies. Self-regulation is a metacognitive strategy that refers to a set of cognitive, behavioral, and motivational strategies that individuals utilize to set, assess progress on, and achieve goals (Graham & Harris, 2000; Zimmerman & Risemberg, 1997). Self-regulatory behaviors are applicable to all aspects of the writing process, and can include behaviors as simple as choosing a quiet environment for writing, and as complex as self-evaluation of progress. The knowledge of and use of self-regulatory strategies develops over time, becoming increasingly sophisticated with proficiency and as individuals learn the appropriate application of strategies (Kuhn, 2000; Pressley, Wharton-McDonald, Mistretta-Hampston, & Echevarria, 1998). Self-regulatory strategies are essential as they allow writers to manage and coordinate the many processes involved in successfully completing a written product. Furthermore, research

suggests that more proficient writers utilize a wider range of self-regulatory strategies than novice writers (Zimmerman & Risemberg, 1997).

Self-regulation is a central component of the Flower and Hayes (1981) model of writing. The monitoring function in the Flower and Hayes model (1981) can be thought of as a self-regulatory process. Monitoring helps writers to assess progress towards goals and task switch both within and between the writing processes. For example, when given a topic, successful writers begin by brainstorming ideas. Once ideas have been generated, many writers begin the process of planning the structure of their writing. At some point during the planning process, writers may realize that they need additional evidence, compelling them to transition back to brainstorming. In sum, writers use self-regulatory strategies to assess their writing and make decisions about transitions between the writing processes.

Prewriting. Prewriting activities are essential to successful writing (Flower & Hayes, 1980; Spivey & King, 1989). Prewriting encompasses both idea generation (brainstorming) and idea organization (planning). These processes can build upon on another but can also be completed independently of each other as they target different aspects of the writing process. Brainstorming targets the initial generation of ideas. In contrast, planning involves the creation of a plan to develop ideas that have already been generated. Brainstorming can be considered the process of initial idea generation, whereas planning is the process of idea organization and setting goals for an essay. It is during the planning process that many ideas are initially elaborated to include brief examples and evidence. In essence, the planning process not only provides the structure

for how an essay will be constructed, it also indicates to the writer where knowledge gaps lie and where additional brainstorming may be necessary.

Prewriting skills have been the subject of numerous research studies. The results regarding the relationship between prewriting behaviors and performance suggest that struggling writers lack prewriting skills (Cameron & Moshenko, 1996; Graham & Harris, 2000). Skilled writers, by contrast, spend a large amount of time on prewriting activities (Flower & Hayes, 1980; Graham & Perin, 2007; Kellogg, 1987). It is important to note that these studies have primarily relied on self-report measures and non-timed writing assignments. Planning behaviors for timed or high-stakes writing may differ in systematic ways that impact writing. That being said, better writers are more likely to engage in planning activities, particularly when given the opportunity and ample time.

Drafting. Drafting can be defined as the writing of the necessary components of an essay: the introduction, body, and conclusion paragraphs; this includes the act of writing that Flower and Hayes (1981) refer to as the translation process. The drafting process presents multiple challenges to the writer because different types of paragraphs must be written differently from one another based on the purpose of that paragraph. Although the style and content of paragraphs vary based on the type and scope of the writing, each paragraph type is designed to fulfill a specific purpose. The purpose of an introduction is to "hook" readers' interest and compel them to read more. In addition, it is expected that an introduction will contain a thesis statement and a preview of the following text. Conclusion paragraphs are equally important; they summarize the details of the essay in a concise fashion and link the arguments back to the thesis statement. Regardless of the scope of the essay, quality writing necessitates that an introductory and

concluding paragraph be included. The necessary elements of introduction and conclusion paragraphs render them challenging for novice writers to compose (Henry & Roseberry, 1997). Fortunately, the defined purposes of these paragraphs allow for more formulaic writing and lend themselves to the application of strategies. Learning to effectively write introduction and conclusion paragraphs is important as these paragraphs aid readers in understanding and retaining information they read in the entire essay (Lorch & Lorch, 1995).

In persuasive writing, writers use body paragraphs to present their arguments to the reader. Like introduction and conclusion paragraphs, these paragraphs have a defined purpose, the presentation of arguments; however, body paragraphs vary widely in their scope and composition. Body paragraphs rely on the structure created in the introduction, explaining and elaborating the central argument presented in the thesis statement (McCarthy, Renner, Duncan, Duran, Lightman, & McNamara, 2008). Each paragraph serves as a virtual mini-essay; to be successful these paragraphs must contain a topic sentence (similar to an introduction paragraph), evidence sentences (the body paragraphs), and a concluding sentence (similar to the conclusion paragraph). The assessment of body paragraphs is based on both the quality of the writing and the quality of the arguments and evidence provided (Crossley, Dempsey, & McNamara, 2011). For this reason, strategies targeting body paragraphs focus on both the actual writing of the body paragraph (topic sentences, and concluding sentences), and the development of strong arguments supported by appropriate evidence.

***Revision*.** Revising is perhaps the most important stage of the writing process. The understanding that writing is an iterative process is of utmost importance to development

as a writer. Traditionally, revision is considered as being completed after finishing a first draft of written work, although word processing software have rendered this process more continuous (Faigley & Witte, 1981; Sommers, 1980) and online and thus in alignment with the Flower and Hayes model (1980). Regardless of when revision occurs, revision is the process during which the writer reviews their writing with the intended goal of improving what they wrote (Hayes & Flower, 1980). In addition to improving text, another goal of revising is to ensure that any goals or criteria set for the writing have been met. Few writers, if any, produce flawless written works with the first draft; this being said, learning to use revision is of key importance for the development of competent writers.

Although cohesion is not necessarily a revision strategy, cohesion is generally assessed and fixed during the revision stage of writing. Cohesion refers to the aspects of the text that aid the reader in understanding and following the text (Graesser, McNamara, Louwerse, &Cai, 2004). Cohesion can be added to a text in a variety of ways, including but not limited to inserting connecting words or phrases, ensuring that all referents are defined, and by adding transitions between paragraphs. Cohesion is important for effective communication to the reader; thus, adding cohesion is to the benefit of the writer as well as the reader.

Self-Efficacy. Self-efficacy refers to an individual's view of one's own ability. A high level of self-efficacy for a task is reflective of the belief that a task can be successfully completed. Self-efficacy, regardless of skill level, influences how students use the strategies and skills they possess. Pajares (2003) reviews the expansive literature on self-efficacy and writing, noting that the research consistently suggests that self-

efficacy is predictive of writing performance, regardless of the inclusion of other related constructs. Research suggests that self-efficacy directly affects writing performance, and indirectly effects performance by impacting and mediating the effects of other important factors that account for writing including prior knowledge, strategy usage, writing apprehension, perceived value, and self-regulatory behaviors. Many researchers have tried to influence self-efficacy with limited success, though some promising work by Schunk and Swartz (1993) suggests that the combination of teaching students to use goals and giving them feedback can improve both self-efficacy and writing achievement. Considering the integral relationship between self-efficacy and achievement, it is understandable why self-efficacy is considered an important component of effective writing.

Bandura (1986; 2012) argues that self-efficacy judgments are task specific and that no general self-efficacy exists. This notion has been supported through the analysis of many studies that have reported mixed impacts of self-efficacy on performance (Bandura, 2012). Researchers who utilized self-efficacy measures that were closely aligned with the tasks of interest found a relationship while those whose measures did not directly relate to outcome measures found little to no relationship between self-efficacy and performance. One exception seems to be the literature on academic self-efficacy (Schunk & Pajares, 2002). The research on academic self-efficacy that has yielded positive relationships between self-efficacy and general academic performance seem to center on literacy (Schunk & Pajares, 2002).

Motivation. Motivation, or the process by which internal and external factors influence an individual to begin and sustain goal oriented behavior, has long been known

to impact performance across domains (Bandura, 1986; Wigfield, 1994). Factors that motivate behavior include but are not limited to: prior experiences with the task, task analysis (including task difficulty), internal and external incentives, expectations, arousal, self-efficacy, and interest (Schunk, Pintrich, & Meece, 2008; Wigfield, 1994). When considering motivation, it is important to differentiate between intrinsic and extrinsic motivation. Intrinsic motivators and motivation tend to have more stable influences on performance whereas extrinsic motivation is dependent on the extrinsic motivator. Many theories of motivation exist (e.g., Expectancy value theory; Wigfield & Eccles, 2000; goal theory; Linnenbrink & Pintrich, 2003), the most comprehensive theory available is Bandura's (1986) social cognitive theory of motivation.

Social cognitive theory accounts for expectancies, goals, and self-efficacy. Social cognitive theory is based on the relationship between individual, behavioral, and environmental factors. Motivation facilitates learning and is thought to be necessary for performance. Motivation in social cognitive theory is goal directed with the main motivational processes being self-efficacy and goals. Self-efficacy impacts choice of behaviors, effort and persistence. Self-efficacy is hypothesized to be a mediating mechanism, mediating the influences of self-efficacy on performance through a variety of mechanisms (Bandura, 2012). The role of self-efficacy in social cognitive theory has been supported by a vast body of research (e.g., Bandura & Schunk, 1981; Bong, 2001; Karsen, Mitra, & Schmidt, 2012). It is important to note that though self-efficacy is considered a component of motivation by this model, both self-efficacy and motivation have been found to exert a unique effects on performance (Pajares & Johnson, 1996).

Prior knowledge. Prior knowledge is one of the strongest predictors of writing performance (McCutchen, 1986; Pajares, 2003; Pajares & Johnson, 1994, 1996). For writing, prior knowledge includes knowledge of the writing process along with content knowledge for an assignment (Graham, Harris, & Mason, 2005). Both aspects are important to performance because, regardless of an individual's knowledge of the writing process, lack of familiarity with the targeted topic affects performance. Prior knowledge also includes prior experiences with a task. These prior experiences impact performance by impacting self-efficacy, motivation, interest, emotions, and attitudes (Bandura, 1986). Prior knowledge updates as new experiences are accrued, and research suggests that practice with a task (increasing prior knowledge with a task) has a positive effect on performance (Britner & Pajares, 2006). The relationship between self-efficacy and prior knowledge is cyclical. Prior experience impacts self-efficacy (Bandura, 1986), and in turn, self-efficacy impacts the application of prior knowledge (e.g., strategy knowledge; Pajares & Johnson, 1996), which draws on prior experience. As such, it is important that individuals are provided with ample practice to foster prior knowledge.

The Writing Pal

The Writing Pal is an intelligent tutoring system designed to teach writing strategies and provide writing practice to students. Intelligent tutoring systems (ITSs) are computer based systems designed to provide instruction and practice for a given topic or domain. Intelligent tutoring systems are widely available for topics such as mathematics and physics, however few exist that target literacy skills. A disproportionate number of ITSs are designed for mathematics based domains due to the nature of these domains. Domains such as mathematics are generally considered well-defined domains, meaning

that they operate using a rule based system, which usually leads to one predefined correct way to complete a problem and a single correct answer. In contrast, writing is an ill-defined domain. There are many ways to successfully write an essay along with varied responses that can yield "correct" answers. For example, there is only one correct answer to 2 + 2; by contrast, writers can identify multiple (valid) arguments to address the question should cell phones be allowed while driving. Ill-defined domains present a unique challenge to researchers; no longer is there a correct answer, or even a correct path to that response. However, researchers in ill-defined domains are able to utilize ITSs to target skills known to be beneficial to those domains. Furthermore, advancements in technology have facilitated providing practice and feedback within ill-defined domains.

The Writing Pal was developed based on both existing research on writing strategies and composition curriculum. The Writing Pal was specifically designed to target the writing of persuasive essays; like those found on many standardized tests (Roscoe & McNamara, 2013). The Writing-Pal provides explicit strategy training situated within the overall process of writing. The Writing-Pal covers strategies across the writing process with specific modules on freewriting, planning, introduction building, body building, conclusion building, cohesion building, and revision. Each module comprises multiple videos covering strategies specific to the targeted stage of writing along with congruent game based practice (for complete listing of topics covered in The Writing-Pal see Appendix A). The videos use animated agents to deliver 5 to 10 minute lessons targeting a specific strategy or concept. In addition to instruction and game-based practice, The Writing-Pal also affords users the opportunity to practice writing persuasive essays and receive immediate feedback on these essays. The Writing Pal essay practice

component utilizes Automated Writing Evaluation (AWE, McNamara, Roscoe, Allen, & Dai, 2015) to provide both a holistic score and substantive feedback.

The Writing Pal covers the entire writing process from idea generation through revision; however, it is designed to be modular, allowing educators and researchers to utilize only the modules they deem necessary. This feature allows educators to target skills they believe their students may be lacking. The studies in this dissertation utilize the modular aspect of the Writing-Pal system to provide instruction and practice to users.

The impact of the Writing-Pal instruction on writers has generally been positive. Roscoe, Brandon, Snow, and McNamara (2014) reported that students who utilized the Writing-Pal were more likely to learn new strategies compared to a writing-only control group. Furthermore, an increase in essay scores has been observed with users of the Writing-Pal (Roscoe, Allen, Cai, Weston, Crossley, & McNamara, 2011). Writing improvements were found not only for those interacting with the full system but also for those who participated in repeated essay practice for which they received feedback from the system. Furthermore, the game based practice available in the Writing Pal has been shown to be engaging for students, a key factor in persistence (Roscoe et al., 2013).

Source-based Writing

The goal of this study is to understand the impact of different types of strategy instruction on source-based essay writing. A wide variety of written tasks can be considered source-based writing tasks, including summaries, reaction papers, syntheses, lab reports, argumentative papers, research papers, and even essay exam questions. Source-based writing differs from experience-based writing because it requires writers to synthesize information from text to produce a response to a prompt. As such, source-

based writing tasks rely on proficiency in both writing and reading. The NAEP (2013; see Table 2) results for reading indicate that although students perform better on reading than writing assessments, many students fail to attain proficiency prior to graduation. Considering this overall lack of literacy proficiency, it is understandable why writers struggle with source-based writing. This lack of proficiency in literacy skills also results in the question: are writers struggling due to their lack of proficiency in writing, reading, or both? Furthermore, what kind of strategy instruction (reading, writing, or both) is most beneficial to building students' competence in completing source-based writing tasks? As the goal of many writing tasks (within both academia and the work place) is to synthesize and communicate information, it is important to investigate what can be done to aid struggling writers in the acquisition and application of the skills necessary to be successful with source-based writing.

