Trends in Research on Writing as a Learning Activity

Perry D. Klein° & Pietro Boscolo*

° Western University, Ontario | Canada

* University of Padova, Padova | Italy

Abstract: This article discusses five trends in research on writing as a learning activity. Firstly, earlier decades were marked by conflicting views about the effects of writing on learning; in the past decade, the use of meta-analysis has shown that the effects of writing on learning are reliable, and that several variables mediate and moderate these effects. Secondly, in earlier decades, it was thought that text as a medium inherently elicited thinking and learning. Research during the past decade has indicated that writing to learn is a self-regulated activity, dependent on the goals and strategies of the writer. Thirdly, the Writing Across the Curriculum (WAC) movement emphasized domain-general approaches to Writing to Learn (WTL). Much recent research is consistent with the Writing in the Disciplines (WID) movement, incorporating genres that embody forms of reasoning specific to a given discipline. Fourthly, WTL as a classroom practice was always partially social, but the theoretical conceptualization of it was largely individual. During the past two decades, WTL has broadened to include theories and research that integrate social and psychological processes. Fifthly, WTL research has traditionally focused on epistemic learning in schools; more recently, it has been extended to include reflective learning in the professions and additional kinds of outcomes.

Keywords: cognitive processes, research methods, writing, writing skills, writing to learn

journal of WRITING RESEARCH

Klein, P.D., Boscolo, P. (2016). Trends in research on writing as a learning activity. *Journal of Writing Research, 7*(3), 311- 350. doi: 10.17239/jowr-2016.07.03.01

Contact: Perry D. Klein, Western University, Faculty of Education, 1137 Western Road, London, Ontario, N6G 1G7| Canada– pklein@uwo.ca.

1. Introduction

Despite its conciseness – or perhaps because of it! –'writing-to-learn' is by no means an expression with a univocal meaning. The two activities that it involves are, in fact, extremely wide-reaching and complex, each conceptualized in different ways. Over the past decades, on one hand, writing has been analyzed as language production, a psychological process, and a practice with different functions/genres related to various socio-cultural contexts. Learning, on the other hand, has been studied from various psychological perspectives. What is common to both writing and learning is their use in both academic and non-academic contexts: Writing and learning take place both in and out of school. In fact, this dual 'location' of writing makes the expression 'writing-to-learn' even more complex. This complexity is increased further when the notion of instrumentality is made explicit, as in the expression 'writing as a tool for leaning': Which writing functions or genres or activities are "tools" for which kinds of learning?

The history of research into writing-to-learn shows the mutual influences of writing and learning, but the relationship is not a symmetrical one: The role of writing has definitely been more prominent. Of course, over the past decades the conceptualization of writing has been shaped by the great "ideas" of learning dominating in psychological research: the two metaphors of writing as a mechanism and as participation. These represent the most important – and often conflicting – views of writing, and reflect the cognitive and the sociocultural approach, respectively (Boscolo, 2014). Writing, however, has shown a remarkable capacity to shape learning, from the relatively simple means of learning (where, for instance, writing aids memory), to its role in the solution of conceptual problems in a variety of disciplinary fields. As will be demonstrated in the following pages, the transition in the view of writing from an individual process which is "useful" for any discipline to a fabric of processes closely connected to specific disciplinary contexts, is a basic aspect in the development of this research. Writing is not an all-purpose ability, but a pattern of activities which can have productive effects on knowing and thinking by interacting with different knowledge fields and learning contexts.

The role of writing has been more prominent than learning because, in a sense, writing has "incorporated" learning. Research on writing as a "way" – or "tool" - for learning tends to overlap with writing research in academic settings. There are very few types of writing which are not related to learning. Learning is central to writing, not only because writing is a cognitively demanding activity, which is rarely carried out without cognitive effort. The processes involved in writing – searching for ideas, organizing, checking, revising, and so on – appear to be the processes through which thinking takes place (Bereiter & Scardamalia, 1987). When learning academic writing, students may learn to expose their thinking, select an appropriate lexicon, and organize their texts. In particular, they can learn to be aware of an audience that is purely virtual (Olson, 2001, 2014). Successful writing requires learning because the writer has to

learn how to shape meaning– i.e., through which lexical choices, cohesion devices, rhetorical moves and inferences about a possible reader's comprehension. The distinction between knowledge telling and transforming (Bereiter & Scardamalia, 1987), which has greatly influenced the discourse on writing instruction, is not just the distinction between novice and mature ways of writing. In fact, the distinction is between a static view of using and reproducing information, and a dynamic one, where a writer transforms what he or she has learned by using knowledge in a purposeful way, or by adopting a style of writing.

Purpose and scope of this review

The question to be addressed here is, what have been the recent trends in research on writing as a learning activity? With respect to the scope of research on "writing as a learning activity," we take this concept to be organized as a prototype with loose boundaries. The prototypical instance would be a study that is explicitly identified as "writing to learn," which compares writing to a non-text activity, or non-compositional transcription activity (e.g., Gingerich, Bugg & Doe et al.; 2014; Klein, Piacente-Cimini & Williams, 2007; Rivard, 2004; Spirgel & Delaney, online). However, the scope of research on WTL is much broader than this. For example, the literature on reading comprehension from multiple texts cannot be ignored, given that the activity used to support comprehension in this literature is usually writing (Britt & Rouet, 2012; Wiley & Voss, 1999). Other studies that have addressed the effects of writing on learning can be found in the research literatures on cooperative learning, computer supported collaborative learning, and learning from primary sources in history (e.g., Dillenbourg, Järvelä & Fischer, 2009; Johnson & Johnson, 1985; Van Drie & Van Boxtel, 2008). Consequently, we have interpreted the concept of "writing to learn" broadly.

We have selected material for review primarily through a dialectical comparison of theory and research. With respect to theory, we have focused on sources that have been widely cited, such as Bereiter and Scardamalia (1987), Britton (1982a), and Galbraith (1999). With respect to empirical evidence, we have particularly attended to previous literature reviews and meta-analyses, which provide a means for indirectly addressing large bodies of previous research (e.g., Applebee, 1984; Graham & Hebert, 2011). Additionally, to sample recent developments, we have given particular attention to very recent (2011-2015) empirical papers in peer reviewed journals and book chapters (e.g., Martínez, Mateos, Martín & Rijlaarsdam, 2015; Spirgel & Delaney, 2014). We have also given particular attention to critical and dissenting opinions (e.g., Siebert & Draper, 2008). We note that recent studies of writing to learn have been indexed under a variety of terms, including very general terms such as "writing," or "learning strategies" (Demirbag & Gunel, 2014; Petko, Egger & Graber, 2014); as well as very specific terms, such as "argumentation" (Felton et al., 2009), "journal writing" (Glogger et al., 2012), and "analogical encoding" (Mason & Tornatora, 2014).

We have identified five kinds of issues, around which trends in research on WTL have revolved. One question will be used to frame each section of this review: (1) What

research methods have informed WTL? (2) What psychological theories and evidence have shaped this research? (3) What kinds of writing (genres) contribute to learning through writing? (4) What is the role of social theories in understanding writing as a learning activity? (5) What kinds of contexts and outcomes characterize research on WTL? We try to address several aspects of each of these trends: How each new trend illustrates both a continuity and a change relative to earlier research; how each trend reflects broader changes in the scholarship of writing; and the extent to which the new trend has resulted in empirically validated claims.

We should be clear that the purpose of this paper is not to provide a systematic review of the results of empirical research, of the kind found in a meta-analysis. That would be redundant, because several excellent meta-analyses have recently been published (Bangert Drowns et al., 2004; Graham & Hebert, 2011; Hebert, Gillespie & Graham, 2013). Rather, we have sought to identify recent trends in research, that is, relatively new directions in theory and empirical investigations. Several recent trends concern issues that are not solely empirical, but also concern new kinds of questions and new purposes. Other recent trends concern new empirical findings, but to date, too few studies have been produced to make judgements about the reliability of effects, or their typical sizes.

2. Trends in Methods and Results: From Controversy to Consensus and Complexity

This section will focus on methodological changes in the WTL literature. The questions to be addressed are: What changes have taken place in research methods? How have these affected our confidence in the effects of writing on learning?