As students' progress through their education, they are provided many opportunities to practice writing both in their composition and content classes. However, the writing completed in content classes differs in systematic ways from writing completed in composition classes (Braine, 1995; Eblan, 1983). Unlike writing completed in composition classes, writing in content classes is almost always based on readings or other kinds of source material. Additionally, source-based writing assignments are judged not only on the quality of the writing but also the accuracy of the information included. To be successful at source-based writing, the writer needs to not only be able to produce quality writing but also to be able to read and understand the sources provided. Given the strong coupling of reading and writing, the goal of this study is to examine the degree to which there are differential benefits to training writers in reading or writing, or both. This

experiment specifically focuses on timed source-based writing when the sources are provided during the testing period.

The understanding of multiple documents and the evaluation of source material has been investigated by researchers (e.g., Britt, & Aglinskas, 2002; Rouet, Britt, Mason, & Perfetti, 1996; Wineburg, 1991), unfortunately, few researchers have directly investigated source-based essay writing. Furthermore, studies of comprehension from multiple texts usually focus on topics that require prior knowledge and are situated in a temporal nature (e.g., history). Those that have examined source-based writing, even short-answer questions, have focused on the proximity of the content to the sources or on the selection of source materials (Britt &Aglinskas, 2002; Foltz, Britt, & Perfetti, 1996; Rouet, Britt, Mason, & Perfetti, 1996). Even those studies that have evaluated the quality of the essays tend to either use non-traditional metrics focused on the sources (e.g., overlap between source material and written answers; Foltz, Britt, & Perfetti, 1996), or do not adequately describe the criteria for quality (Britt & Aglinskas, 2002

Few studies have examined the effects of instruction or training on students' ability to utilize source material (Britt & Aglinskas, 2002; Foltz, Britt, & Perfetti, 1996). Those that have done so have focused on the effects of training related to sourcing (i.e., students' ability to evaluate source material and select relevant information to respond to questions; Britt & Aglinskas, 2002; Foltz, Britt, & Perfetti, 1996; Rouet, Britt, Mason, & Perfetti, 1996 and have not targeted problems learners may experience with the comprehension of the sources or the processes involved in the writing of essays or short-answer questions. The skills necessary to evaluate and select source material are important; however, these skills are likely to be of little help to those struggling with

basic comprehension and writing processes. Because the present study focuses on students' ability to compose higher quality source-based writing and because the sources are provided to writers (i.e., they do not chose the sources), there is little overlap between this study and existing research on the use of multiple documents.

Writing and reading are both exercises in the construction of meaning or understanding. When writers produce text they communicate (or construct) meaning; whereas readers construct meaning through their interpretation of text (Spivey, 1990). These goals are inherently intertwined when considering source-based writing, and as such, the processes underlying both writing and reading must be considered. Like writing, reading is a complex cognitive process that necessitates taking into account many of the same aspects of the individual and tasks that impact writing. Prior research suggests that more skilled readers connect ideas with prior knowledge and explain both ideas and the connection between ideas to construct a coherent representation of text (Chi et. al, 1989; Magliano & Millis, 2003). In contrast, less skilled readers tend to rely on paraphrasing and direct quotations from text (Magliano & Millis, 2003; O'Reilly & McNamara, 2007). These findings suggest that to be able to effectively communicate information from text it may be beneficial to train writers to become better readers.

iSTART-ME.

iSTART is an intelligent tutoring system that was developed to improve the reading comprehension skills of struggling readers. The iSTART system is designed following the Construction-Integration (C-I; Kintsch, 1988) model of reading. The C-I model represents reading as a network that takes into account both features of the text and prior knowledge. This model relies on three levels of representation: surface

structure, propositional text base, and the situation model. The surface structure is comprised of the words and the syntactic structure of text. The propositional structure represents the underlying meaning of the text. The situation model goes beyond the text and includes information that is not explicit in the text.

To construct a coherent mental representation of text, readers need to actively process and integrate concepts from the text and prior knowledge (Graesser, Singer, & Trabasso, 1994). The association of the current text with other texts or prior knowledge is crucial to developing a coherent understanding (McNamara, Ozuru, Best, & O'Reilly, 2007). Many readers struggle to comprehend texts at deep levels for a variety of reasons; some may struggle with basic reading skills, whereas others may struggle due to unfamiliarity with the domain. The instruction in and use of strategies has been found to help readers comprehend text.

One type of comprehension strategy, self-explanation, or the process of explaining the text to oneself, has been found to be particularly helpful to struggling readers (McNamara, 2004). Self-explanation requires readers to actively engage with the text resulting in deeper processing. Unfortunately, few individuals spontaneously self-explain, and those who do self-explain poorly (McNamara, Levinstein, & Boonthum, 2004). Hence SERT (Self-explanation reading training; McNamara, 2004; McNamara & Scott, 1999) was created to train and provide practice in comprehension strategies to support the process of self-explanation. Training students in comprehension strategies has been found to enhance students' ability to generate inferences from the text, construct coherent mental models, and develop a deeper understanding of the concepts covered in the text (McNamara, 2004; McNamara et al, 2006, 2007). SERT was found to be

effective for increasing both comprehension and exam scores (McNamara, 2004; McNamara & Scott, 1999) and was developed into the intelligent tutoring system iSTART.

SERT and iSTART are based around the teaching of five comprehension strategies: comprehension monitoring, paraphrasing, prediction, bridging, and elaboration (McNamara, 2004). Comprehension monitoring, individuals' awareness of their understanding of text underlies all of the other strategies. Recognizing a lack of understanding can lead to the use of additional reading strategies (McNamara, Levinstein, & Boonthum, 2004). Paraphrasing helps readers to gauge their understanding of the text by requiring them to restate the text in their own words. The prediction strategy is used to anticipate what is coming in the text and can be used to remind the reader to attend to key concepts. Comprehension strategies also foster inference making through the use of bridging. When learning about the bridging strategy, learners are taught to link the content between sentences or paragraphs. Students are also taught to connect what they are reading to their prior knowledge using the strategy of elaboration. The iSTART system has been rigorously tested (e.g., Jackson, Boonthum, & McNamara, 2009; 2010; Jackson, Boonthum-Denecke, & McNamara, 2012; McNamara et al., 2006, 2007) and the current version of iSTART-ME includes a redesigned interface and a suite of educational games to foster engagement and persistence during training (Jackson, Boonthum-Denecke, & McNamara, 2012; Jackson, Dempsey, & McNamara, 2012; Snow, Allen, Jacovina, & McNamara, 2015; Snow, Jackson, Varner, & McNamara, 2013a, 2013b).

iSTART-ME includes instructional videos, a demonstration module, coached practice module, and a suite of both generative and identification games. The

instructional videos in iSTART-ME use animated agents to teach self-explanation and comprehension strategies. The demonstration module allows the user to see the self-explanation strategies applied to a real text. Then, in coached practice users are guided through a text and prompted to self-explain target sentences. Students receive feedback (see Appendix B) and coaching from an animated agent after each self-explanation. Self-explanations are rated on a 0-3 scale, with students earning points and iBucks for higher scoring self-explanations to use in other areas of the system. As a student earns points various games and features are unlocked in the system. Students can earn points and iBucks by completing any type of practice but pay iBucks to play identification games. iSTART-ME also includes personalizable features where users can pay iBucks to change the avatar and screen color.

Self-explaining in iSTART may provide additional benefits beyond the process of self-explanation. The act of writing about what you read can aid in the learning of new information (Hebert, Gillespie, & Graham, 2013; Newell, 2007). Prompting readers to write about what they have read impacts understanding by fostering explicit knowledge and the construction of relationships between ideas, allowing readers to compare what they've written to other sources and as a result altering their knowledge of the topic. However, there are important distinctions between iSTART and *writing to learn*. While self-explanation can be considered a strategy related to writing to learn, that is not the focus of iSTART per se. The focus of iSTART is on providing students with instruction and training on comprehension strategies, and self-explanation is the vehicle for doing so. Notably, iSTART was developed because less skilled readers and low knowledge readers do not benefit from the process of self-explanation (Chi, Bassok, Lewis, Reimann, &

Glaser, 1989; Chi, de Leeus, Chiu, & LaVancher, 1994; McNamara, 2004). In contrast to approaches focusing on having students write about what they are reading, iSTART focusses on the benefits of providing instruction and practice on using effective comprehension strategies. For example, many of the studies that have investigated the benefits of iSTART have compared the benefits of self-explanation for students who have received training and those who have not (e.g., McNamara, 2004) or have examined students' comprehension of challenging text with and without having received iSTART training, but without prompting students to self-explain (e.g., McNamara et al., 2006). Hence, the focus of iSTART is not on writing to learn, but rather on learning strategies that enhance comprehension. These strategies are intended to generalize beyond the context of training to students' comprehension, as well as to performance in their courses, such as exam grades (McNamara, in press; McNamara et al., 2007).

Transfer

An important aspect of this study is that it examines the transfer of training in comprehension (iSTART) and writing persuasive essays (Writing Pal) to a task that is not specifically practiced, source-based writing. This study assesses the transfer of the skills learned in iSTART and the Writing Pal to a novel problem, source-based writing. It might be argued that the skills taught in the Writing Pal directly transfer to other writing tasks, however, research suggests that practice within AWE systems such as the Writing Pal may not transfer to writing completed outside of the AWE environment (Stevenson & Phakiti, 2013). The Writing Pal provides instruction in addition to generative practice; however, the instruction is explicitly situated within the task of timed experience-based persuasive writing. Nonetheless, as source-based writing requires both reading and

writing, and as the Writing Pal and iSTART target basic skills in these domains, the skills taught in training are expected to have the potential to transfer to the more complex task of source-based writing.

Overview of Study

One way of examining the differential importance of reading and writing to source-based essay writing is to provide instruction on one, the other, or both. To do so in this study, the Writing Pal and iSTART are used to provide instruction to participants. The Writing Pal and iSTART are intelligent tutoring systems that increase proficiency in writing and reading (respectively) by instructing users in strategy usage and provide a platform to practice those strategies. One goal of this study is to begin to understand the differential impact each type of strategy instruction may have on source-based writing. Furthermore, this study investigates the extent to which the impact of type of strategy instruction varies as a function of prior reading and writing abilities. The following sections discuss in more detail the components of Writing Pal and iSTART that will be utilized in the present experiment.

Writing Pal

In source-based writing, writers communicate their understanding of source material through writing. If writers experience difficulties with basic writing, fostering their understanding of the text may have no impact on the quality of source-based writing. Assessments of source-based writing center on content; however, poorly written essays are generally rated lower in quality than are well written essays regardless of content. Therefore, scoring highly on source-based writing assignments requires writers

to effectively balance the demands of both reading and writing. Those who have particular weaknesses in basic writing skills are likely to benefit from writing instruction.

In this study, writing instruction is provided via the Writing Pal. The Writing Pal is consists of nine modules (see Appendix A for overview of lesson content) that cover the entire writing process from planning through revision. Each module contains instructional videos along with game-based practice. The strategy lessons in the Writing Pal vary in length from 5 to 10 minutes and feature one of three animated agents discussing the target strategy. The content of these videos was developed collaboratively with educators, content experts, and researchers. The game-based practice includes both generative and identification games designed to enhance student motivation and persistence in the Writing Pal (Roscoe et al., 2013).

As the Writing Pal was designed to teach strategies for SAT-style argumentative essays, not all of the lesson videos and games are applicable to source-based writing. The modular aspect of the Writing Pal affords picking and choosing videos and games based on the nature of the task. A total of nine videos and three games from four different modules were selected for inclusion in this study (see Appendix C for an overview of the content of the selected videos). Strategy training in this study targets planning, introduction, body, and conclusion paragraphs. Specifically, this study includes lessons covering the topics of: *Positions, Arguments, and Evidence* (planning), *Thesis Statements* (introductions), *Argument Previews* (introductions), *Topic Sentences* (body paragraphs), *Evidence Sentences* (body paragraphs), *Strengthening Evidence* (body paragraphs), *Conclusion Building* (conclusions), and *Summarizing* (conclusions). Two generative

games (*RoBoCo* and *Lockdown*) and one identification game (*Planning Passage*) were also selected to be included in this study.

The strategy lessons selected to be used in this study are lessons expected to be applicable to source-based writing, and are framed in a way that makes them applicable to essentially any kind of writing. When writing a source-based essay it is crucial that the writer selects appropriate evidence from the sources. For this reason, the majority of the lessons discuss evidence in some fashion. Strong introduction and conclusion paragraphs are also critical to any successful essay; as such, lessons targeting critical parts of these paragraphs were used.

The use of the game-based practice available in the Writing Pal has been shown to enhance strategy acquisition, engagement, and motivation (Allen, Crossley, Snow, & McNamara, 2014). The range of games appropriate for the present study was limited because many of the games rely on the player having seen all of the lessons in the module. One identification and two generative games were selected for this study from three different modules, Planning, Body Building, and Conclusion Building. Planning passage is an identification game wherein players identify the appropriate arguments for a position, and the appropriate evidence to support an argument. The two generative games used in this study were RoBoCo and Lockdown; these games require the player to construct responses in natural language. In RoBoCo, the player builds robots by writing topic and evidence sentences given a thesis statement. In Lockdown, players are asked to write a conclusion paragraph based on an outline; a high quality conclusion paragraph serves to stop computer hackers.

iSTART

To be successful in source-based writing, writers need to communicate their understanding of source material. However, if writers experience difficulties with basic reading, fostering their writing abilities may have no impact on the quality of source-based writing. A well written essay that is off topic, or does not communicate an understanding of source material will receive a lower score than an essay that is less well written but on topic (See Rubric in Appendices D and E). Successful source-based writing requires that individuals build a mental representation of the meaning of the texts they are provided (Flower & Hayes, 1984; Kintsch & van Dijk, 1978; Witte, 1985). To build these mental representations of text, individuals must be able to comprehend the text. More coherent mental representations (i.e., the situation model) result in more sophisticated application of the source materials to the question, such as linking sources to each other as opposed to summarizing each source individually.

For the present experiment, participants watched all seven instructional videos (i.e., five targeting specific strategies, along with an overview and summary video), the demonstration video, completed a text in coached practice, and had access to the suite of games. iSTART was designed to aid students in reading science texts; however, the strategies taught are applicable to any kind of text. All of the games targeting the application or identification of self-explanation strategies were available to participants in this study. Because the available games target all of the self-explanation strategies, participants were given the ability to choose which games they completed.

Because iSTART instruction requires less time than the Writing Pal to complete, and all lesson videos are applicable to understanding source materials, participants in the

present study viewed all of the lesson videos along with the demonstration video. Participants who spent their full training time in iSTART then split their time between coached practice and free choice within the environment (access to coached practice and games). As practice is necessary to develop proficiency in self-explanation, participants in the blended condition who split time between iSTART and the Writing Pal were required to complete at least one text in coached practice.

Experiment

This experiment investigates the impact of strategy instruction on source-based essay writing. To this end, participants were randomly assigned to one of four groups: a no instruction control group, , iSTART only, Writing Pal only, or blended instruction (both iSTART and Writing Pal training). The study included two sessions. The first session comprised a pretest assessing initial reading and writing ability, as well as strategy training for experimental conditions. During the second session, participants completed a timed source-based writing task.

The impact of strategy instruction might be expected to differ as a function of prior ability. That is, if writers struggle with basic writing, the quality of their source-based essay should improve with writing strategy instruction. By contrast, if writers struggle more with basic reading skills, the quality of their source-based essay should be higher if they are provided reading strategy instruction. However, reading and writing ability are highly correlated. As such, it may prove challenging to tease apart the differential effects of strategy training as a function of individual differences in reading or writing. In that case, source-based writing might be expected to benefit from a

combination of writing and reading strategy instruction regardless of individual differences in reading or writing.

Method

Participants

Participants included 261 undergraduate Psychology students from Arizona State University who participated for credit in their Psychology 101 course. A total of 251 participants completed both sessions of the two-session experiment. Ten participants did not complete the study. Participants were randomly assigned to one of four groups; Writing-Pal only (n=64), iSTART only (n=64), Blended instruction (n= 65), and Control (n=63). Of those participants who experienced both iSTART and Writing-Pal, 32 participants experienced iSTART first, the remaining participants in this group interacted with the Writing Pal first. Of the 260 participants, demographic data is only available for 233 due to an experimenter error and reliance on participants to have completed the demographic survey used to prescreen Psychology 101 students.

Participants ranged in age from 17 to 43 with a mean age of 19.7 years (SD = 3.1). Half of participants were freshmen (50%). Participants reported a number of ethnic backgrounds with the majority being Caucasian (54%), Hispanic (15%), or Asian (18%) decent. Over 75% of the participants reported English as their first language, of the 25% that did not, 32% reported Chinese, 18% reported Spanish, 11% reported Arabic, and 9% reported Korean as their first language. The majority of English language learners participating in this study reported having studied English for 7 or more years (73%). Although a 12^{th} grade level of English proficiency was listed as necessary to participate

in this experiment, the data from L2 participants analyzed to assess the appropriateness of combining the data from L1 and L2 participants.

Measures

Prior writing ability. Prior writing ability was assessed using a 25-minute SAT-style essay that participants completed prior to training. This essay was completed using Qualtrics and participants received no feedback regarding the quality of their essay. The essay was automatically submitted after 25 minutes and participants were not able to submit the essay early. The prompts utilized to assess prior writing ability are SAT style persuasive essay prompts (obtained from onlinmathlearning.com, see Appendix F). These prompts are from retired SAT exams and have been minimally edited to increase clarity.

The essay was scored using an algorithm currently utilized in the Writing Pal for college-level students. This algorithm was developed based on expert ratings of similar essays and scores each essay on a 1 to 6 scale (similar to the SAT rating scale). Accuracy of the AWE system utilized by the Writing Pal has been found to be equivalent to expert accuracy (44-55% exact and 94-96% adjacent accuracy; McNamara et al., 2015).

Prior Reading Ability. Prior reading ability was assessed using the Gates-MacGinitie Reading Test (GMRT; MacGinite & MacGinitie, 1989). The GMRT is comprised of 48 multiple-choice questions about 11 unique passages. Participants were given 20-minutes to complete the GMRT after which they were automatically moved onto another task. Each item was scored correct/incorrect (1/0) to produce a numerical score out of 48.

Self-efficacy and motivation. Participants completed measures of both self-efficacy and motivation during both sessions of this experiment. Participants completed

the Writing Skills Self-Efficacy Scale (WS3, see Appendix G) along with reading self-efficacy and task specific self-efficacy items. Assessments of general motivation were at the beginning of each experimental session (I am motivated to participate; I plan on doing my best).

Writing Skills Self-Efficacy Scale. The Writing Skills Self-efficacy Scale (WS3) was designed for this experiment to assess general self-efficacy towards writing activities. The 31 items included in this measure are specific to tasks completed during the writing process, but general enough to be able to apply to multiple kinds of writing tasks. Participants respond on a 0-100 scale, indicating how confident they are that they can successfully complete a given task. The WS3 contains four subscales targeting the different phases of the writing process: general writing, prewriting, drafting, and revising. The general writing subscale contains items targeting individuals' beliefs about their ability to communicate effectively in writing. The prewriting subscale targets idea generation, drafting targets the utilization of fact-based evidence. The revising scale targets an individual's beliefs about their ability to identify, and fix problems in their writing as well as their ability to fix problems that are identified for them.

Reading self-efficacy. Reading self-efficacy items (see Appendix H) target individuals' beliefs regarding their ability to understand text. Items cover understanding of texts of various genres along with the ability to synthesize information across texts. The items also target self-explanation strategies such as paraphrasing, bridging, and elaboration.

Task specific self-efficacy. In line with Bandura (2006), general self-efficacy items were supplemented with questions that specifically targeted the task the

participants were completing. Task-specific self-efficacy items for source-based essay writing included 10 items targeting understanding and appropriately incorporating source materials into essay. For example, items included: *understand the relevance of sources to an essay question*, and *correctly summarize the main points of a reading* (see Appendix I).

System performance. Logs of participants' actions in iSTART and the Writing Pal were used to help assess the impact of instruction on performance. Of particular interest is time spent in instructional videos, and time spent in identification and generative practice. These values vary for each participant as some students skip through videos and others rewind and rewatch videos. The number of times a videos and games were used was also assessed; some participants watched videos multiple times as they would not receive credit for completion if they did not watch the video to the end to trigger the check point.

Source-based essay questions. Participants completed a 40-minute source-based essay task during this experiment. Because prior knowledge complicates assessment of both writing and reading (McNamara & Kintsch, 1996), it was necessary to use a prompt and texts that require little prior knowledge to understand. For this reason, two prompts were selected from past Advance Placement Tests of English Language and Composition (available from the College Board at APcentral.collegeboard.com, 2011 and 2011 Form B). The prompts selected were from the spring and summer 2011 exams and focus on related topics, green living (see Appendix K) and the locavore movement (see Appendix K). Participants utilized a webpage to access the source materials and typed their essays in Microsoft word. These essays were scored using the question specific scoring guide

released by College Board (see Appendix D for green living and Appendix E for locavore scoring guide).

Procedure

Screen capture software was initialized at the beginning of the session. The pretest was comprised of demographic, motivation, and self-efficacy measures. Participants then completed a 25-minute timed SAT style persuasive essay followed by the Gates MacGinitie Reading Test. The trajectory of each student following initial testing varied based on condition (see Table 3). Those in the control condition completed a prior knowledge test and the Gates MacGinitie Vocabulary Test (GMVT, MacGinitie & MacGinitie, 1989) prior to completing a series of working memory and attention control tasks to control for time on task. The results from these tasks are not discussed in the present study. The Writing Pal only condition completed the Writing Pal in a pre-defined order (see Table 3 for details) with game-based practice completed following the relevant videos. The iSTART group watched all of the instructional videos, followed by the demonstration video. Following completion of the videos, they interacted with coached practice for 45 minutes followed by 45 minutes of free access to the system. The blended group completed an abridged version (1 hour in each system) of both the Writing Pal and iSTART training (see Table 3) and the order of presentation of the Writing Pal and iSTART was counterbalanced. In the blended condition, participants played games for a shorter period of time and did not view the argument preview or topic sentence videos in the Writing Pal. During iSTART training, participants were required to complete one text in coached practice and in any time remaining after completion participants were given free access to the system.

After training, participants had completed session one of the experiment. Participants returned between 1 and 3 days later to complete session two. After arriving for session two, participants completed a motivation questionnaire prior to being introduced to the source-based writing task. The directions were read aloud to the participants (see Appendix L). They were provided their prompt, and they then completed a task specific self-efficacy questionnaire. Following the questionnaire, participants were directed to a web page containing the prompt, sources, and a word document to download and write in. Experimenters downloaded the word file for participants and entered the participant ID in the header before allowing participants to begin the source-based writing task. Participants were shown how to use the split screen function to allow for simultaneous viewing of their essay and the source materials, as well as how to access sources. Participants were instructed that they were required to utilize the entire 40 minutes and that they would be given a 5-minute warning before their time was up. Following the study, participants were thanked for their time and debriefed.

Table 3. Flow of Source-based Essay Study

	Condition				
			Sections counterbalanced		
	iSTART only	Writing Pal only	Blended (Writing-Pal section)	Blended (iSTART section)	Control
Session 1 (3 hours)			Demographics Motivation and self-efficacy measures 25-minute SAT-style essay Gates MacGinitie Reading Test		
	Over video	Positions, Arguments, and Evidence video	Positions, Arguments, and Evidence video	Overview video	Prior knowledge test
	Comprehension Monitoring video	Play Planning Passage twice	Play Planning Passage	Comprehension Monitoring video	Gates MacGinitie Vocabulary Test
	Prediction video	Thesis Statements video	Thesis Statements video	Prediction video	Component processes test
	Paraphrasing video	Argument Preview video	Body Building overview video	Paraphrasing video	Symmetry Span
	Elaboration video	Body Building overview video	Evidence Sentences video	Elaboration video	Operation Span
	Bridging video	Topic Sentences video	Strengthening your Evidence video	Bridging video	Flanker Attention Control Task
	Summary video	Evidence Sentences video	Play RoBoCo for 10 minutes	Summary video	
	Demonstration video	Strengthening your Evidence video	Conclusion Building Overview video	Demonstration video	
	45 minutes of Coached Practice	Play RoBoCo for 20 minutes	Summarize the Essay video	1 text in Coached Practice	
	45 minutes of practice (users choice)	Conclusion Building Overview video	Play Lockdown for 10 minutes	user choice of practice in iSTART	
		Summarize the Essay video			
		Play Lockdown for 20 minutes			
Session 2 (1 hour)			End session 1 Motivation assessment Introduction to source-based writing Self-efficacy measure 40-minute source-based writing task		

Results

Data Cleaning

Of the 261 participants who began the study, 251 completed both sessions. The 10 participants who did not complete the study were dropped from all analyses. Due to experimenter error and the incomplete Psychology 101 demographic questionnaires, demographic data was unavailable for 18 participants. Grade Point Average was unavailable for 14 additional participants. The 18 participants for whom no demographic data was collected ($n_{no\ instruction} = 4$, $n_{iSTART} = 6$, $n_{Writing\ Pal} = 4$, $n_{blended} = 4$) were dropped from all analyses. The resulting data set consists of 232 participants ($n_{no\ instruction} = 59$, $n_{iSTART} = 55$, $n_{Writing\ Pal} = 58$, $n_{blended} = 60$).

Outliers were assessed for key variables including age, GPA, essay scores, days between sessions. There were 5 outliers for age, 4 in their 30's, and a 43 year old; these participants were maintained in the sample as no differences were observed between younger participants (17-29) and older participants in initial writing skills (30-43), F (1, 227) = .032, p = .86; or reading skills, F (1, 227) = .90, p = .34. Maintaining these participants resulted in a non-significant trend for a condition effect, F (1, 173) = 2.2, p = .090, with those in the blended condition marginally older than participants in all other conditions. One outlier was observed for the number of days elapsed between sessions, this participant had 16 days between sessions. However, as this participant received no training during their first session, the participant's data was maintained in the sample.

Initial Assessments of Skills

Experience-based writing. Because approximately 25% of the sample identified as L2, writing ability was evaluated for differences between the groups. All persuasive essays were scored using the algorithm from The Writing Pal designed for college-aged writers. Scores ranged from 2 to 6 with a mean of 3.55 (*SD* = 0.81). A One-way ANOVA was completed to assess differences in initial essay score as a function of ESL status. Participants who identified English as their first language scored significantly higher on persuasive writing (*M* = 3.76, *SD* = 0.76) than participants who identified another language as being their first language (*M* = 2.98, *SD* = 0.67); F (1, 230) = 47.86, $p < .001$. Based on this finding and the centrality of writing to the ability to complete source-based writing, all subsequent analyses examine only L1 participants. The resulting data set consists of 175 participants ($n_{no\ instruction} = 48$, $n_{iSTART} = 41$, $n_{Writing\ Pal} = 41$, $n_{blended} = 45$).

Of the remaining 175 participants, 73 wrote about images and impressions and 102 wrote about competition and cooperation. This number is uneven because 17 participants entered the wrong information when asked to enter the last letter of their ID, resulting in the incorrect initial essay prompt. Prompt effects were assessed, and no prompt effect on score was observed for participants, F (1, 173) = 3.01, $p = .085$. Differences in initial writing ability were also assessed as a function of condition to assess equivalence between the groups. A non-significant trend for differences in initial writing ability was observed as a function of condition, F (3, 171) = 2.44, $p = .067$, with those in the blended condition (*M* = 3.98) scoring slightly higher than participants in the iSTART condition (*M* = 3.56; see Table 4 for means for all groups).

Gates MacGinitie Reading Test. GMRT scores were computed by dividing the number of correct answers by the total number of questions to produce a proportion correct score. Score on the GMRT ranged from 21-98% correct with a mean of 64% correct (*SD* = .20). No differences in initial reading ability were observed as a function of condition, F (3, 171) = 1.96, p = .12 (see Table 4 for means).