2.1 Early Controversy

Early work on the effects of writing on learning was marked by views that were strongly held, yet speculative. Historically, authors in the humanities made claims about the consequences of writing and written text for the individual mind and for societies, based largely on historical and cross-cultural comparisons (Donald, 1991; Goody & Watt, 1963; Ong, 1982). At the same time, many professional writers testified to the effects of writing on thinking and understanding; relevant quotes have been collected in an interesting chapter by Murray (1980).

Consistent with this, several writing educators claimed that writing inherently led to learning, basing their claims primarily on theory, anecdote, or extrapolation from research on writing other than WTL (Britton, 1982a; Emig, 1977). Early research on WTL was frequently comprised of chapters by writing educators or subject area educators who took these theories up, often citing Britton or Emig; they integrated these theories with their personal experiences in the classroom (e.g., edited volumes by Gere, 1985; Thaiss 1986; Young & Fulwiler, 1986). Other research comprised ethnographic studies of WTL in classrooms (e.g., Rosaen, 1989, 1990).

At the same time (1970s and 1980s), some researchers sought to test the effects of writing on learning using experimental methods. Most frequently, these experiments contrasted two kinds of writing activities, for example, one in a genre that required composing an extended text such as an essay, and another activity in a genre that required more restricted composing, such as responding to short-answer questions. Applebee (1984) reviewed this early research, and noted that due to the modest number of previous studies and conflicting findings, there was limited evidence that writing contributes to learning.

Almost 10 years later, Ackerman (1993) reviewed the empirical literature again, both quantitative and qualitative. He noted that whereas advocates often claimed that writing is a unique means of learning, its effects had seldom been compared to other media. The results of experimental studies were mixed: Contrary to the expectations of Britton (1982a) and others, in most studies journal writing usually did not produce significantly greater learning than other activities; essay writing produced greater learning than other activities in only half of the studies reviewed. Like Applebee, Ackerman concluded that writing as a means of learning is "at best an argument yet to be made" (p. 335). He also concluded that there was a need to consider contextual variables, and that the empirical literature could be more clearly understood if we give up the idea that writing inevitably leads to learning. At about the same time, several reports using methods such as thinking-aloud, textual analysis, and case studies, showed that the process and content of writing was shaped partly by the assignment, but also partly by the individual decisions of writers, many of whom interpreted these activities in ways not intended by the researcher or teacher (Durst, 1987; Greene, 1993; Newell & Winograd, 1995; Penrose, 1992).

Consequently, by the turn of the millennium, the tone of much of the literature on WTL shifted from declamatory to tentative and analytical. Tynjälä, Mason and Lonka (2001) edited a volume on *Writing as a Learning Tool*, which exemplified this trend. Authors of various chapters empirically tested hypotheses or investigated questions about the effects of specific aspects of writing on learning, using statistical methods or systematic qualitative methods (Boscolo & Mason, 2001; Hartley, & Tynjälä, 2001; Linnakylä, 2001; Slotte & Lonka, 2001). This focus on hypotheses about specific practices continued to characterize much research on WTL for the rest of the decade (e.g., Cantrell, Fusaro & Dougherty, 2000; Hand, Wallace & Yang, 2004; Klein, 2000, 2004; Rivard, 2004).

2.2 Recent Progress in the Methodology of Writing to Learn

During the most recent decade, experimental studies have continued to take place. Most have shown significant effects of writing on learning (Atasoy, 2013; Drabick, Weisberg, Paul & Bubier, 2007; Gingerich et al., 2014; Yildiz, 2012); at the same time, some studies have shown null or limited effects (e.g., Linton et al., 2014; Spirgel & Delaney, online 2014; Yassin & Yong, 2013). Researchers have measured the effects of writing on learning in varied ways, over both short time scales such as the particular

writing activity, and longer time scales such as the unit of study or the academic year (Correnti, Matsumura, Hamilton & Wang, 2012; Schumacher & Nash, 1991; Tomas & Richie, 2014).

The recent application of more refined research methods has led to a greater consensus on the effects of writing on learning. Notably meta-analysis, although not a new method, has recently permitted a systematic integration of numerous, disparate findings. Bangert-Drowns et al. (2004) reviewed previous experiments, most of which compared writing-intensive units of study to units that were not writing intensive. Overall, writing had effects on learning that were significant, but on average, small. These effects varied according to particular instructional conditions, from null to medium in size.

In a recent meta-analysis of the effects of writing on reading, Graham and Hebert (2011) found that writing improved reading comprehension, for both average and weaker readers and writers. This was true of four types of writing: extended writing (e.g., persuasive writing); summary writing; note taking; and answering or generating questions. The effect size was d = .37, which is comparable to the effectiveness of other interventions for reading comprehension. Effect sizes were significantly higher in middle school than high school. Further, instruction in writing (process writing, text structure, or paragraph/sentence construction) improved students' reading comprehension, although only half of studies met two-thirds of a set of quality indicators. Increasing the amount written by students improved their reading skill, but here too, the quality of studies was uneven. A subsequent meta-analysis showed that, contrary to some often-repeated claims, there was limited evidence for differences in the effects of various genres of writing activities; more on this below (Hebert, Gillespie & Graham, 2013). These meta-analyses each presented further information about interaction effects, sampling and limitations.

Another way in which meta-analysis has contributed to a more nuanced view of the effects of writing on learning is by identifying moderator variables. These are variables that make the effect on a dependent variable larger or smaller. Meta-analyses have addressed the effects of moderator variables such as the following: Instruction in writing versus writing without instruction (Graham & Hebert, 2011); the educational level of students (Bangert-Drowns, et al., 2004); the frequency and duration of writing activities; the type of discipline in which students write (Bangert-Drowns et al., 2004); and methodological features such as the type of dependent measure (Hebert et al., 2013).

The identification of moderator variables has also been supported by the use of analysis of variance and multivariate analysis of variance. These methods have shown that learning is affected by several kinds of interactions: The interaction between media (writing versus talk) and achievement level (Rivard, 2004); the interaction between individual traits such as level of self-monitoring and the type of writing task (Galbraith, 1996; Kieft, Rijlaarsdam, & van den Bergh, 2008); and the interaction between the writer's knowledge or achievement level, and the type of activity or instructional

support (De La Paz & Wissinger, 2015; Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Hebert, Graham, Rigby-Wills & Ganson, 2014).

The consideration of moderator variables raises cautions about method. For example, some studies in the WTL literature have relied on dependent measures similar to the writing treatment condition. These "treatment inherent measures" are a concern (see Hebert et al., 2013 for a review), because there is evidence that writing interventions impact treatment inherent measures more powerfully than other measures (Hebert et al., 2013; Linton, Pangle, Wyatt, Powell & Sherwood, 2014).

A third recent methodological development has been the identification of mediating variables. A mediating variable is one that is affected by an independent variable (here,, writing), and which in turn affects the dependent variable (here, learning). Mediating variables are represented in hypotheses about the possible "active ingredients" in WTL. Data on mediating variables is collected using methods such as textual analysis and verbal think-alouds. During the 1980s and 1990s, several researchers measured such variables (Durst, 1987; McCrindle & Christensen, 1995; Newell & Winograd, 1995). However, they did not use statistical methods to test whether these variables actually exerted a mediating role. More recently, methods such as path analysis have been used for this purpose (e.g., Glogger, Schwonke, Holzäpfel, Nückles & Renkl, 2012; Klein & Kirkpatrick, 2010; Leopold, Sumfleth & Leutner, 2013; Petko, Egger & Graber, 2014; Wäschle, Gebhardt, Oberbusch & Nückles, 2015; Wäschle, Lehmann, Brauch & Nückles, 2015). These have supported the mediating role of elements such as cognitive strategies in WTL. The results of this research will be discussed below in the section on psychological processes in WTL.

3. Trends in Understanding Psychological Processes: From the Written Medium as Agent, to Self-Regulation and More

This section will focus on the how of WTL with respect to psychological processes. We will address trends in research on three questions: What regulates the psychological process of WTL? Do elaborative cognitive processes contribute to learning? Do spontaneous cognitive processes contribute to learning?

3.1 The 1970s and 1980s: Written Text as a Causal Agent

Early literature on writing across the curriculum frequently assumed that it was text, as a medium, that inherently elicited specific cognitive processes, and that these processes resulted in learning. The work of James Britton (1972/1982a, 1982b) was particularly influential in both Britain and the United States. He proposed that much of the writer's knowledge is initially tacit. When the writer begins an utterance, he or she sometimes does not know how it will be completed. Writing allows the syntax and semantics of language to shape this knowledge "at the point of utterance." Britton drew a theoretical connection between expressive writing and the Vygotskian notion of "inner speech," which like expressive writing, is a type of discourse directed toward the self.

Based on this theory, Britton advocated the increased use of expressive writing in classrooms. He based this recommendation on a large research project in British schools (Britton, Burgess, Martin, McLeod, & Rosen, 1975). However, this project simply documented that in classrooms, expressive writing was less common than transactional writing. The project did not investigate whether expressive writing really elicits spontaneous cognitive processes; nor did it investigate whether expressive writing and spontaneous cognitive processes contribute to learning. In spite of this lack of relevant evidence for Britton's claims, during the 1980s his recommendation of expressive writing was regularly cited in the writing across the curriculum literature (e.g., see volumes by Fulwiler & Young, 1982; Gere, 1985; Thaiss, 1986;). This preference for expressive writing included related practices such as freewriting, inkshedding, and the writing of informal essays (Elbow, 1973, 1981; Murray, 1980; Thompson, 1990). The point that we wish to highlight here is that under this theory, writing was thought to lead relatively automatically to learning, without requiring specific strategies on the part of the writer.

Another early conception that attributed learning to writing, per se, was advanced by Emig (1977). Her influential paper on "Writing as a Mode of Learning" enumerated the characteristics of writing that she believed "uniquely" correspond to learning strategies. For example, successful learning strategies "make generative conceptual groupings, synthetic and analytic," just as writing "establishes explicit and systematic conceptual groupings through lexical, syntactic, and rhetorical devices" (p. 128). Metaphorically, we might say that this view ascribed agency, not so much to the writer, as to the textual medium itself.

3.2 The 1980s and Early 1990s: The Writer as Strategic Agent

During the early 1980s, cognitive models emerged that conceptualized writing as a strategic process of goal-directed problem solving; the work of Hayes and Flower (1980) was particularly influential (Flower & Hayes, 1981a, 1981b; Hayes and Flower, 1980; for a review, see Alamargot & Chanquoy, 2001). These new cognitive theories ascribed a high degree of agency to the writer, whose goals, motives, knowledge, strategies, and decisions determine the course of the writing process, and consequently the effect of writing on learning (Hayes, 2012; Kellogg, 2008; McCutchen et al., 2008). An important implication of the cognitive view is that there is nothing inherent in written text as a medium that guarantees learning; rather, the specific strategies that the writer applies to the task are critically important. Thus, a theme in the cognitive tradition has been that learning during writing requires relatively sophisticated goals, complex strategies, and high levels of knowledge about writing, which generally characterize more experienced and skilled writers (see Klein, 1999 for a review). For example, in the influential cognitive theory of Bereiter and Scardamalia (1987), the central distinction is between writers who transform knowledge during writing and those who tell what they already know. Novice writers typically engage in knowledge-telling, in which the writer uses topic knowledge, genre knowledge, and the

proposition currently in working memory, to retrieve the subsequent proposition from long term memory; this proposition is then translated into text. In contrast, expert writers engage in a strategic process of knowledge transforming, based on a dialectical interplay between the elaboration of the rhetorical message of the text, and the construction of the knowledge content of the text.

These new cognitive theories contradicted Britton's view that spontaneity in writing is the condition for learning. Conversely, the new cognitive theories were consistent with Applebee's (1984) review of WTL, mentioned above. Applebee drew on Craik and Lockhart's (1972; Craik & Tulving, 1975) depth of processing theory, proposing that writing contributes to learning to the extent that the writer elaborates relationships among ideas. From this, Applebee drew the implication that different kinds of writing activities have different effects on learning; for example, summarization may lead the writer to recall a broad range of content, while analytical essay writing may increase the writer's understanding of the specific relationships that are the focus of the text. These views illustrate the connections between sholars' beliefs about the psychological processes thought to lead to learning, and the genres that they recommend.

3.3 Mediating Processes in Learning

Following on the mixed reviews by Applebee (1984) and Ackerman (1993), Klein (1999) reframed the question, not as, does writing cause learning, but through what cognitive processes does writing affect learning? That is, what cognitive processes differentiate between instances of writing that lead to learning, and those that do not? He identified four kinds of theories about WTL in the previous literature. These theories implicated processes that ranged on a spectrum from relative spontaneity to greater planfulness and complexity. At the spontaneous end of the spectrum was the shaping at the point of utterance theory described above (Britton, 1982b; cf., Elbow, 1981; Galbraith, 2009). The next most complex, forward search, was the theory that writing allows individuals to externalize ideas, so that they could review these ideas and construct inferences, evaluate, and modify them (Young & Sullivan, 1984). The third type, genre theory was the conception that various text genres invite the elaboration of different types of relationships among concepts (Applebee, 1984). The fourth, backward search, was the theory that the setting of goals and subgoals is integral to knowledge transforming during (Bereiter & Scardamalia, 1987). Klein concluded that each theory was supported by some research, but at that time, none had conclusive support.

Since the turn of the millennium, there has been an increasing trend to closely theorize and investigate the psychological processes involved in learning during writing. Perhaps the longest continuing idea in research on WTL is that each genre of writing evokes particular forms of reasoning, which in turn lead to different kinds or degrees of learning (Applebee, 1984; Wiley & Voss, 1996, 1999). This literature has produced two paradoxical but logically reconcilable findings.

On one hand, writing assignments in different genres do not consistently yield correspondingly different effects on learning. Contrary to Britton's initial proposal,

expressive writing does not contribute more to learning than writing in other genres (for reviews and meta-analyses, see Ackerman, 1993; Graham & Hebert, 2011; Stotsky, 1995). Similarly, another much-favoured genre has been argumentation, which is thought to elicit critical thinking and learning. Some studies have shown that argumentation contributes more to thinking or learning than writing in other genres (e.g., Langer and Applebee, 1987, Chapter 6, 8; Wiley and Voss, 1999). However, other studies have not replicated these differences in genre effects (Langer & Applebee, 1987, Chapter 7). A recent meta-analysis found no differences between the following pairs of writing activities, on most measures of reading comprehension: extended writing (frequently argumentation) versus answering questions; summary versus answering questions; summary versus note-taking; answering questions versus note-taking (Hebert, Gillespie & Graham, 2013). Extended writing was more effective than question answering, but only on measures that involved extended writing; and summary was more effective than question answering on measures of free recall.

On the other hand, path analysis and analogous methods have supported the role of genre -appropriate reasoning in learning. With respect to argumentation, Klein and Kirkpatrick (2010) found that students' genre knowledge predicted their text quality, which in turn predicted their learning (cf., Klein & Samuels, 2010). Klein, Piacente-Cimini and Williams (2007) found that in an analogy writing activity, students who included more analogical moves (e.g., comparing features of the source and the target), showed greater learning. In learning protocols (similar to learning journals), Glogger, Holzäpfel, Schwonke, Nückles and Renkl (2009) found that greater use of cognitive operations in text lead to greater learning (Glogger et al, 2012; Klein 2000, 2004; Wäschle, Gebhardt et al., 2015).

How can these seemingly contradictory findings on the effects of genre on learning be reconciled? One possible answer is that differential effects of genre writing occur largely within genre, rather than between genres. That is, differences between genres in their effects on learning appear only occasionally (e.g., Wiley & Voss, 1999; Gil, Bråten, Vidal-Abarca & Strømsø, 2010). However, differences within a given genre, between students who engage in genre appropriate reasoning operations, versus those who do not, appear more consistently. In short, the effect of the genre on learning may depend on the student's ability to understand and fulfill the reasoning operations that it invites.