Table 4. Means and F-values by Condition.

	n	Overall		No instruction control		iSTART		Writing Pal		Blended		*F*
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
Demographics												
Age	175	19.62	3.37	19.33	2.63	19.20	2.21	19.17	1.91	20.71	5.30	2.2*
Semesters in Higher Ed	175	2.63	2.05	2.67	2.28	2.14	1.71	2.44	1.72	3.16	2.74	1.75
Motivated to participate	175	4.26	1.07	4.04	1.15	4.22	0.96	4.34	1.09	4.44	1.03	1.23
Looking forward to participate	174	3.85	1.14	3.65	1.21	3.83	0.98	4.07	1.06	3.89	1.25	1.07
Prior Abilities												
Persuasive Writing Score	175	3.76	0.76	3.69	0.80	3.56	0.74	3.80	0.64	3.98	0.78	2.44*
Gates Reading Score (proportion)	175	0.64	0.20	0.61	0.18	0.63	0.21	0.62	0.22	0.70	0.19	1.96
Prewriting self-efficacy	170	44.08	8.57	43.89	8.50	43.54	7.89	43.30	8.67	45.48	9.08	0.56
Drafting self-efficacy	168	102.02	12.70	100.75	12.39	100.95	11.82	101.78	14.77	104.45	11.73	0.78
Revision self-efficacy	169	72.63	10.92	71.29	11.75	72.00	8.91	73.00	11.32	74.20	11.40	0.59
General writing self-efficacy	167	62.89	8.86	61.84	9.56	62.51	7.48	62.28	9.24	64.88	8.86	1.02
Total writing self-efficacy	165	281.38	37.79	278.45	38.53	279.00	32.79	279.67	41.93	288.09	37.81	0.61
Reading self-efficacy	173	94.99	17.20	90.30	19.27	95.59	17.91	94.45	17.14	99.84	12.97	2.45*
Outcomes												
Frustration	175	2.63	1.24	2.52	1.18	2.27	1.30	2.93	1.25	2.80	1.18	2.4*
Enjoyment	175	2.91	1.05	3.23	1.02	2.85	1.06	2.85	1.11	2.67	0.98	2.41*
Boredom	175	3.85	1.16	3.31	1.06	3.83	1.09	4.14	1.20	4.16	1.11	6.00***
Motivated to participate T2	175	3.83	1.25	4.02	1.21	3.73	1.32	3.88	1.29	3.37	1.20	0.66
Looking forward to participate T2	175	3.45	1.20	3.58	1.29	3.56	1.14	3.37	1.24	3.29	1.12	0.65
Prewriting self-efficacy T2	169	41.60	8.94	40.87	8.84	41.56	9.25	39.33	10.57	44.18	64.47	2.00
Drafting self-efficacy T2	167	97.37	16.66	93.39	17.77	98.89	14.77	94.58	20.04	102.88	11.67	3.03**
Revision self-efficacy T2	171	70.58	11.86	68.31	13.54	70.72	10.33	69.78	12.79	73.68	9.86	1.67
General writing self-efficacy T2	169	60.11	11.29	57.77	12.28	61.31	9.92	57.60	12.90	63.93	8.53	3.25**
Total writing self-efficacy T2	162	269.85	45.13	259.23	51.16	272.26	41.73	263.66	48.23	284.38	34.69	2.62*
Task specific self-efficacy	174	87.12	15.00	84.48	16.27	88.95	12.57	84.71	17.83	90.55	12.01	2.62
Source-based writing score	175	3.85	1.51	3.60	1.36	3.44	1.40	3.83	1.28	4.51	1.75	2.62***

$p < .10$ *, $p < .05$ **, $p < .001$ ***

Self-Efficacy

Reliability analyses were completed for four sub-scales of the WS3 to assess reliability of the WS3. All subscales and the full scale were found to have Cronbach's alpha values exceeding minimum standards for reliability, and all item-total correlations were also above minimum values (see Table 5 for complete reliability information). Test-retest reliability was also assessed by creating sum scores and correlating scores at time one and time two. The test-retest reliability values are generally lower than acceptable values; however this it to be expected as training and context may impact responses to self-efficacy questions. The reading self-efficacy scale was only administered once and displayed and appropriate reliability with a Cronbach's alpha value of $\alpha = .95$. Task specific self-efficacy also displayed an appropriate level of reliability, $\alpha = .96$.

Differences in initial self-efficacy as a function of group membership were assessed, no differences were found between conditions, on initial ratings of self-efficacy for prewriting, drafting, revising, general writing, or total writing score (for means and *F*-values see Table 4). There was a non-significant trend in differences in initial reading self-efficacy (F (3, 169) = 2.45, p = .065), with participants in the blended condition outscoring those in the control condition.

Table 5
Reliability of the Writing Skills Self-efficacy Scale

	Cronbach's α T1	Cronbach's α T2	Test-Retest Reliability
Prewriting	0.87	0.92	0.61
Drafting	0.92	0.97	0.63
Revising	0.92	0.95	0.70
General Writing	0.85	0.93	0.64
Overall	0.97	0.98	0.67

Motivation

Participants responded to two motivation questions at the beginning of each session they attended. Differences in initial motivation were assessed as a function of condition assignment. No differences in motivation were observed as a function of condition on either motivation question (*I am motivated to participate, F* (3, 171) = 1.23, *p* = .30; *I am looking forward to today's session, F* (3, 171) = 1.07, *p* = .37). Differences in motivation at session 2 and enjoyment ratings of the previous session were also examined. No differences in motivation were observed as a function of condition on either motivation question (*I am motivated to participate, F* (3, 171) = .66, *p* = .58; *I am looking forward to today's session*, *F* (3, 171) = .65, *p* = .58). However, differences in boredom, enjoyment and frustration at previous session were observed as a function of condition. Participants in the no instruction control group reported significantly less boredom (*M* = 3.31) during their first session then those in all other groups (M_{iSTART} = 3.83, $M_{Writing\ Pal}$ = 4.17, $M_{blended}$ = 4.16; *F* (1, 171) = 6.00, *p* = .001. Marginal differences were observed between groups on enjoyment and frustration. Participants who were assigned to the no instruction control group reported marginally more enjoyment (*M* = 3.23) than those assigned to the blended instruction condition (*M* = 2.67; *F* (1, 171) = 2.41, *p* = .069). Participants who interacted with only iSTART (*M* = 2.27) reported marginally less frustration than those in the Writing Pal ($M_{=}$ 2.93) or blended instruction (*M* = 2.80) conditions, *F* (1,171) = 2.40, *p* = .070.

Performance during Training

iSTART. iSTART videos were coded as complete based on time spent in the videos, a video was considered complete if the time spent was within 10 seconds of the

experimenter computed minimum time to finish the video. Some participants viewed the instructional videos multiple times during the study, primarily because participants closed videos early and had to view the video again (at least part of it) to trigger the check point. Completion rates for the videos ranged from 66% (Elaboration and Bridging) to 92% (Overview and Demonstration). In total, participants received credit for watching between 1 and 8 videos with the over half of the participants (58%) watching all 8 videos. Unfortunately, over 20% of participants completed fewer than half of the assigned videos. There was no difference in the number of videos completed as a function of condition (iSTART vs. blended), F (1, 81) = 2.37, p = .13. Overall instruction time in iSTART ranged from 4 min5 s – 50 min 53s, with an average time of 12min 16s (*SD* = 13min 11s). These numbers are highly skewed by those who did not watch videos; for those watching more than half of the videos, total instruction time ranged from 20min 57s – 50min 53s with an average instructional time of 27min 20s (*SD* = 3min 32s). There was a significant difference in instruction time as a function of condition, F (1, 81) = 3.98, p = .049, with those in the iSTART condition receiving on average almost 2 ½ minutes more of instruction (*M* = 26min 29s, *SD* = 5min 43s) than those in the blended condition (*M* = 24min 2 s, *SD* = 5min 26s). Average checkpoint performance ranged from 0 – 4 out of 4 possible points with an average score of 3.16 (*SD* = .78). There was no difference in average checkpoint scores as a function of condition, F (1, 81) = .77, p = .38 (see Table 6 for means).

Conditions were designed so that all participants completed at least one text in coached practice; however three participants in the blended condition ran out of time and did not complete coached practice. For the first coached practice text, average self-

explanation scores ranged from 1.61 to 3.00 with a mean of 2.57 (*SD* = .40). Average self-explanation score did not vary as a function of condition, F (1, 80) = 2.17, p = .144. Participants spent between 6min 8s and 34 min 21s completing the first text, with an average time of 14min 17s (*SD* = 5min 25s). Participants spent on average 3 ½ minutes longer completing their first coached practice text if they were in the iSTART condition (*M* = 16min 2s, *SD* = 6min 12s), than if they were in the blended condition (*M* =12min 37s, *SD* = 3min 57s), F (1, 82) = 8.93, p = .004. Participants in the iSTART condition spent 45 minutes interacting with coached practice and 26 of those participants interacted with additional texts during that time. During the total 45 minutes participants interacted with from 1 to 5 texts with an average of 2.12 (*SD* = 1.12) texts viewed. The average score across all coached practice texts for iSTART participants was 2.54 (*SD* = .38).

After completing their first assigned time/text in coached practice participants had a variety of games available to them along with the continued availability of coached practice. Not all participants in the blended condition had time to complete games because the time to complete Writing Pal, the iSTART videos, and coached practice varied by participant. For those in the iSTART condition, only two continued to interact with coached practice. Two generative practice games were available to participants, 9 participants played Map Quest ($M_{SE\ score}$ = 1.30, *SD* = .48) and 8 played show down ($M_{SE\ score}$ = 2.05, *SD* = .57). The identification games award points based on correctly identifying the self-explanation strategy used in an example, the number of participants in each condition playing each game and the average scores can be found in Table 6. No differences in average scores on any games were observed as a function of condition.

Table 6. *Number of Participants and Average Scores on Practice Games and Check Points by Condition.*

	Balloon Bust		Bridge Builder		Dungeon Escape		Strategy Match		Checkpoint Score
Condition	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*M (SD)*
iSTART	35	730.80 (424.48)	30	38.58 (28.89)	33	206.26 (143.28)	24	259.75 (114.15)	3.26 (0.47)
Blended	29	676.57 (395.90)	15	57.11 (59.07)	21	245.95 (149.20)	12	234.25 (128.03)	3.08 (0.98)

Writing Pal. Writing Pal videos were coded as complete based on the amount of time spent in the video. If participants were within 10 seconds of the minimum of the total video time, they were counted as having completed the video. Some participants viewed the instructional videos multiple times during the study. The most common reason for this was that participants closed videos early and had to view the video again (at least part of it) to trigger the check point. Across conditions, completion rates for the videos ranged from 47% (Summarize the Essay) to 89% (Positions, Arguments, and Evidence). In total, participants received credit for watching between 0 and 9 videos (Writing Pal condition) or 0 and 7 videos (blended condition). For the Writing Pal condition only, 40% of participants watched all of the videos; similarly, only 39% of participants in the blended condition watched all of the videos. Unfortunately, over 20% of Writing Pal participants and 38% of blended participants completed fewer than half of the assigned videos. Because participants were assigned differing numbers of videos and game plays based on condition, direct comparisons of instructional time spent and game plays cannot be completed.

Performance scores on checkpoints in Writing Pal were converted to proportion correct because checkpoints differed in number of questions. Average checkpoint proportion correct scores ranged from 22 to 95% correct, with a mean of 74% (*SD* =

14%). The full ranges of scores were observed for all checkpoints except those for Topic Sentences and Strengthening Your Evidence, for these checkpoints no participant received a score of zero. There was a marginal difference in checkpoint performance based on condition, F (1, 82) = 3.02, p = .086, with those in the Writing pal condition scoring on average of 5% lower (M = 0.71, SD = 0.15) than those in the blended condition (M =0.77, SD = 0.13). All games in Writing Pal assign scores based on performance (see Table 7 for means by group); no differences were observed in scores as a function of condition.

Table 7. *Number of Participants and Average Scores on Practice Games and Check Point Scores by Condition.*

	Planning Passage		RoBoCo		Lockdown		Check Point Score (proportion correct)
Condition	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*M (SD)*
Writing Pal	35	114.80 (24.52)	35	105.71 (93.13)	36	164.17 (324.38)	0.71 (0.15)
Blended	42	110.38 (21.54)	36	85.56 (97.58)	22	172.73 (153.04)	0.76 (0.13)

Overall time in systems. Overall instructional, practice, and total system times were computed for each group, excluding users who did not complete any videos or training. Overall instruction time varied as expected, with those in iSTART receiving less training than those in Writing Pal, who received less than blended, F (2, 123) = 52.50, p < .001. Practice time also varied as a function of condition, F (2, 122) = 36.46, p < .001, with those in the iSTART condition spending significantly more time in practice than participants in the other two conditions. Total time spent in an intelligent tutoring system varied as a function of condition, F (2, 122) = 24.57, p < .001. Post-hoc tests revealed

that those in Writing Pal condition spent less total time interacting with the system than those in the iSTART and blended conditions. Aggregate times spent in a system, in training, and in practice are presented in Table 8.

Table 8. Aggregate Time Spent Within Tutoring Environments

	Total System Time	Total Practice Time	Total Instruction Time
Condition	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
iSTART	86min 19s (14min58s)	59min 50 s (16min 20s)	26min 29s (5min 43s)
Writing Pal	68min 19s (15min2s)	36min 57s (9min 49s)	32min 30s (9min 34s)
Blended	88min24s (11.30)	41min 50s (10min 53s)	46min 34s (11min 38s)

Source-Based Writing

Essays were rated using a modified version of the rubric provided by the Advanced Placement Exam. Because participants were not explicitly instructed in and did not receive training in how to cite source material, participants were given credit for any direct reference to source material provided. Source-based essays ranged in score from 1 to 8 with a mean score of 3.85 (*SD* = 1.5). Participants wrote varying amounts, with the length of essays ranging from 116 words to 1036 words (*M* = 484.20, *SD* = 167.89). Across prompts, writers used an average of 2.86 sources out of either 6 or 7 sources (varied by prompt). Only one participant utilized all of the sources available, and three writers did not explicitly reference any source material.