3.4 Self-Regulation in Writing to Learn

A related topic on which there has been marked progress during the past decade has been the role of self-regulation of writing processes during learning. "Self-regulation" refers to the goal-directed, strategic process of monitoring and controlling one's own psychological processes. As we saw above, early theories that ascribed agency largely to the textual medium are at odds with cognitive theories of WTL, which ascribe agency to the writer. Empirical research has largely supported the latter view. In the Bangert-Drowns et al. (2004) meta-analysis noted above, a significant mediating

variable was the use of metacognitive writing prompts, that is, prompts that required students to reflect on their own learning. In a related finding, Klein, Boman and Prince (2007) used think-aloud protocols and textual analysis followed by path analysis to show that what Klein called "metacognitive writing operations" (goal setting, organizing, evaluating, revising) contributed unique variance to learning, independently of more basic operations such as generating ideas and transcribing text. Berthold and colleagues (2007) found that metacognitive strategies, such as checking understanding, made a significant contribution to learning, independent of the contribution of cognitive operations, such as elaborating knowledge (cf., Glogger et al., 2012; Nückles et al., 2009; Petko et al., 2014).

The implication of research on self-regulation is that it is possible to teach students metacognitive strategies that increase the effectiveness of writing as a tool for learning. The mostly heavily researched form of cognitive strategy instruction in writing has been Self-Regulated Strategy Development (SRSD; Graham, McKeown, Kiuhara & Harris, 2012; Harris & Graham, 1996). In the first decade of research, SRSD was exclusively concerned with learning to write. Evidence shows that both the teaching of particular writing strategies, and the teaching of self-regulatory processes in which students set goals and monitor their writing process, contribute to text quality (Graham et al., 2012). During the past decade, research has expanded from using strategy instruction for learning to write, toward also using strategy instruction to write to learn (see MacArthur, 2014 for a review). Some of this research has specifically employed SRSD (e.g., De La Paz & Felton, 2010), while other research has employed different approaches to teaching writing strategies (e.g., Martínez, Mateos, Martín & Rijlaarsdam, 2015).

Researchers have investigated the effect of writing strategy instruction on learning in several domains: literature (Boscolo & Carotti, 2003; Kieft, Rijlaardam & van den Bergh, 2006; Kieft et al., 2008; Lewis & Ferretti, 2009, 2011; Wong, Kuperis, Jamieson, Keller, & Cull-Hewitt, 2002); science (e.g., Hand, Wallace & Yang, 2004); and history (De La Paz & Felton, 2010; Martinez et al., 2015). Strategy instruction has also improved students' writing and learning in tasks such as discourse synthesis (Britt & Rouet 2012; Gelati, Galvan, Boscolo, 2014; Martínez et al., 2015). The same is true of learning protocols (similar to learning journals): The teaching of cognitive operations and the teaching of metacognitive (self-regulatory) operations each contribute significantly to learning during writing (Berthold, Nückles & Renkl, 2007; Hübner, Nückles, & Renkl, 2010).

We will return to focus on strategy instruction in the section below, in which we consider the shift toward discipline-specific approaches to WTL. In the meantime, we will note that studies employing strategy instruction have produced significant, and sometimes large, effects on learning during writing. Another important result of instruction in self-regulation, which has emerged during the past decade, has been the finding that it contributes to learning for students who are low-achieving and students who have learning disabilities (e.g., Ferretti, MacArthur, & Okolo, 2001; Taylor, Therrien, Kaldenberg, Watt, Chanlen, & Hand, 2012; Wong et al., 2002). At the same

time, a national survey of secondary teachers in the United States suggests that most teachers do not use of strategy instruction to support writing to learn (Gillespie, Graham, Kiuhara, & Hebert, 2014), suggesting that this is an important focus for professional development.

3.5 Other Recent Trends in Research on Psychological Processes

In addition to the significant effect of self-regulatory operations, there has also been a strand of research concerning the role of spontaneous processes in learning. Galbraith (1992; 1999; 2009) created a new kind of theory of WTL that ascribes learning to spontaneous writing processes (Elbow, 1973, 1981). His knowledge constituting model uses the contemporary framework of parallel distributed processing. Galbraith has tested this model indirectly, through studies that show that drafting activities, which favour spontaneous writing, are relatively effective for students who are low self-monitors; conversely, writing activities based on rhetorical planning are more effective for students who are high self-monitors (cf., Ong, 2013).

Finally, a very recent trend has been to apply Cognitive Load Theory to WTL. Working memory plays a critical role in writing and writing to learn (e.g., Galbraith, Ford, Walker & Ford, 2005). Cognitive load theory concerns principles for designing instruction to (a) reduce load on working memory that is extraneous, that is, caused by inefficient instructional methods; and (b) to maintain at an optimal level intrinsic working memory load, which directly concerns the relationships central to schema formation (Sweller, Ayres, & Kalyuga, 2011). This theory was initially developed to support learning in domains characterized by algorithmic problem solving, such as mathematics. More recently, researchers have begun to extend cognitive load theory to less algorithmic domains, such as written composition (Schworm & Renkl, 2007; Si & Kim, 2011; Zhu & Zhang, 2005). Writing in general has shown several kinds of cognitive load effects, so it will be of interest to discover whether these are also applicable to the effects of writing on learning. To date, one finding seems to be expertise reversal, in which relatively low knowledge writers benefit from low cognitive load conditions, while relatively knowledgeable writers are either less advantaged, or even disadvantaged, by low cognitive load conditions (Klein & Ehrhardt, 2013, April; Klein, Haug, & Arcon, 2015, August; Nückles, Hübner, Dümer & Renkl, 2010).

4. Trends in the Genre of Writing to Learn: From Writing Across the Curriculum to Writing in the Disciplines

This section will focus on another major trend in the what of WTL: What kind, or genres, of writing activities potentially contribute to learning? And, what is the relationship between disciplines and genre in WTL?

4.1 4.1 Early Writing to Learn: Writing As Domain-Neutral

As we noted above, Britton's influential view was that the most appropriate form of writing was expressive, which often took the form of journaling. A related approach was one in which students would begin with freewriting, and then develop a more formal text through a process of drafting and revision (e.g., Britton, 1982b; Elbow, 1981). A different view at the time was that the argumentative (or "analytical") essay or theme was most appropriate because it encourages depth of processing (Langer, & Applebee, 1987; Stotsky, 1995). What these views had in common was that they implied that a certain genre of writing would lead to learning across a variety of disciplines. We will refer to this as a "domain-general" or "discipline-neutral" view.

It is notable that these genres (journal, essay) were derived primarily from the humanities, and experts in the early writing across the curriculum movement were generally teachers or professors trained in the humanities. For example, Zinsser's influential (1988) book, *Writing to Learn*, carried the telling subtitle, *How to Write and Think Clearly About any Subject at All*. Throughout the book, Zinsser expressed a conception of "good writing" that took the humanities as a standard, and took popular nonfiction in the sciences and social sciences as exemplary texts. For example, in the chapter on "Crochets and Convictions," Zinsser emphasized that good writing is dependent on organization, brevity, and the avoidance of jargon. Later in the book, he pleaded with scientists: "Reduce your discipline—whatever it is—to a logical sequence of clearly thought sentences. You will thereby make it clear, not only to other people, but to yourself. You will find out whether you know your subject as well as you thought you did" (p. 198).

4.2 Context for Change: Writing in the Disciplines

In the meantime, discipline-neutral conceptions of writing were being challenged by the movement toward writing in the disciplines (hereafter 'WID"). An influential early paper was Bazerman's (1981) "What Written Knowledge Does: Three Examples of Academic Discourse." It analyzed three texts, from sociology, biochemistry, and literary criticism, respectively. Bazerman showed that the three texts differed in the kinds of objects under study, the traditions of the disciplinary literature, the anticipated audience, and role of the author. Perhaps most relevant to writing to learn, he documented striking differences concerning the conceptions of evidence and argumentation in each discipline. He described, for example, how Hartman's (1978) review of Wordsworth's poem, "Blessing the Torrent," used the reviewer's own writing to evoke an aesthetic state of mind that would allow the reader to experience the poem in a new way. Bazerman concluded that "In mediating reality, literature, audience and self, each text seems to be making a different kind of move in a different game" (1981, p. 46; cf., Myers, 1985). This belief that the nature of writing is specific to each discipline was consistent with social theories of writing, such as sociocultural theory, which proposed that each genre has evolved historically, under the influence of specific institutional structures and disciplinary cultures, and expresses corresponding

epistemological commitments (Bazerman, 1988; Olson, 1994; Russell, 1997). For a review of writing and rhetoric in various academic disciplines, see Bazerman et al., (2005).

4.3 Discipline-Specific Conceptions of Writing to Learn

Educationally, scholarship in WID suggested the need to shift writing education and writing as a learning activity, from the domain-general conception of writing across the curriculum, toward a more domain-specific conception (Bazerman et al., 2005; Russell, 1997). During the 1990s, many college writing educators and researchers began to explicitly treat writing as a practice that is inter-twined with disciplinary forms of communication, inquiry, and argumentation. They also treated disciplinary instructors as collaborators in shaping pedagogy and research (e.g., Monroe, 2002; Walvoord, Hunt, Dowling, McMahon, Slacker & Udel, 1997). For example, Carter (2007) collected data on the development of educational outcomes across faculties and departments in a large state university. He found that four "meta-genres" characterized intended outcomes related to writing; several disciplines used more than one of them.

Early in the millennium, research on WTL in elementary and secondary education also began to shift toward more discipline-specific genres and practices. An extensively researched approach was the Science Writing Heuristic (SWH; Akkus, Gunel & Hand, 2007; Benus, Yarker, Hand, & Norton-Meier, 2013; Keys, Hand, Prain & Collins, 1999; Hand, Wallance & Yang, 2004). This approach is based on the conception that professional science is a community of inquiry mediated largely by writing. The SWH creates analogous communities in elementary and secondary classrooms. Students carry out an inquiry process, in which activities such as small group discussion, hands-on inquiry, large group discussions, and reading occur cyclically. Weaving through this process and connecting the phases are individual and collaborative writing activities. Students' writing is guided by a template that is similar to a scientific research report, but with the elements of argumentation strongly foregrounded. As with disciplinary science, the process includes peer collaboration and review through small and large group activities, with an emphasis on proposing explanations and evaluating them on the basis of evidence.

At the same time, in *Writing as a Learning Tool*, both Olson (2001) and Nelson (2001) referred to the role of the disciplines and professions in shaping personal literacy and learning, which suggests a domain-specific aspect. However, in the early 2000s, domain-specific approaches in elementary and secondary WTL were still the exception. Particularly in work that was psychologically-oriented, discipline-neutral practices continued to be foregrounded; typical examples of research topics included journal writing (Cantrell, Fusaro & Dougherty, 2000; Klein, 2000), note-taking and essay-writing (Slotte & Lonka, 2001), portfolio creation (Linnakylä, 2001), and writing with technology (Hartley & Tynjälä, 2001).

In the past decade, the trend toward discipline-specificity in WTL has accelerated, and spread to elementary and secondary writing, and to psychologically oriented

research. Earlier, we noted the important role that strategy instruction has played during the past decade; much of this has been discipline-specific. MacArthur (2014) has recently reviewed cognitive strategy instruction research in writing at the elementary and secondary level in three disciplines: Science, history and literature. For example, during the 2000s, research on WTL in history became largely discipline-specific in its approach (De La Paz, 2005; De La Paz and Felton, 2010; Ferretti, MacArthur & Okolo, 2001; Wiley, Steffens, Britt, and Griffin, 2014; van Drie, van Boxtel & Braaksma, 2014). To develop this approach, writing researchers used studies in which professional historians reasoned about contested issues (Seixas, 1993; Wineburg, 2001). Researchers then typically created sets of materials, such as primary source documents, which students could use to inform writing about a controversial question. In this context, students were taught to read historical materials, interpret them critically, and use them as evidence in arguments (De La Paz, 2005; De La Paz and Felton, 2010; Ferretti et al., 2001; Wiley et al., 2014; Van Drie et al., 2014). In a recent study, De La Paz and Felton (2010) taught students a multi-step strategy for reading historical documents critically; and followed this with a Self-Regulated Strategy Development approach to teaching argument writing (De La Paz & Graham, 1997). MacArthur (2014) noted positive effects in the literature on cognitive strategy instruction in WTL in history, as well as limitations on the number studies to date, and their methods; he called for further replication.

During the 2000s, writing educators also developed discipline-specific, cognitive strategy approaches to WTL in literary studies (Boscolo & Carotti, 2003; Lewis & Ferretti, 2009, 2011). In one of the most discipline-specific approaches, Lewis and Ferretti (2009) drew on a previous analysis of the strategies (*topoi*) that literary critics apply to interpret texts (Fahnestock & Secor, 1991). The researchers translated these *topoi* into reading and writing strategies, which they taught to secondary students, with significant effects. The reader is referred to MacArthur (2014) for a detailed review of strategy instruction in literary studies.

This development of discipline-specific approaches in WTL has paralleled similar developments in the related subdiscipline of content area literacy education. Researchers have increasingly challenged the notion that discipline-neutral content literacy practices, such as journal writing and general reading comprehension strategy instruction, are sufficient for literacy and learning in each specific discipline. For example, Siebert and Draper (2008) carried out a content analysis of influential content literacy resources for math teachers. They showed that these sources, even where they purported to address mathematics, neglected the distinctive nature of mathematics with respect to representations, reading strategies, conceptual content, and texts. They noted that content area literacy resources have typically been shaped by psychologists and literacy scholars, rather than by disciplinary educators. Siebert and Draper argued for broader definitions of texts and literacy, which would include disciplines such as mathematics. This was one of several recent calls to teach students the particular forms

of reading, reasoning, and writing needed in specific secondary school subjects (Moje, 2008; Shanahan & Shanahan, 2008).

4.4 Limitations of the WAC versus WID Distinction in Writing to Learn

We have sketched a trend in the WTL literature, from the relatively domain-neutral Writing Across the Curriculum approach, toward a more domain-specific Writing in the Disciplines approach. It should be noted that our interpretation of these developments is somewhat different from that of McLeod and Maimon (2000), who challenged the "myth" that writing across the curriculum is opposed to writing in the disciplines. They argued that from the outset, WAC involved a collaboration of writing educators with disciplinary educators, and that this collaboration supported disciplinary learning and reasoning.

We should also note that contemporary WTL continues to include discipline-neutral practices, and the effectiveness of these practices is strongly supported by empirical research. For example, the reflective journal entry (or learning protocol) is a relatively discipline-neutral genre. Several studies and a meta-analyses have shown that writing in this genre reliably contributes to learning (Bangert-Drowns et al., 2004; Hübner, Nückles, & Renkl, 2010; Nückles, Hübner, & Renkl, 2009; Uzoglu, 2014). Combining these elements, McNeill and Krajcik, (2009) investigated the role of domain-general and domain-specific argumentation in science; the authors concluded that each makes a distinct contribution to learning (cf., Mason & Boscolo, 2001).

There is also a further complication to the WAC/WID distinction in WTL. Although research in this area has become more discipline-specific, there is a sense in which it has evolved, not primarily toward writing in the disciplines, but instead toward reading in the disciplines. In some projects, researchers have taught strategies, which are specific to a given discipline, for critically reading and interpreting documents; the student's critical interpretation then becomes the content for an essay composed using a discipline-neutral argument strategy (e.g., De La Paz & Felton, 2010). The fact that such writing is relatively discipline-neutral probably reflects educational and developmental considerations. Writing in the disciplines, with the goal of producing texts similar to those of professionals, is a goal that is authentic for students in graduate or professional school. However, it is less authentic for students at the elementary or secondary level, whose goal is usually to gain an initial understanding of disciplinary knowledge and methods. For these younger students, writing in a subject area may be considered a "school genre," that is, a genre with a purpose and structure that is relatively specific to writing in schools. Writing in a school genre may be a way to introduce elementary and secondary students to disciplinary knowledge and aspects of disciplinary reasoning, although the product may be dissimilar to professional writing in the same discipline (Bazerman, 2009; Berkentotter & Huckin, 1993).