Scores and length of the essays, and utilization of sources were assessed as a function of prompt to ensure that no differences existed due to the assigned topic and sources. No effect of prompt was found on score, F (1, 172) =. 728, p = .39, or length of essay, F (1, 171) = 1.88, p = .17. However, a significant difference in number of sources utilized was observed between the prompts, F (1, 172) = 5.59, p = .02, with those

responding to the prompt on green living utilizing more source material (M = 3.05, SD = 1.04) than participants responding to the locavore prompt (M = 2.69, SD = .98).

Effects of Strategy Instruction

An initial analysis assessed the overall correlation of source-based essay score with initial reading and writing proficiency along with correlations as a function of strategy instruction group. There was a significant correlation between initial writing ability and source-based essay score, r = .311, p< .001 and between initial reading ability and source-based essay score, r = .323, p < .001. When examining correlations separately by condition, initial writing is only significantly related to source-based essay score for the iSTART group (r = .359, p =.021; see Table 9 for correlations); there is a marginal correlation between initial writing ability and source-based writing score for the no instruction control condition (r = .272, p = .060).

The relationship between initial reading ability and source-based essay score is significant for both the no instruction control group (r = .317, p =.028) and the blended instruction group (r = .383, p=.009). There is a marginal correlation between reading ability and source-based essay score for the Writing Pal group (r = .306, p = .052).

Table 9. Correlations Between Prior Abilities and Source-based Writing by Condition

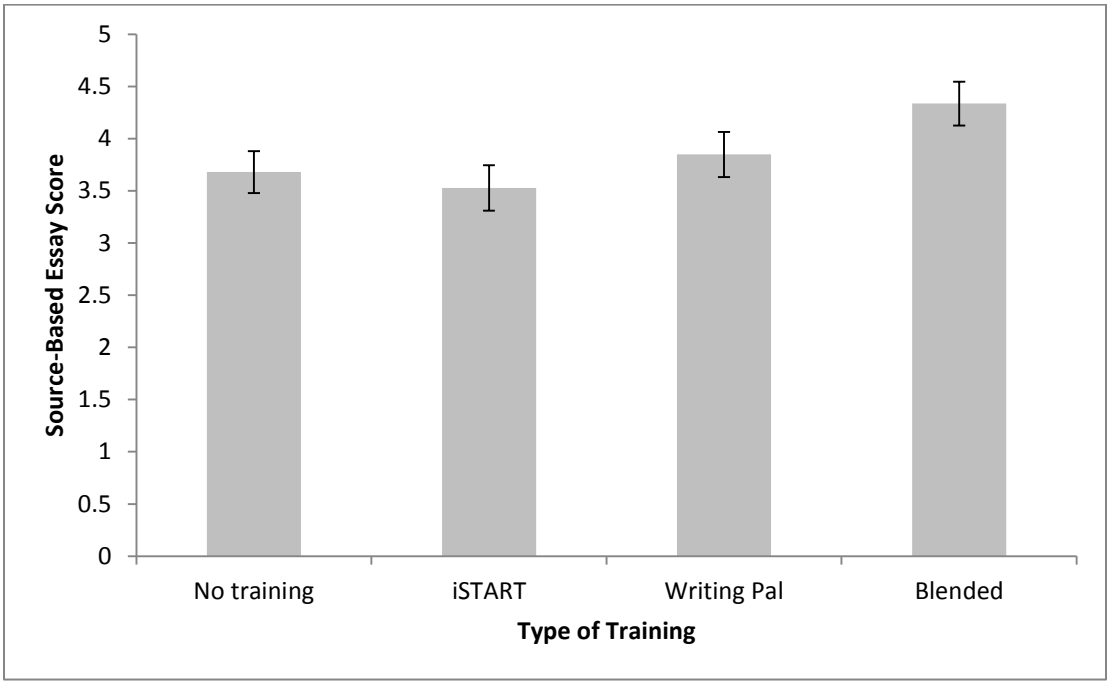
	Prior Writing Ability		Prior Reading Ability	
Condition	*r*	*p*	*r*	*p*
Control	0.27	0.060	0.32	0.028
iSTART	0.36	0.021	0.17	0.300
Writing Pal	0.20	0.210	0.31	0.052
Blended	0.26	0.086	0.38	0.009

Because half of the blended condition received each order of instruction ($n_{iSTART\text{-}Writing\ Pal}$ =23, $n_{Writing\ Pal\ -\ iSTART}$ = 22), order effects were assessed using a one-way

ANOVA. No difference was observed in source-based essay score as a function of the order of instruction, F (1, 43) = .002, p = .97. Thus, all participants who received blended instruction were combined into a single group for all subsequent analyses.

A one-way ANOVA was completed to assess the impact of type of strategy instruction on source-based writing score. Performance on the source-based writing task was found to vary as a function of type of strategy instruction completed, F (3, 171) = 4.61, p = .004, η^2 =.075. Post-hoc tests revealed that those in the blended instruction group outperformed participants in all other groups on source-based writing (see Table 5 for descriptive statistics). Analyses were conducted to examine if the condition effect was present when controlling for initial reading and writing abilities. There was a significant effect of strategy instruction on source-based essay score controlling for the effects of initial reading and writing abilities, F (3, 169) = 2.71, p = .047, η^2 = .046. The covariates of initial writing ability (F (1, 169) = 5.51, p = .02, η^2 =.032) and initial reading ability were found to be significantly related to differences between groups on source-based essay score (F (1, 169) = 14.72, p = .006, η^2 =.044). Post-hoc tests indicate that after controlling for initial reading and writing ability participants in the blended condition scored higher than those in the no instruction and iSTART conditions. In addition, there was a non-significant trend of those who received blended instruction (M = 4.36, SE =.22) performing better in source-based writing than participants in the Writing Pal group (M = 3.87, SE =.22), 95% CI $_{\text{mean difference}}$ [-1.08-.109], p = .11. No other significant differences between groups were observed.

Figure1. Source-based Writing Score by Condition



Several analyses were conducted to examine whether the impact of strategy instruction varied as a function of prior abilities. The first approach was to examine ability in terms of proficiency splits (more skilled, less skilled). For writing proficiency the dispersion of scores was such that a traditional median split was not appropriate. To create proficiency splits for writing ability writers with scores of 2 and 3 were classified as less skilled and those who scored from 4 to 6 more skilled. This cut off was chosen for two reasons: first, this created the closest to equal split (35%/ 65%), and second, the SAT rubric classifies essays receiving a 4 as displaying adequate mastery whereas scores of 3 are representative of developing mastery. The resulting split identified 62 participants as less skilled writers and 113 participants as more skilled writers. A traditional median split was completed for reading proficiency resulting in 92 participants classified as less skilled readers and 83 classified as more skilled readers.

The differential impact of prior writing ability level on source-based essay score as a function of strategy instruction was assessed. A main effect of type of strategy instruction was observed, F (3, 167) = 3.25, p = .023; η^2 = .055; as was a main effect for writing proficiency level, F (1, 167) = 10.03, p = .002, η^2 = .057. The interaction between strategy instruction and writing proficiency level was non-significant predictor of score differences between groups, F (3, 167) = .28, p = .843, η^2 = .005.

The differential impact of strategy instruction based on initial reading skill was then assessed. Main effects for type of strategy instruction (F (3, 167) = 3.92, p = .010, η^2 = .066) and reading proficiency level, F (1, 167) = 8.01, p = .005, η^2 = .046. The interaction between strategy instruction and reading proficiency level was a non-significant predictor of score differences between groups, F (3, 167) = .118, p = .95, η^2 = .014.

In addition to the individual impact of reading and writing ability level, a 3-way interaction between strategy instruction, reading ability, and writing ability was examined. When including both initial reading and writing proficiency levels, the main effect for strategy instruction was significant, F (3, 159) = 3.34, p =.021, η^2 = .059. A main effect was observed for writing proficiency level, F (1, 159) = 6.17, p = .014, η^2 = .037; but not for reading proficiency level, F (1, 159) = 1.96, p = .16, η^2 = .012. Consistent with prior analyses, the interactions between type of strategy instruction and writing proficiency level (F (3,159) = .77, p = .51, η^2 = .014), and instruction and reading proficiency level (F (3, 159) = 1.13, p = .34, η^2 = .021) were non-significant predictors of score differences. In addition, the interaction between writing proficiency level and reading proficiency level had no impact on source-based writing score, F (1, 159) = 1.08,

p = .30, η^2 = .007. The three-way interaction between strategy instruction, reading proficiency level, and writing proficiency level was a non-significant predictor of score differences between instruction groups, F (3, 159) = 0.83, p =.63, η^2 = .015.

Another statistical method used to assess the impact of strategy instruction on source-based essay writing is hierarchical linear regression using dummy or contrast coding to allow for the inclusion of condition variables. All analyses performed using ANOVA/ANCOVA were replicated using this method. In addition, analyses were performed comparing all conditions to control, and comparing those who received any writing instruction to those who did not.

A linear regression was conducted using dummy variables representing the conditions to predict source-based essay score. The no instruction control group was used as the reference group in this analysis to assess if a type of instruction provided any benefits to source-based writing score. The resulting model was significant, F (3, 171) = 4.61, p = .004, *adj*. r^2 = .059. The only significant predictor of score was the dummy code for the blended condition (β = .264, p = .003, see Table 10 for a complete list of coefficients and confidence intervals) suggesting that benefits of strategy training are only observed when participants receive blended strategy training. This analysis was repeated including Z-scores for prior reading and writing ability as predictors of source-based essay score in block 1. The resulting model was significant, F (5, 169) = 7.49, p <.001. The results mirrored previous results, with prior reading (β =.215, p =.006) and writing (β =.182, p = .020) ability serving as significant predictors of source-based writing quality. Again, the only group that significantly differed on source-based writing score from the no instruction control was the blended strategy group (β = .191, p = .026).

Table 10. Regression Coefficients for Predictors of Source-based Writing Score Using Control as Reference Group

Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence Interval	
					4.61 **	0.059		
Constant	3.60	0.21		171.00***			3.19	4.02
Dummy iSTART	0.23	0.31	0.064	0.73			-0.39	0.84
Dummy Writing Pal	-0.17	0.31	-0.047	-0.53			-0.78	0.45
Dummy Blended	0.91	0.30	0.260	2.99**			0.31	1.51

$p < .10$ *, $p < .05$ **, $p < .001$ ***

Given the significant difference between source-based writing scores for those in the no instruction control and blended conditions, an additional linear regression was completed using the blended condition as the reference group. This model allowed for the assessment of differences in source-based essay scores between the blended condition and participants who received iSTART and Writing Pal training. Again, the resulting model was significant, F (3, 171) = 4.29, p = .006, *adj.* r^2 = .054. The regression coefficients for all groups were both negative and significant (see Table 11), suggesting that participants who received blended strategy instruction out performed those who received single strategy instruction (iSTART, Writing Pal) or no instruction. This analysis was repeated including the Z-scores for prior reading and writing ability as predictors of source-based writing score in block 1 to control for initial ability. The resulting model was significant, F (5, 169) = 7.24, $p < .001$ (see Table 12). Prior reading (β =.219, p =.005) and writing (β =.179, p = .023) were significant predictors of source-based writing quality. After accounting for initial abilities, only the no instruction control (β = -.172, p =.047) and iSTART (β = -.215, p =.013) groups significantly differed on

source-based writing scores from the blended group. The difference between those who received Writing Pal and blended training and was non-significant (β = -.123, p = .15).

Table 11. Regression Coefficients for Predictors of Source-based Writing Score using Blended Condition as Reference Group

Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence Interval	
					4.29**	0.054	4.05	4.89
Constant	4.47	0.21		20.92***				
Dummy Code Control	-0.86	0.30	-0.25	-2.83**			-1.46	-0.260
Dummy Code iSTART	-1.03	0.31	-0.29	-3.29**			-1.65	-0.410
Dummy Code Writing Pal	-0.64	0.31	-0.18	-2.04*			-1.26	-0.021

p < .10 *, p <.05 **, p < .001 ***

Table 12.Hierarchical Regression Coefficients Controlling for Prior Ability using Blended Condition as Reference Group

Step	Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence interval	
1						14.24	0.13		
	Constant	3.85	0.11		36.34***			3.642	4.06
	Zscore Writing Ability	0.32	0.12	0.21	2.76**			0.092	0.55
	Zscore Reading Ability	0.35	0.12	0.23	3.01**			0.12	0.58
2						7.24	0.15		
	Constant	4.29	0.21		20.81***			3.88	4.69
	Zscore Writing Ability	0.27	0.12	0.18	2.29*			0.037	0.50
	Zscore Reading Ability	0.33	0.12	0.22	2.83**			0.099	0.56
	Dummy Code Control	-0.59	0.29	-0.17	-2.01*			-1.17	-0.01
	Dummy Code iSTART	-0.76	0.30	-0.22	-2.51*			-1.36	-0.16
	Dummy Code Writing Pal	-0.44	0.30	-0.12	-1.46			-1.03	0.15

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

Though the overall model is significant, the inclusion of the interaction terms did not result in a significant r^2 change, Δ *adj.* $r^2_{block\ 3}$ = .013, p = .46. In the model including the interaction terms, prior reading ability was a significant predictor of source-based writing quality (β = .459, p = .002). Similar to the prior analysis, scores on source-based

writing did not differ between those in the Writing Pal and blended conditions (β = -.112, p = .20). The difference between scores for those in the iSTART and blended conditions was significant (β = -.230, p = .009), and there was a non-significant trend suggesting a score difference between the no instruction control and blended groups (β = -.169, p = .057). All of the interaction terms were non-significant (see Table 13) predictors of source-based essay score.

This analysis was repeated to assess the differential impact of strategy instruction on source-based writing based on prior writing ability. The model including the interaction terms was significant, F (7, 167) = 7.85, p = .001, *adj*. r^2 = .103. Though the overall model is significant, the inclusion of the interaction terms did not result in a significant r^2 change, $\Delta r^2_{block\ 3}$ = .002, p = .95. There was a non-significant trend for prior writing ability as a predictor of source-based writing quality (β = .252, p = .065). There was also a non-significant trend suggesting that participants in the Writing Pal condition received lower scores on source-based writing compared to participants in the blended condition when the interaction terms (condition*writing ability) were included in the model (β = -.152, p = .087). Those who received blended training performed significantly better on source-based writing than those in the iSTART (β = -.219, p = .016), and the no instruction control group (β = -.200, p = .026). All of the interaction terms were non-significant (see Table 14) predictors of source-based essay score.

The impact of the three-way interaction between condition, prior reading and prior writing ability on source-based essay scores was examined using hierarchical regression. The interaction terms between each condition and prior abilities were included in block three, and the three-way interaction terms were included in block 4.

The model including the three-way interaction terms was significant, F (11, 160) = 2.93, p = .001, *adj.* r^2 = .144. Though the overall model is significant, the inclusion of the interaction terms did not result in a significant r^2 change, $\Delta r^2_{block\ 3}$ = -.021, p = .64; $\Delta r^2_{block\ 4}$ = -.007, p = .72. Prior reading proficiency (β = .413, p =.009) was a significant predictor of source-based writing performance but prior writing ability (β = .126, p =.37) did not predict performance on source-based writing in the model including the three-way interaction. Source-based essay scores for the iSTART group significantly differed from those for the blended condition (β = -.216, p = .023). There was a non-significant trend suggesting a possible difference between the no-instruction control and blended groups (β= -.150, p =.11). None of the interaction terms were significant, though there was a non-significant trend for the impact of the interaction between prior reading ability and the iSTART condition (β =-.194, p = .11; see Table 15 for complete results).

Table 13. Hierarchical Regression for Interaction Between Condition and Reading Skill

Step	Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence interval	
1						20.08***	0.099		
	Constant	3.85	0.11		35.66***			3.64	4.07
	Zscore Reading Skill	0.49	0.11	0.32	4.48***			0.27	0.70
2						7.55***	0.131		
	Constant	4.34	0.21		20.96***			3.93	4.75
	Zscore Reading Skill	0.44	0.11	0.3	4.03***			0.22	0.65
	Dummy Code Control	-0.66	0.30	-0.19	-2.25*			-1.25	-0.08
	Dummy Code iSTART	-0.88	0.30	-0.25	-2.91**			-1.48	-0.28
	Dummy Code Writing Pal	-0.46	0.30	-0.13	-1.53			-1.06	0.13
3						4.67***	0.129		
	Constant	4.27	0.22		19.84***			3.84	4.69
	Zscore Reading Skill	0.69	0.22	0.46	3.13**			0.26	1.13
	Dummy Code Control	-0.58	0.30	-0.17	-1.92			-1.17	0.02
	Dummy Code iSTART	-0.82	0.31	-0.23	-2.65**			-1.42	-0.21
	Dummy Code Writing Pal	-0.40	0.31	-0.11	-1.29			-0.82	0.44
	Reading *Control	-0.19	0.32	-0.59	-0.60			-0.92	0.27
	Reading * iSTART	-0.47	0.30	-0.16	-1.54			-1.08	0.13
	Reading * Writing Pal	-0.33	0.30	-0.11	-1.08			-0.92	0.27

$p < .05$ *, $p < .01$ **, $p < .001$ ***

Table 14. Hierarchical regression for interaction between condition and writing skill

Steps	Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence interval	
1	-					18.55	0.092		
	Constant	3.85	0.11		35.52***			3.64	4.07
	Zscore Writing Skill	0.47	0.11	0.31	4.31***			0.25	0.68
2	-					6.78	0.12		
	Constant	4.34	0.21		20.75***			3.93	4.75
	Zscore Writing Skill	0.40	0.11	0.27	3.65***			0.18	0.62
	Dummy Code Writing Pal	-0.54	0.30	-0.15	-1.76			-1.14	0.07
	Dummy Code iSTART	-0.80	0.31	-0.23	-2.60*			-1.41	-0.19
	Dummy Code Control	-0.68	0.30	-0.20	-2.27*			-1.26	-0.09
3	-					3.86	0.10		
	Constant	4.35	0.22		19.97***			3.92	4.78
	Zscore Writing Skill	0.38	0.20	0.25	1.86			-0.024	0.78
	Dummy Code Writing Pal	-0.54	0.31	-0.15	-1.72			-1.15	0.08
	Dummy Code iSTART	-0.78	0.32	-0.22	-2.44*			-1.4	-0.15
	Dummy Code Control	-0.68	0.30	-0.20	-2.25*			-1.28	-0.08
	Writing* Control	0.01	0.29	0.01	0.05			-0.55	0.58
	Writing * iSTART	0.13	0.31	0.04	0.43			-0.48	0.74
	Reading*Writing Pal	-0.07	0.34	-0.02	-0.22			-0.74	0.59

$p < .05$ *, $p < .01$ **, $p < .001$ ***

Given these results all interaction terms were dropped from models. Based on the previous findings the differences in source-based essay scores between those who received any writing strategy training and those who did not was assessed. A model assessing the impact of receiving any writing strategy instruction on source-based essay scores, controlling for prior reading and writing ability, was significant, F (3, 171) = 11.47, $p < .001$, *adj.* $r^2 = .153$. Consistent with prior models, prior reading (β =.227, p =.003) and writing (β =.188, p = .016) were significant predictors of source-based writing

quality. There was a significant benefit to receiving writing instruction (β = .162, *p* = .024.).

Impact of time in training on performance. As training, practice, and total time significantly differed as a function of group membership the impact of time on task for those receiving strategy training on source-based writing score was assessed. An ANCOVA was conducted to determine if differences between strategy instruction groups on source-based writing controlling for prior abilities and the impact of total time spent in tutoring systems was significant. There was a significant effect of strategy instruction group controlling for prior abilities and total time on task, F (2, 120) = 3.17, p = .046, η^2 = .05. The covariates initial writing ability (F (1, 120) = 3.91, p = .05, η^2 =.032) and initial reading ability were found to be significantly related to source-based essay score (F (1, 120) = 4.88, p = .029, η^2 =.039); however, the covariate of total time was not significantly related to source-based essay score, F (1, 120) = 0.57, p = .81, η^2 <.001. Post-hoc tests indicate that, after controlling for total-time on task, initial reading and writing ability, participants in the blended condition (M =4.35, SE = .224) scored higher than those in the iSTART (M = 3.55, SE = .233) condition.

Table 15. Hierarchical Regression for 3-way interaction

Step	Predictor	B	SE	β	*t*	*F*	Adj. R^2	95% Confidence interval	
1						14.24	0.13		
	Constant	3.85	0.11		36.34***			3.64	4.06
	Zscore Reading Ability	0.35	0.12	0.23	3.01***			0.12	0.58
	Zscore Writing Ability	0.32	0.12	0.21	2.76***			0.09	0.55
2						7.24	0.15		
	Constant	4.29	0.21		20.81***			3.88	4.69
	Zscore Reading Ability	0.33	0.12	0.22	2.83***			0.10	0.56
	Zscore Writing Ability	0.27	0.12	0.18	2.29*			0.04	0.5
	Dummy Code Writing Pal	-0.44	0.30	-0.12	-1.46			-1.03	0.15
	Dummy Code iSTART	-0.76	0.30	-0.22	-2.51*			-1.36	-0.16
	Dummy Code Control	-0.59	0.29	-0.17	-2.00*			-1.17	-0.01
3						3.64	0.14		
	Constant	4.23	0.22		19.41***			3.8	4.66
	Zscore Reading Ability	0.62	0.23	0.41	2.67**			0.16	1.08
	Zscore Writing Ability	0.19	0.21	0.13	0.90			-0.23	0.61
	Dummy Code Writing Pal	-0.37	0.31	-0.11	-1.20			-0.98	0.24
	Dummy Code iSTART	-0.65	0.32	-0.18	-2.05*			-1.27	-0.02
	Dummy Code Control	-0.52	0.30	-0.15	-1.72			-1.12	0.08
	Reading *Writing Pal	-0.30	0.32	-0.10	-0.94			-0.93	0.32
	Reading* iSTART	-0.69	0.34	-0.23	-2.01*			-1.37	-0.01
	Reading * Control	-0.24	0.34	-0.08	-0.71			-0.91	0.43
	Writing *Control	0.069	0.30	0.03	0.23			-0.53	0.67
	Writing & iSTART	0.36	0.34	0.12	1.05			-0.32	1.04
	Writing * Writing Pal	-0.01	0.35	-0.003	-0.03			-0.69	0.67
4						2.93	0.13		
	Constant	4.23	0.22		19.31***			3.79	4.66
	Zscore Reading Ability	0.62	0.23	0.41	2.66**			0.16	1.08
	Zscore Writing Ability	0.19	0.21	0.13	0.89			-0.23	0.61
	Dummy Code Writing Pal	-0.39	0.32	-0.11	-1.22			-1.01	0.24
	Dummy Code iSTART	-0.77	0.33	-0.22	-2.29*			-1.43	-0.11
	Dummy Code Control	-0.51	0.32	-0.15	-1.61			-1.14	0.12
	Reading *Writing Pal	-0.30	0.32	-0.1	-0.95			-0.93	0.33
	Reading* iSTART	-0.58	0.36	-0.19	-1.60			-1.29	0.13
	Reading * Control	-0.24	0.34	-0.08	-0.71			-0.92	0.44
	Writing *Control	0.06	0.31	0.02	0.20			-0.55	0.68
	Writing & iSTART	0.42	0.35	0.14	1.21			-0.27	1.12
	Writing * Writing Pal	-0.005	0.35	-0.001	-0.01			-0.69	0.68
	Reading * Writing * Control	-0.025	0.26	-0.01	-0.10			-0.53	0.48
	Reading * Writing * iSTART	0.25	0.22	0.10	1.12			-0.19	0.69
	Reading * Writing * Writing Pal	0.05	0.21	0.02	0.25			-0.37	0.48

$p < .10$ *, $p < .05$ **, $p < .001$ ***

To assess the impact of practice time, an ANCOVA was conducted to determine if differences between strategy instruction groups on source-based writing scores controlling for both practice time and prior abilities was significant. There was a significant effect of strategy instruction group controlling for prior abilities and practice time, F (2, 121) = 6.35, p = .047, η^2 = .05. The covariates initial writing ability (F (1, 121) = 4.27, p = .041, η^2 =.03) and initial reading ability were found to be significantly related to source-based essay score (F (1, 121) = 5.12, p = .025, η^2 =.04); however, the covariate of practice time was not significantly related to source-based essay score, F (1, 121) = 0.19, p = .66, η^2 =.002. Post-hoc tests indicate that, after controlling for practice time and initial reading and writing ability, participants in the blended condition (M =4.36, SE = .216) scored higher than those in the iSTART (M = 3.58, SE = .232) condition.

To assess the impact of instructional time s, an ANCOVA was conducted to determine if the differences between source-based writing score for different strategy instruction controlling for instructional time and prior abilities. There was a non-significant trend for the effect of strategy instruction group controlling for instructional time and prior abilities, F (2, 121) = 5.41, p = .073, η^2 = .04. The covariates initial writing ability (F (1, 121) = 3.98, p = .048, η^2 =.032), and initial reading ability (F (1, 121) = 4.85, p = .03, η^2 =.038) were found to be significantly related to source-based essay score. Instructional time was not significantly related to source-based essay score, F (1, 121) = 0.30, p = .58, η^2 =.002.

Impact of self-efficacy and motivation on source-based writing. The correlations were computed between source-based essay score and self-efficacy and answers to motivation

questions to assess the relationship between different types of self-efficacy, motivation and source-based writing. Contrary to hypotheses none of the self-efficacy or motivation measures were correlated with source-based writing and thus were examined further with relation to source-based writing. However, as expected, the types of self-efficacy are correlated with one-another (see Table 16).

Table 16. Correlations between Source-based writing score and Measures of Self-efficacy and Motivation

	1	2	3	4	5	6	7	8	9	10	11	12
1. Source Writing Score	---											
2.Prewriting Self-efficacy	0.02											
3. Drafting Self-efficacy	0.07	.86**										
4.Revision Self-efficacy	0.018	.79**	.88**									
5.General Writing Self-efficacy	0.053	.86**	.94**	.84**								
6.Total Writing Self-efficacy	0.04	.91**	.98**	.93**	.96**							
7.Reading Self-efficacy	0.066	.52**	.64**	.61**	.60**	.62**						
8.Task Self-efficacy	0.07	.81**	.89**	.80**	.85**	.88**	.63**					
9.Enjoyment	0.046	.23**	.25**	.17*	.22**	.23**	0.14	.17*				
10.Boredom	-0.009	-0.099	-0.071	-0.064	-0.053	-0.054	-0.055	-0.078	-.62**			
11.Frustration	0.007	-0.07	-0.15	-0.047	-.16*	-0.088	-0.091	-0.11	-.37**	.47**		
12.Looking forward to participating	-0.004	.22**	.23**	.21**	.23**	.24**	0.1	.21**	.59**	-.56**	-.35**	
13.Motivation	-0.019	.17*	.25**	.19*	.22**	.23**	0.095	0.14	.54**	-.45**	-.30**	.66**

p <.05 *, p < .01 **

Discussion

This study investigated the impact of strategy instruction in reading comprehension and experience-based persuasive writing on source-based writing. Participants were randomly assigned to one of four groups: no instruction control, writing strategy instruction, reading strategy instruction, or blended (both reading and writing) strategy instruction. This study sought to answer two questions: Do writers who receive different types of strategy instruction produce essays that differ in quality, and does the impact of type of strategy instruction vary as a function of prior abilities?

The assessment of the impact of strategy instruction on source-based writing indicated a benefit for blended strategy instruction over reading comprehension, writing, and no strategy instruction, with no differences between the latter three conditions. After accounting for initial ability in reading and writing, type of strategy instruction remained a significant predictor of students' source-based essay scores. Participants who received blended strategy instruction produced higher quality source-based essays than those who received reading strategy training or no training. A non-significant trend suggested a difference between those received blended and writing strategy instruction indicating that the addition of reading strategy instruction potentially increases source-based essay scores. When comparing each type of instruction to the no instruction control, while controlling for initial reading and writing ability, only blended strategy instruction outperformed the no instruction control group. The lack of difference between the Writing Pal and control conditions suggests that, though the difference between blended and writing strategy instruction is not significant (i.e., $p=.15$), there is a benefit to receiving reading strategy instruction in addition to writing strategy instruction. Prior

research has indicated that writing to learn (e.g., summarization) can enhance reading comprehension (Hebert, Gillespie, & Graham, 2013), and that self-explanation training can impact overall course performance (e.g., McNamara, in press; McNamara et al., 2007); however, this may be the first study to show a benefit of reading comprehension instruction on writing outcomes.