4.5 Discourse Synthesis

Discourse synthesis, or writing from sources, is an activity in which a writer draws on several source texts, integrating information and synthesizing a new text (Mateos et al., 2014; Segev-Miller, 2007; Spivey, 1997). The research on discourse synthesis overlaps with other research literatures in which students integrate multiple sources to create a text, such as the literatures on argumentation, and on reading comprehension from multiple documents (Britt & Rouet, 2012; Wiley & Voss, 1996). With respect to process, Spivey (1997) noted that writing from sources requires authors to select, connect and organize information to construct a new text. This construction requires writers to remap content from across different source texts, decomposing sources and re-composing them to create a structure that differs from any one source (Boscolo, 1996; Segev-Miller, 2007). Cognitively, this requires writers to construct an intertext model, which is comprised of intertext predicates relating elements of two or more texts (Britt & Rouet, 2012). This typically requires a recursive process, in which the writer iteratively cycles between reviewing sources and composing (Mateos et al., 2008). This is a strategic process that requires self-regulation (Britt & Rouet, 2012; Mateos et al., 2008). The ability to carry out discourse synthesis depends on the student's conceptual model of the writing from sources task (Britt & Rouet, 2012; Segev-Miller, 2007; Smeets and Solé, 2008).

On the face of it, the process of discourse synthesis is also a process of learning. The product of discourse synthesis is a unique integration, which may go beyond the information given in the sources (Segev-Miller, 2007; Martínez et al., in press). Consistent with this, Mateos and colleagues have shown that teaching a discourse synthesis strategy to students can improve both their writing and their conceptual learning (Mateos, Solé, Martín, Cuevas, Miras, & Castells, 2014; cf., Britt & Rouet 2012; Gelati et al., 2014; Reynolds & Perin, 2009). For example, in one recent study, Martínez et al. (2015) taught sixth year students a strategy for writing from sources, in which they interpret each source, construct a concept map for each source, construct a concept map that integrates the various sources, and draft a text. The strategy instruction included modelling, collaborative writing, and finally individual writing. Relative to a control group that read the same sources, the instructional group showed significant increases in complexity of writing processes, text quality, transformation of content, and content learning.

It has been proposed that in multi-source writing tasks, genres such as argumentation and explanation, which require an integrated product different in genre from the source texts, contribute more to learning than tasks in which the product is in the same genre as the source texts (Britt & Rouet, 2012; Cerdán & Vidal-Abarca, 2008; Wiley and Voss, 1996, 1999). As we have noted, there is no clear consensus on this issue in the research literature. Previous studies have shown that both summary and discourse synthesis, which do not require the transformation of sources into a new genre, nonetheless require integrative activity, and can result in the growth of conceptual knowledge (Gelati et al. 2014; Martinez et al, 2015).

An additional question that has arisen in argument writing concerns the distinction between deliberation and persuasion. It has been proposed that persuasive argumentation (i.e., disputation) invites writers to defend their preconceived opinions; whereas deliberative argumentation (discussion or exploration) encourages writers to consider alternative claims and make reasoned judgments. However, in spite of this interest, the question of whether written discussion and deliberation differ in their effects on learning has seldom been investigated empirically. Differences in the effects of persuasion and deliberation goals on oral and written discourse are significant but complex (e.g., Nussbaum & Kardash, 2005). One study has shown a main effect of deliberative peer talk over a control condition, but not over disputatious peer talk, on subsequent writing and learning (Felton et al., 2009); the other study has shown more complex interactions between type of argumentation and previous writing achievement (Klein & Ehrhardt, April 2013). This is a topic for further research.

4.6 Combining Text with Other Media

A marked recent trend in research on genre and WTL has concerned the multiplicity of literacies. Historically, it was common to contrast the supposed powers of written text with the lesser or different powers of other media (Emig, 1977; McLuhan, 1962; Ong, 1982). Consequently, until recently "writing to learn" was almost exclusively conceived as textual. This was sometimes tempered by a consideration of the role of talk in relation to writing (see Klein, 1999 for a review). However, during the 1980s and 1990s, the superiority of text for thinking and learning came under increasingly critical treatment across the humanities. Cross-cultural and linguistic research showed that writing and speech have characteristics and uses that are overlapping and heavily dependent on social context and genre (Biber & Vasquez, 2008; Scribner & Cole, 1981; Street, 1984).

At the same time, semioticians argued that many aspects of culture can be considered to comprise sign systems analogous to language. Some scholars drew out the implications of a semiotic approach for thinking and learning (Smagorinsky, 1995; Suhor, 1984; Unsworth, 2011). They showed, for example, that in the professions and in school subjects such as science, a variety of kinds of representations are integral to the construction of knowledge (Kress, Jewitt, Ogborn & Tsatsarelis, 2001; Smagorinsky, 1995). This diversity of media has often been discussed under the rubric of the New Literacies or multiliteracies (Baker, 2010; Leu, Kinzer, Coiro, & Cammack, 2004). For example, Carter (2007) noted in his study of writing in university departments that fine arts departments framed intended outcomes mainly in terms of non-written performances and products. Consistent with this new recognition of the diversity of sign systems in education, writing to learn during the 2000s expanded to include the combination of writing with other kinds of media. In effect, WTL came to include "composing across the curriculum" (Smagorinsky, 1995) and "electronic writing across the curriculum" (see volume by Reiss, Selfe & Young, 1998).

This diversification of media appears to be well-founded; several recent studies have shown greater learning from activities in which students create multimodal representations than from activities that comprise writing only (Demirbag & Gunel, 2014; Leopold & Leutner, 2012; Leopold, Sumfleth and Leutner, 2013). The effect of creating multimedia representations promises to be a topic of continuing research. Hand and his colleagues have carried out a ground-breaking program of experimental research on the effects of students creating products that integrate textual and nontextual media, such as PowerPoint slides, equations, and graphs, empirically comparing the effects of various combinations and sequences of these representations on science learning (e.g., Gunel, Hand & Gunduz, 2006; Hand, Gunel & Ulu, 2009; McDermott & Hand, 2013).

5. Trend: From the Individual Writer to the Social-Cognitive System

In an earlier section, we noted that the conception of causal agency in writing has shifted from the textual medium to the individual writer. In this section, we will further explore trends in research about who is involved in WTL, with a consideration of the writer in a broader social and technological context.

5.1 1970s and 1980s: Limited Theorization of Social Aspects of Writing to Learn

As we have seen, from the 1970s through the 1980s, learning through writing was attributed to internal psychological dynamics, triggered either by the text as a medium (Britton, 1982b; Emig, 1977), or by strategies internal to the writer (Bereiter & Scardamalia, 1987). This individual and internal focus was mirrored by an emphasis on journal writing, a type of text that was composed by the individual writer primarily for himself or herself (volumes edited by Gere, 1985; Thaiss, 1986; Young & Fulwiler, 1986). At the same time, however, WTL was supported by practices that were inherently social. These included instruction and feedback from the teacher and collaboration with peers (Elbow, 1981; Langer & Applebee, 1987; Rosaen, 1989, 1990; Thompson, 1990). However, in this early literature, the social aspects of WTL were not highly theorized.

5.2 The Turn Toward Social Theories in Writing

From the 1980s through the present, social theories have played an increasingly important role in writing research (Nystrand, 2006; Prior, 2006; Russell, 2013a). One influential perspective has been sociocultural theory, including Cultural and Historical Activity Theory (Engeström, 2009; Russell, 1997). Other related theories have included distributed cognition and situated cognition (Carter, 2007; Englert, Mariage & Dunsmore, 2006; Haas & Witte, 2001; Klein & Leacock, 2012). Each of these theories is different, but they share overlapping subsets of the following ideas: Writing practices and text genres have been constructed over historical time; they have been shaped by

macrosocial, institutional, and microsocial contexts; many written texts are the product of several contributors, including one or more authors, reviewers, and editors; writing practices make use of multiple tools; writing practices are learned through instruction and apprenticeship; and each writing practice is, to some degree, particular to a given social context and does not transfer readily to other contexts.

In discussing the rise of social theories of writing, several authors (Nystrand, 2006; Prior, 2006; Starke-Meyering & Paré, 2011) have acknowledged the contributions of cognitive theories, but claimed or implied that these were inadequate because they did not address social, historical or political aspects of writing. To various degrees, they have suggested that cognitive theories of writing have been replaced by social theories. We agree that there has been a marked development of the social theorization of writing from the 1980s through the present. However, we believe that this replacement narrative is mistaken in three important ways. First, as we have shown above, cognitive theories have been very strongly supported by empirical research; secondly, they have continued to influence theoretical work, empirical research, and pedagogy; and thirdly, as will become apparent below, the "social" theories are each actually comprised of both social and cognitive elements.

5.3 Theorizing the Social Aspect of Writing to Learn

We will not describe the social theories of writing in detail here; for a comparison of these theories, see Nardi, 1996. Rather, we will focus on the connections that have recently been made between social theories of writing and research on WTL. Among social theories, the one that has perhaps most frequently been discussed in relation to WTL is sociocultural theory. For example, several contributors to *Writing as a Tool for Learning* identified sociocultural theory as important influence (Nelson, 2001; Olson, 2001; Tynjälä et al., 2001). Olson (2001), for instance, noted that literacy allows access to literate institutions, and that it affects individual consciousness of both language and forms of argumentation. Tynjälä and colleagues (2001), referring to Vygotsky's work, discussed the complementary nature of cognitive and social constructivist theories, noting that "these individual processes always have a social and cultural history" (p. 14). More recently, Bazerman (2009) has proposed that Vygotskian sociocultural theory provides a perspective on the role of genre in WTL: Socialization into a genre allows the learner to use it as a perspective on knowledge, as well as a vehicle for communication, and in this way, to restructure knowledge.

A particular development of sociocultural theory, which shapes current thinking about WTL, is activity theory. This is an object-oriented theory that conceptualizes writing in terms of relationships among tools, the subject (in the sense of an agent), rules or norms, objectives or motives, division of labor, and community (Engestr•m, 2009; Russell, 2009). Russell (2009; 2013a; 2013b) has followed Miller (1984) in conceiving of genre as a form of social action (cf., Bakhtin, 1986). Each genre is then conceived as having a characteristic social function, which is typified and routinized as

a form of tool-mediated action. Genre can then serve as a space in which to support disciplinary learning (Bazerman, 2009; Russell, 1997; 2013b).

Another theoretical perspective that has been used to conceptualize the social aspect of WTL is distributed cognition (Klein & Leacock, 2012; Newell, 2006). According to this theory, in complex human activities, cognition is instantiated in a system comprised of multiple individuals, and both internal and external symbolic representations, often ranged across time and space. For example, external representations can complement individual cognition by structuring activities, providing information, or making inferences transparent by representing information perceptually (Hutchins, 1995; Zhang & Patel, 2006). The writing of disciplinary texts has been proposed as a prototypical instance of distributed cognition (Cronin, 2004; Zhang & Norman, 1994). For example, in professional science, writing is used to construct knowledge in a network that is distributed among authors, reviewers, and editors. More generally, distributed cognition has been used to characterize writing and knowledge construction in academic and professional writing (Freedman & Smart, 1997; Klein, 2014; Newell, 2006; Rivers, 2011). Writing in the professions has been found to be highly collaborative, and mediated by previous texts and by technology (Beaufort, 2008; Haas & Witte, 2001). Distributed cognition has also influenced the understanding of computer-supported collaborative writing (Dillenbourg, Järvelä, & Fischer, 2009; Hewitt & Scardamalia, 1998; Mason, 1998).

A related theory is situated cognition, which proposes that complex cognitive processes are embedded in the context in which they are learned, and that learning is apprenticeship into participation in such a context (Brown, Collins & Duguid, 1989; Robbins & Aydede, 2009). Carter and colleagues (Carter Ferzli & Wiebe, 2004; 2007) investigated LabWrite, a tool that facilitated the writing of lab reports as interpretations of experiments. They found that the effects of this intervention were not limited to internal cognitive processes, but also included impacts on other behaviors that incorporated contextual elements into thinking and learning. For example, students began to re-examine their readings and attend lectures, which in turn affected their learning.

5.4 Social Practices in Writing to Learn

There has been a long-established scholarly and professional literature concerning classroom practices in WAC and WTL (e.g., Nystrand et. al, 2001). These practices can be considered social and cultural in the sense that they typically include multiple participants and mediation by cultural tools. For example, Childers, Gere and Young (1994) noted in *Programs and Practices: Writing Across the Secondary School Curriculum* that first-generation WAC programs were based on the cognitive development of individual students, and that WAC gradually shifted toward learning as a social process, which included collaboration, audience, and social context. We will now discuss research concerning several such processes.

Instruction and Facilitation. In the sections above, we have made several references to the role of facilitation and instruction in WTL (e.g., De La Paz & Felton, 2010; Martinez et al., 2015). These and other studies illustrate the importance of social support for individual cognitive processes (e.g., Carter et al., 2004; Roelle, Krüger, Jansen & Berthold, 2012; Wong et al., 2002).

Collaboration. Early research on cooperative and collaborative learning included writing activities such as "academic controversy" (Johnson & Johnson, 1985). Systematic reviews of cooperative learning research (not specifically of writing) showed the value of both group goals (e.g., a written text), and individual accountability in which each student is required to contribute to the group goal, as significant moderators of learning (see Johnson & Johnson, 2002 for a meta-analysis). During the past two decades, several kinds of WTL activities have included collaboration, the most heavily researched being the Science Writing Heuristic (Hand, Wallace & Yang, 2004). A readership is also an important source of social support for writing to learn (Chen, Hand & McDowell, 2013; Gunel, Hand & McDermott, 2009).

Recently, some studies have qualitatively examined the processes through which collaboration during writing can contribute to learning (Klein 2014; Milian 2005; Nykopp, Marttunen and Laurinen, 2014). To date, a common theme has concerned the extent to which students build on one another's ideas, often by completing one another's sentences. To date, few studies have empirically compared the effects of individual and collaborative writing on learning; an exception was the Felton et al. (2009) study cited above, in which deliberation followed by writing was significantly more effective than individual writing. Further experimental research is needed to investigate the effects of collaborative writing on learning.

Computer supported collaborative learning. Traditionally, computer supported collaborative learning has not been treated as part of the WTL literature. However, CSCL platforms have always included writing as the principle medium for interaction (Dillenbourg et al., 2009; Stahl, Koschmann & Suthers, 2006). One of the first CSCL platforms to be developed was Knowledge Forum (formerly, Computer Supported Intentional Learning Environment), which Bereiter and Scardamalia created partially based on their knowledge transforming model of writing (Bereiter & Scardamalia, 1987; Chuy, Scardamalia & Bereiter, 2012). In CSCL platforms, argumentation is a common genre, providing a vehicle for groups of students to engage in critical thinking, to challenge one another's misconceptions, and to reconstruct their knowledge (Chen & She, 2012; Yeh & She, 2010; (Choi, Hand & Norton-Meier, 2014).

In addition to CSCL, computers have played other roles in writing and learning. For example, Carlson and colleagues (2008) used a platform for calibrating the ability of engineering students to review peer assignments, with initial results that are promising. In other research, the computer has functioned as a tutor, providing contingent scaffolding for learning during the writing process (Schwonke et al., 2006). In yet

another role for computing in WTL, Fisher (2007) created a simulation of a biotechnology organization using a content management system called MyCase. Telecommunication students played the role of consultants. The system supported and evoked writing by using business software such as email. Video-recorded characters provided information and challenges to the writers. This situation provided a realistic context for writing, allowing the cycling of documents for response and feedback.

Many CSCL platforms and methods have combined multiple features. For example, argument-driven inquiry integrates hands-on investigation, training in argumentation, small group discussions, report writing, audience feedback, and masked peer review (Sampson et al., 2013; cf., Chen & She, 2012; Syh-Jong, 2007). It would be desirable to decompose complex CSCL interventions into separate variables for experimental investigation. For example, one recent study used a 2 x 2 design to disentangle the effects of medium (weblogs versus paper and pencil) from the effects of prompting (cognitive and metacognitive prompts versus no prompts). They found that in both media, students in the prompted condition learned more than in the unprompted condition; however, within the unprompted conditions, students in the paper condition learned more than those in the weblog condition (Petko, Egger & Graber, 2014; cf., Braaksma, Rijlaarsdam & Janssen, 2007).