Contrary to expectations, the impact of strategy instruction did not differ as a function of initial abilities. The lack of an interaction between instruction condition and prior skills was confirmed using multiple statistical approaches, including ANOVA and hierarchical linear regression. While the effects of instruction on performance were not significantly moderated by prior skills, the correlations speak toward the presence of skill-based dependencies. Specifically, prior writing ability was unrelated to performance for those who received writing training (i.e., Writing Pal and blended conditions), and prior reading ability was unrelated to performance for those received the full dosage of iSTART training. Hence, strategy training may destabilize the correlation between initial skills and source-based writing. Importantly, however, when using the blended approach, additional iSTART training may be necessary to fully destabilize the relationship between reading comprehension and source-based writing.

The impact of overall time, instructional time, and practice time on source-based writing performance were also assessed. Though time on task is often offered as an explanation for differences between training groups, the results suggest that overall time and practice time had no impact on source-based essay scores. The finding that the differences between training groups on source-based writing scores were only marginally different after accounting for instructional time is, however, problematic. Time on task

was controlled as much as possible; however, it was impossible to equate time across the conditions. Moreover, an inherent aspect of the study includes differences in instructional time because iSTART contains less instructional material than does Writing Pal, and the blended condition intrinsically includes instruction from both. Thus, total instructional time varies systematically with condition rendering it impossible to differentiate between the impact of instructional time and condition. The lack of difference in performance between those who received iSTART and Writing Pal suggests that instructional time may not be the substantive cause of differences observed between the groups. Furthermore, it is doubtful that an additional 6 minutes of instruction is the key to enhanced performance on the writing task. The correlations, for example, point toward a more complex advantage for blended instruction due to the components of instruction, and not to the time spent on instruction.

Limitations and Future Directions

As encouraging as it is that blended strategy training transfers to source-based writing, it is important to note that training condition only accounted for 2 to 5 percent of the variance in source-based writing score. This being said, the ability to benefit from loosely aligned training suggests that if training were more closely aligned with the task, additional benefits may be observed. Minimal changes would be needed to increase the alignment between training and source-based writing. For example, in iSTART, two modules could be added, one on the selection of relevant information for answering questions; and a module providing instruction to learners to use the bridging inference strategy to make connections between sources. For the Writing Pal, adding modules on

the inclusion and selection of source material, and on how to compare and contrast sources in writing may be beneficial for completing source-based writing tasks.

One objective of the study was to investigate the extent to which the benefits of training depended on prior skills. No such dependencies were observed. However, the destabilization of correlations between prior skills and source-based writing score as a function of condition indicate that this question calls for further investigation. In addition, one concern regards the distribution of scores. The majority of participants in this study scored in the middle range of initial ability on measures of reading and writing ability with very few participants receiving scores indicative of very high or very low proficiency. Hence, the sample may not be sufficiently heterogeneous to encompass the full spectrum of ability. Alternatively, more sensitive tests of initial abilities may be needed to assess finer grained differences between participants.

Due to differences in initial ability, all non-native English speakers were dropped from the analyses. Future work should target potential differences between first and second language speakers in both the process and the product of writing source-based essays. This study is unable to adequately investigate this issue for two primary reasons. First, the current study includes a limited sample of non-native English speakers. Second, certain behaviors observed during the sessions of non-native English speakers potentially obscure the effects of training. Specifically, many of those who spoke English as a second language utilized translation sites not only to translate sources into their native language, but also to translate text back into English.

Finally, several changes to the system would facilitate a better understanding of the impact of strategy instruction on source-based writing. First, disabling the fast

forward button during the first viewing of any instructional videos would ensure that participants received all training. Second, controlling practice options might be controlled to allow for the assessment of the impact of different kinds of practice. Third, new instructional videos could be added to each system to enhance the alignment between training and source-based writing. Finally, a follow-up study might consider including a larger, more diverse (in terms of prior abilities) sample by targeting students in multiple areas or schools.

Conclusions

The present study examined the impact of non-aligned reading and writing strategy training on source-based writing. Source-based writing differs in many ways from the skills targeted in the Writing Pal and iSTART, making this study a test of skill transfer. The results suggest that when taught in conjunction with one another, the skills taught in the Writing Pal and iSTART transfer, providing a benefit to students' source-based writing skill.

The finding that no benefit was observed for those who received either type of single strategy instruction reinforces the notion that both reading and writing skills are necessary for proficiency in source-based writing. To succeed at source-based writing, both comprehension and the ability to convey that comprehension are necessary. Furthermore, this study suggests that not only can writing facilitate reading comprehension, but also, that reading comprehension may benefit writing outcomes on writing tasks that require source material.

Developing skills in source-based writing is essential for success in today's society as professionals are rarely requested to develop arguments based solely on their

experience. As the task relies both on the ability to communicate in language and the ability to understand source material it is reasonable to conclude that both reading and writing strategy training are necessary to increase proficiency. The present study trained learners on remotely aligned tasks and found that even when training does not align with the target task, if learners received both reading comprehension and writing strategy training, an increase in source-based writing score was observed. Based on the present findings it is clear that to impact source-based writing outcomes both reading and writing instruction are necessary.

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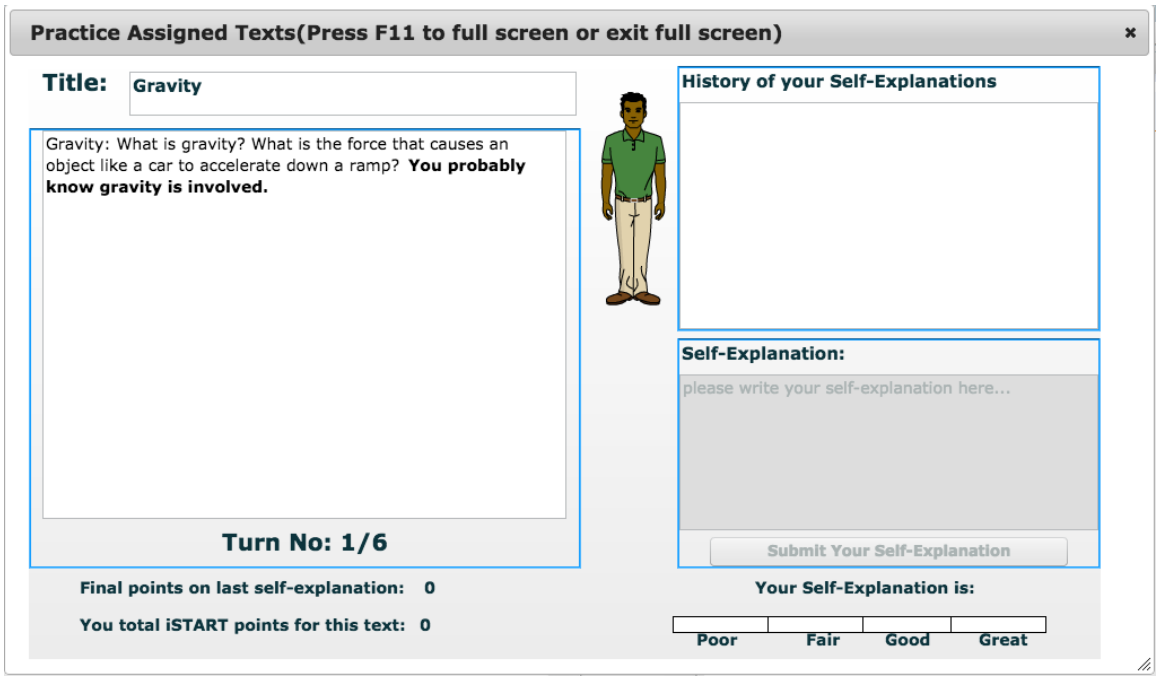
APPEDNIX A

TOPICS IN WRITING PAL

Module	Content
Freewriting	Strategies to quickly generate ideas during freewriting
Planning	Planning your essay using outlines and graphic organizers with a specific focus on positions, arguments and evidence
Introduction Building	Thesis statements, argument previews, attention grabbing techniques
Body Building	Topic sentences, evidence sentences, strengthening evidence
Conclusion Building	Restating thesis statements, summarizing arguments, closing the essay
Paraphrasing	Changing words and structure, condensing short sentences, breaking up long sentences
Cohesion Building	Using connectives, defining referents, and threading ideas
Revising	Reviewing essay for completeness, adding, removing, moving and substituting information

APPENDIX B

iSTART COACHED PRACTICE


Practice Assigned Texts(Press F11 to full screen or exit full screen)
Title:
Gravity
Gravity: What is gravity? What is the force that causes an object like a car to accelerate down a ramp? You probably know gravity is involved.
Turn No: 1/6
History of your Self-Explanations
Self-Explanation:
please write your self-explanation here...
Submit Your Self-Explanation
Final points on last self-explanation: 0
You total iSTART points for this text: 0
Your Self-Explanation is:
Poor
Fair
Good
Great

APPENDIX C

SELECTED VIDEOS FROM WRITING PAL

Module	Video
Planning	Positions, Arguments, and Evidence
Introduction Building	Thesis Statements
Introduction Building	Argument Preview*
Body Building	Overview
Body Building	Topic Sentences*
Body Building	Evidence Sentences
Body Building	Strengthening Your Evidence
Conclusion Building	Overview
Conclusion Building	Summarize the Essay

* These videos only seen by Writing Pal only group

APPENDIX D

AP® ENGLISH LANGUAGE AND COMPOSITION 2011 SCORING GUIDELINES FOR GREEN LIVING PROMPT

The score should reflect a judgment of the essay's quality as a whole. Remember that students had only 40 minutes to write; the essay, therefore, is not a finished product and should not be judged by standards appropriate for an out-of-class assignment. Evaluate the essay as a draft, making certain to reward students for what they do well.

All essays, even those scored 8 or 9, may contain occasional lapses in analysis, prose style, or mechanics. Such features should enter into your holistic evaluation of an essay's overall quality. In no case may an essay with many distracting errors in grammar and mechanics be scored higher than a 2.

---

9 Essays earning a score of 9 meet the criteria for a score of 8 and, in addition, are especially sophisticated in their argument, thorough in development, or impressive in their control of language.

8 Effective

Essays earning a score of 8 **effectively** develop a position on the extent to which government should be responsible for fostering green practices. They develop their position by effectively synthesizing* at least three of the sources. The evidence and explanations used are appropriate and convincing. Their prose demonstrates a consistent ability to control a wide range of the elements of effective writing but is not necessarily flawless.

7 Essays earning a score of 7 meet the criteria for a score of 6 but provide more complete explanation, more thorough development, or a more mature prose style.

6 Adequate

Essays earning a score of 6 **adequately** develop a position on the extent to which government should be responsible for fostering green practices. They develop their position by adequately synthesizing at least three of the sources. The evidence and explanations used are appropriate and sufficient. The language may contain lapses in diction or syntax, but generally the prose is clear.

5 Essays earning a score of 5 develop a position on the extent to which government should be responsible for fostering green practices. They develop their position by synthesizing at least three sources, but how they use and explain sources is somewhat uneven, inconsistent, or limited. The argument is generally clear, and the sources generally develop the student's position, but the links between the sources and the argument may be strained. The writing may contain lapses in diction or syntax, but it usually conveys the student's ideas adequately.

4 Inadequate

Essays earning a score of 4 **inadequately** develop a position on the extent to which government should be responsible for fostering green practices. They develop their position by synthesizing at least two sources, but the evidence or explanations used may be inappropriate, insufficient, or less convincing. The sources may dominate the student's attempts at development, the link between the argument and the sources may be weak, or the student may misunderstand, misrepresent, or oversimplify the sources. The prose generally conveys the student's ideas but may be less consistent in controlling the elements of effective writing.

3 Essays earning a score of 3 meet the criteria for a score of 4 but demonstrate less success in developing a position on the extent to which government should be responsible for fostering green practices. They are less perceptive in their understanding of the sources, or their explanation or examples may be particularly limited or simplistic. The essays may show less maturity in control of writing.

2 Little Success

Essays earning a score of 2 demonstrate **little success** in developing a position on the extent to which government should be responsible for fostering green practices. They may merely allude to knowledge gained from reading the sources rather than citing the sources themselves. These essays may misread the sources, fail to develop a position, or substitute a simpler task by merely summarizing or categorizing the sources or by merely responding to the prompt tangentially with unrelated, inaccurate, or inappropriate explanation. The prose often demonstrates consistent weaknesses in writing, such as grammatical problems, a lack of development or organization, or a lack of control.

1 Essays earning a score of 1 meet the criteria for a score of 2 but are undeveloped, especially simplistic in their explanation, weak in their control of writing, or do not cite even one source.

0 Indicates an on-topic response that receives no credit, such as one that merely repeats the prompt.

APPENDIX E

AP® ENGLISH LANGUAGE AND COMPOSITION 2011 SCORING GUIDELINES FOR LOCAVORE PROMPT

The score should reflect a judgment of the essay's quality as a whole. Remember that students had only 40 minutes to write; the essay, therefore, is not a finished product and should not be judged by standards appropriate for an out-of-class assignment. Evaluate the essay as a draft, making certain to reward students for what they do well.

All essays, even those scored 8 or 9, may contain occasional lapses in analysis, prose style, or mechanics. Such features should enter into the holistic evaluation of an essay's overall quality. In no case may an essay with many distracting errors in grammar and mechanics be scored higher than a 2.

---

9 Essays earning a score of 9 meet the criteria for a score of 8 and, in addition, are especially sophisticated in their argument, thorough in development, or impressive in their control of language.

8 Effective

Essays earning a score of 8 **effectively** develop a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They develop their position by effectively synthesizing* at least three of the sources. The evidence and explanations used are appropriate and convincing. Their prose demonstrates a consistent ability to control a wide range of the elements of effective writing but is not necessarily flawless.

7 Essays earning a score of 7 meet the criteria for a score of 6 but provide more complete explanation, more thorough development, or a more mature prose style.

6 Adequate

Essays earning a score of 6 **adequately** develop a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They develop their position by adequately synthesizing at least three of the sources. The evidence and explanations used are appropriate and sufficient. The language may contain lapses in diction or syntax, but generally the prose is clear.

5 Essays earning a score of 5 develop a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They develop their position by synthesizing at least three sources, but how they use and explain sources is somewhat uneven, inconsistent, or limited. The argument is generally clear, and the sources generally develop the student's position, but the links between the sources and the argument may be strained. The writing may contain lapses in diction or syntax, but it usually conveys the student's ideas adequately.

4 Inadequate

Essays earning a score of 4 **inadequately** develop a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They develop their position by synthesizing at least two sources, but the evidence or explanations used may be inappropriate, insufficient, or less convincing. The sources may dominate the student's attempts at development; the link between the argument and the sources may be weak; or the student may misunderstand, misrepresent, or oversimplify the sources. The prose generally conveys the student's ideas but may be less consistent in controlling the elements of effective writing.

3 Essays earning a score of 3 meet the criteria for a score of 4 but demonstrate less success in developing a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They are less perceptive in their understanding of the sources, or their explanation or examples may be particularly limited or simplistic. The essays may show less maturity in control of writing.

2 Little Success

Essays earning a score of 2 demonstrate **little success** in developing a position that identifies the key issues associated with the locavore movement and examines their implications for the community. They may merely allude to knowledge gained from reading the sources rather than citing the sources themselves. These essays may misread the sources, fail to develop a position that evaluates, or substitute a simpler task by merely summarizing or categorizing the sources or by responding to the prompt tangentially with unrelated, inaccurate, or inappropriate explanation. The prose of these essays often demonstrates consistent weaknesses in writing, such as grammatical problems, a lack of development or organization, or a lack of control.

1 Essays earning a score of 1 meet the criteria for a score of 2 but are undeveloped, especially simplistic in their explanation, weak in their control of writing, or do not allude to or cite even one source.

0 Indicates an on-topic response that receives no credit, such as one that merely repeats the prompt.

APPENDIX F

SAT PROMPTS AND INSTRUCTIONS

Images and Impressions:

You will now have 25 minutes to write an essay on the prompt below.

The essay gives you an opportunity to show how effectively you can develop and express ideas. You should, therefore, take care to develop your point of view, present your ideas logically and clearly, and use language precisely.

Think carefully about the issue presented in the following excerpt and the assignment below.

All around us appearances are mistaken for reality. Clever advertisements create favorable impressions but say little or nothing about the products they promote. In stores, colorful packages are often better than their contents. In the media, how certain entertainers, politicians, and other public figures appear is sometimes considered more important than their abilities. All too often, what we think we see becomes far more important than what really is.

Do images and impressions have a positive or negative effect on people?

Plan and write an essay in which you develop your point of view on this issue. Support your position with reasoning and examples taken from your reading, studies, experience, or observations.

Competition and Cooperation:

You will now have 25 minutes to write an essay on the prompt below.

The essay gives you an opportunity to show how effectively you can develop and express ideas. You should, therefore, take care to develop your point of view, present your ideas logically and clearly, and use language precisely.

Think carefully about the issue presented in the following excerpt and the assignment below.

While some people promote competition as the only way to achieve success, others emphasize the power of cooperation. Intense rivalry at work or play or engaging in competition involving ideas or skills may indeed drive people either to avoid failure or to achieve important victories. In a complex world, however, cooperation is much more likely to produce significant, lasting accomplishments.

Do people achieve more success by cooperation or by competition?

Plan and write an essay in which you develop your point of view on this issue. Support your position with reasoning and examples taken from your reading, studies, experience, or observations.

APPENDIX G

WRITING SKILLS SELF-EFFICACY SCALE

Directions: Please rate how certain you are that you can successfully complete each of the tasks listed below by selecting a confidence rating from 0 -100 on the scale provided

0 10 20 30 40 50 60 70 80 90 100

Subscale	Statement
Prewriting	Come up with enough ideas for a paper
Prewriting	Use a flow chart to organize my ideas
Drafting	Use connectives and transitions to relate my ideas to each another
Drafting	Use consistent wording throughout a paper
Drafting	Structure a paper so that similar ideas are included in the same paragraph or section
Prewriting	Use an outline to structure a writing assignment
General Writing	Write a paper targeted at a specific audience (e.g., peers, novices, experts)
Drafting	Use a thesis statement to state my position in an introduction
General Writing	Write a research paper
General Writing	Write a short story
Revision	When my teacher or reviewer identifies a problem in my writing I can fix that problem and similar ones
Drafting	Write an introduction to attract the attention of my readers
General Writing	Write a convincing argument essay
Revision	Find problems in my papers and fix them
Revision	Proofread a paper for spelling and grammar errors
Drafting	Use pronouns (e.g., he, she, it, that) so that the meaning is clear to the reader
General Writing	Effectively communicate my ideas in writing
Revision	Reorganize a paper to increase clarity of my arguments
Revision	Identify flaws in my arguments
Drafting	Conclude a paper by summarizing my ideas
Drafting	Utilize fact-based evidence to support my arguments
Drafting	Address opposing claims in an argument essay
Revision	Identify and remove unnecessary information from my papers
Revision	I can identify run on sentences in my writing and fix them
Revision	Identify where additional evidence is needed
Prewriting	Make an in depth outline for a writing assignment
General Writing	Write an article critique
General Writing	Fulfill the requirements of an assignment on the first draft
Drafting	Come up with convincing arguments to support my thesis
Drafting	Conclude a paper without presenting additional evidence
Prewriting	Prepare for an in class essay

APPENDIX H

READING SELF-EFFICACY QUESTIONS

Please rate how certain you are that you can successfully complete each of the tasks listed below by selecting a confidence rating from 0- 100 on the scale provided below.

	0	10	20	30	40	50	60	70	80	90	100
Read a science text and understand it the first time	○	○	○	○	○	○	○	○	○	○	○
Read a social studies text and understand it the first time	○	○	○	○	○	○	○	○	○	○	○
Read a piece of literature and understand it the first time	○	○	○	○	○	○	○	○	○	○	○
Synthesize information across paragraphs	○	○	○	○	○	○	○	○	○	○	○
Incorporate what i'm reading about with information I already know	○	○	○	○	○	○	○	○	○	○	○
Restate what i'm reading in my own words	○	○	○	○	○	○	○	○	○	○	○
Be aware of which topics I understand while reading	○	○	○	○	○	○	○	○	○	○	○
Be aware of which topics I do not understand while reading	○	○	○	○	○	○	○	○	○	○	○
Link information i'm reading about to information I've learned in other classes	○	○	○	○	○	○	○	○	○	○	○
Predict what will come next while reading	○	○	○	○	○	○	○	○	○	○	○
Understand new words or phrases based on the context in which they were used	○	○	○	○	○	○	○	○	○	○	○

APPENDIX I

TASK SPECIFIC SELF-EFFICACY QUESTIONS FOR SOURCE-BASED

Please rate how certain you are that you can successfully complete each of the tasks listed below by selecting a confidence rating from 0- 100 on the scale provided below.

	0	10	20	30	40	50	60	70	80	90	100
Evaluate credibility of source material	○	○	○	○	○	○	○	○	○	○	○
Correctly summarize the main points of a passage or reading	○	○	○	○	○	○	○	○	○	○	○
Write an essay based on things that I have read	○	○	○	○	○	○	○	○	○	○	○
Select relevant information from a passage to support a thesis	○	○	○	○	○	○	○	○	○	○	○
Develop a thesis based on source material I have located	○	○	○	○	○	○	○	○	○	○	○
Develop a thesis based on source material provided to me	○	○	○	○	○	○	○	○	○	○	○
Develop a coherent essay including evidence from multiple sources	○	○	○	○	○	○	○	○	○	○	○
Properly cite and quote sources in an essay	○	○	○	○	○	○	○	○	○	○	○
Paraphrase source material for my own writing	○	○	○	○	○	○	○	○	○	○	○
Understand the relevance of sources to an essay question	○	○	○	○	○	○	○	○	○	○	○

APPENDIX J

GREEN LIVING SOURCE-BASED QUESTION

Today you will be writing a source based essay. You will have 40 minutes to read the sources below and respond to the following prompt.

Green living (practices that promote the conservation and wise use of natural resources) has become a topic of discussion in many parts of the world today. With changes in the availability and cost of natural resources, many people are discussing whether conservation should be required of all citizens.

Carefully Read the following six sources, including the introductory information for each source. Then synthesize information from at least three of the sources and incorporate it into a coherent, well-written essay that develops a position on the the extent to which government should be responsible for fostering green practices.

Make sure that your argument is central, use the sources provided in the file links below to illustrate and support your reasoning. Avoid merely summarizing the sources. Indicate clearly which sources you are drawing from, whether through direct quotation, paraphrase or summary. You may cite sources as Source A, Source B, etc, or by using the descriptions in parentheses.

Source A (Winters)
Source B (Webber)
Source C (Friedman)
Source D (Samuelson)
Source E (graph)
Source F ("Energy Savers")

APPENDIX K

LOCAVORE SOURCE-BASED ESSAY PROMPT

Today you will be writing a source based essay. You will have 40 minutes to read the sources below and respond to the following prompt.

Locavores are people who have decided to eat locally grown or produced products as much as possible.With an eye to nutrition as well as sustainability (resource use that preserves the environment), the locavore movement has become widespread over the past decade.

Imagine that a community is considering organizing a locavore movement. Carefully read the following seven sources, including the introductory information for each source. Then synthesize information from at least three of the sources and incorporate it into a coherent, well-developed essay that identifies the key issues associated with the locavore movement and examines their implications for the community.

Make sure that your argument is central, use the sources provided in the file links below to illustrate and support your reasoning. Avoid merely summarizing the sources. Indicate clearly which sources you are drawing from, whether through direct quotation, paraphrase or summary. You may cite sources as Source A, Source B, etc, or by using the descriptions in parentheses.

Source A (Maiser)
Source B (Smith and MacKinnon)
Source C (McWilliams)
Source D (chart)
Source E (Gogoi)
Source F (Roberts)
Source G (cartoon)

APPENDIX L

SOURCE-BASED ESSAY DIRECTIONS

Today you will be completing a source-based essay. For source-based essays you are provided with a prompt directing you to select a stance on a subject along with multiple sources that you can use to formulate and back up your position. You will have 40 minutes to read over the source material and compose your essay. Please keep in mind that I cannot clarify the prompt or source materials for you. However if you have any other questions please raise your hand and I will be with you momentarily.

APPENDIX M

HUMAN SUBJECTS IRB APPROVAL

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Danielle McNamara
LSI: Learning Sciences Institute
480/727-5690
dsmcnama@asu.edu

Dear Danielle McNamara:

On 4/10/2014 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Studying the differential impact of reading and writing strategy training on document based essay writing
Investigator:	Danielle McNamara
IRB ID:	STUDY00000335
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Consent form , Category: Consent Form; • HRP-503a, Category: IRB Protocol; • Appendix A-F, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Appendix G, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Appendix H, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Preconsent Script, Category: Participant materials (specific directions for them); • Sona Recruitment, Category: Recruitment materials/advertisements /verbal scripts/phone scripts;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 4/10/2014.

APPENDIX N

CONSENT FORM

Investigator: Dr. Danielle McNamara
Department of Psychology - The Learning Sciences Institute
Arizona State University

Title: Literacy and Strategy Use

I, _____, hereby agree to participate as a volunteer in the above named research project.

The purpose of this study is to investigate the role of strategy instruction and use in document-based essay writing, and how the use of strategies varies across different kinds of writers. You will complete a series of tasks assessing writing, reading, thinking, and memory skills. The information gathered in this project will help psychologists to understand the writing processes.

I understand that the information collected in this study will be kept confidential within the limits of the law.

I understand that participation is voluntary and that at any time I am free to refuse to participate or answer any question without prejudice to me. I also understand that I am free to withdraw from the experiment at any time.

I understand that this study will consist of one 3 hour session and one 1 hour session (for a total of 4 hours) and that, for participation, I will receive credit toward my Psychology course, a course that I am enrolled in this semester.

I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

Signature _____ Date ____/_____/_____

If you have any questions regarding research participants' rights please contact the Chair of the Committee for the Protection of Human Research Participants at (480) 965-6788.

TITLE OF THE RESEARCH

Literacy and Strategy Use

INVITATION TO PARTICIPATE
You are invited to participate in this project designed to improve students' writing composition.

BASIS FOR SELECTION
All students over the age of 18 who are enrolled in the psychology subject pool are invited to participate in this study.

PURPOSE OF THE STUDY
The purpose of the study is to assess the effects of a computer-based strategy programs on students' writing composition.

EXPLANATION OF PROCEDURE
If you agree to participate you will complete a series of brief tasks assessing writing and thinking skills in a lab setting on campus. Two sessions will be needed to complete this study.

POTENTIAL BENEFITS
The information gathered in this project will be used to assess the usefulness of computer software designed to help students' improve their writing composition and whether it can be successfully integrated into schools.

POTENTIAL RISKS
You will be at minimal risk of psychological or physical discomfort or harm during the completion of this research. All students will be asked to complete a series of tasks. A researcher will be present at all times. As required by the university review board, note that Arizona State University does not have any funds budgeted for compensation for injury, damages, or other expenses.

ASSURANCE OF CONFIDENTIALITY
All information obtained in this study that could identify you will be kept confidential within the limits allowed by law. The information will be kept in a locked filing cabinet and in secure computer files. The specific results of your participation will not be provided to you or to any other persons or institutions. The information obtained in this study may be published in scientific journals or presented at scientific meetings, but your identity will never be included with this information.

WITHDRAWAL FROM STUDY
Participation in this study is voluntary. If you decide to participate, you are free to withdraw from the study at any time.

OFFER TO ANSWER QUESTIONS
If you have any questions about this project, please do not hesitate to contact the principal investigator, Dr. Danielle S. McNamara at dsmcnamara1@gmail.com. If you have questions concerning your rights as a research participant, you may contact the Chair of the Committee for the Protection of Human Research Participants at (480) 965-6788.