Critical pedagogy. Some authors have conceived of writing as a form of critical social action (Kostouli, 2009; Luke 2012; Russell, 2013b). For example, Russell (2013b) points out that university level WAC has sometimes underscored the authority of disciplines, but it also offers the opportunity to criticize these same disciplines. Similarly, at the elementary and secondary level, content area educators have used writing assignments to engage students in thinking critically about society (Christensen, 1999; Comber, Thomson & Wells, 2001; Huang, 2011). Traditionally, critical pedagogy has not been considered part of "writing to learn." However, writing activities in this tradition can include substantial subject area reasoning and conceptual content. For example, in an interesting series of studies, young children wrote letters as a form of critical social action (Vasquez, 2014). The letter-writing activities involved learning and thinking critically about topics such as conservation and nutrition. To date, research in critical literacy has not included pretests and post-tests of students' conceptual knowledge. We suggest that critical pedagogy would be a context for future research on WTL.

6. Other Meanings of Writing-To-Learn: Epistemic and Reflective Learning

At the beginning of this review, we wrote that the meaning of learning in its relationship to writing has remained somewhat vague, while the role of writing in the acquisition and organization of knowledge in school settings has been emphasized. In fact, there is an instrumentality of WTL that is different from the epistemic one. Learning is not only the acquisition of knowledge and skills in academic settings: learning and writing also take place in professional settings. The role of writing in the

workplace has been examined in depth (e.g., Leijten, Van Waes, Schriver, & Hayes, 2014; Schriver, 2012), although much less than in the school. We can find a different perspective on writing-to learn in professional contexts, where writing is viewed as an aid for reflecting about one's professional competence and performance.

The word 'reflection' has been used extensively in literature on experiential learning (e.g., Kolb, 1984; Schön, 1983), and, not surprisingly, it has been neglected or ignored in psychological studies of thinking. In fact, reflection indicates a person's contact with him/herself, a sort of tacit monologue, through which a person can make a provisional balance of his/her achievements, failures, and doubts or fears, and plan activities. Reflection is conceptualized as a metacognitive practice, in which not only thoughts but also emotions are activated. Writing aimed at stimulating reflection is called reflective, and various studies in vocational education show examples of this type of instrumentality of writing (see Ortoleva & Bétrancourt, 2015). Reflective writing has also been shown to be an effective channel for a variety of emotional expressions and handling them (e.g., Hoover, 1994; Kember, 2001; Kember, McKay, Sinclair, & Wong, 2008; Wade & Yarbrough, 1996). Writing can facilitate reflection and metacognitive processes such as analytic thinking, problem solving, and decision-making. For instance, in critical reflection processes, professionals use higher-order thinking to analyze and evaluate their experiences. In such processes, theory is connected to practice. In modern health-care systems, reflective processes are increasingly related to writing activities (Breuer, Newman, & Newman, in press).

There are common aspects as well as differences between epistemic and reflective writing. One common aspect is that writing is not limited to written text, but can include the writing tools of digital technology, such as wikis, blogs, e-portfolios. For instance, a wiki environment can be appropriate for teachers of the same discipline to share and discuss their ideas on how to teach a specific topic or assess students' learning. Apprentices can be taught to use different modes and media depending on the specificity of their professional field (e.g., photos) to guide their reflection on their apprenticeship experience, assess their competence, or select appropriate learning tasks (Cattaneo & Boldrini, in press).

A second aspect regards the relationship between epistemic and reflective writing. Although different, they should not be viewed as entirely distinct from each other. On the one hand, improving one's competence in a discipline thanks to a thoughtful use of writing can contribute to making a student-writer aware of writing as a tool for learning, and of him/herself as a learner. On the other, recognizing the role of reflective writing in improving professional competence contributes to increasing one's self-conception and agency in the workplace (Kurunsaari, Tynjälä, & Piirainen, in press). The positive effect of writing on school and professional awareness is well exemplified when writing is a basic aspect of a profession - for instance, for a researcher. In this case, writing is a tool for raising awareness of one's identity as a scholar. Writing to learn for undergraduate students represents an integration of the two main meanings of writing

as a tool for learning: a student uses WTL, and through writing he/she reflects on his/her identity as a future researcher (Akerlind, 2008; Tynjälä, 2008).

A recent phenomenographic study (Kurunsaari, Tynjälä and Piirainen, in press), conducted with physiotherapy students at the bachelor's degree level, provides an interesting analysis of how students experience reflective writing as a tool for learning in their education. The students were used to video-recording their own activities at school and, after their first year of university, they also did so at practical training sites. They selected situations in which they practiced core skills related to evaluation of patients, training and counselling. Reflective writing was utilized to increase students' awareness of different aspects of learning various skills. Each student's task was to contemplate, reflect and write in his or her own way; no specific writing genre was required. The students were interviewed on their experiences with reflective writing within the last months of their studies. From the interviews, four descriptive categories of writing emerged: 1) writing as a useless task; 2) writing as a tool for deepening understanding; 3) writing as a tool for self-reflection; and 4) writing as a tool for professional development. Each category was characterized by a function of writing, focus of reflection, contribution to professional learning, emotions, main attribute of writing, and importance for learning. The relationship between the categories was a hierarchical one; that is, each higher category included aspects of the lower ones, whereas no lower category included aspects of the higher ones.

Students who viewed writing as useless recognized no contribution to professional learning, and expressed negative emotions. In the second category, students experienced reflective writing as a tool for deepening their understanding and viewed writing as a useful and important activity, although they admitted that at the beginning, they did not like to write. In the third category, the students felt that the writing task required personal insight and regarded not only their actions, but also their interactions with others. Thus, in addition to developing their thinking, the students felt that writing contributed to their wider personal growth. While in the previous categories negative attitudes toward writing were expressed at the onset, the respondents in this category expressed positive feelings toward reflective writing from the beginning. Lastly, in the fourth category, reflective writing was considered a tool not only for self-reflection, but also as a tool for developing professional competence and identity. The focus of reflection expanded from the students' actions and interactions with patients to their interaction with the professional community. The students' understanding of, and collaborations with, clients, colleges and multi-professional workplaces widened. The perceived usefulness of writing thus expanded from improving one's personal development to enhancing one's own social growth as a member of a community. The students reported that they felt inspired and motivated.

7. Conclusion

We have outlined five recent trends in the evolution of research on WTL. The first has been the adoption of increasingly sophisticated analytical tools as a means of critically evaluating theories and practices. Early work on WTL was comprised of theoretically-driven claims as well as individual experiments, which produced varied and inconclusive results. During the past decade, researchers have used meta-analysis to objectively integrate the results of multiple studies. At the same time, meta-analysis has been used to identify the instructional variables and student characteristics that moderate the effects of writing on learning. Methods such as path analysis have been used to investigate the psychological processes and text characteristics that mediate the effects of writing on learning. The result has been a consensus that writing contributes significantly to learning with effects that, on average, are small to medium in size; however, these effects can be increased, depending on the extent to which moderator variables are mobilized.

With respect to trends in research on psychological processes, early authors assumed that text as a medium inherently elicits learning; some asserted that spontaneous cognitive processes accounted for learning during writing. However, research during the past decade has supported cognitive models, which present WTL as dependent on the goals and strategies of the writer. Cognitive processes directed toward task content, and self-regulated processes directed toward the writer's own cognition, both contribute significantly to learning. Recently, these processes have been mobilized through cognitive strategy instruction to teach students how to use writing as a learning tool.

The third trend in research on WTL concerns the genre of writing activities. In the Writing Across the Curriculum movement, a common view was that expressive (journal) writing or the argumentative essay were largely applicable regardless of the discipline. During the past decade, studies have focused on teaching students cognitive strategies for reading and writing that are specific to subject areas such as science, history, and literature. At the same time, some discipline-neutral genres, such as metacognitive journal writing, and discourse synthesis, have also been shown to contribute significantly to learning. An additional related trend has been the shift from an exclusive focus on writing text, toward research on the composition of multimedia products that integrate text with graphics and other representations.

The fourth trend has been the increasing theorization of the social aspects of WTL. Initially, WTL was theorized primarily in psychological terms. During the past decade, sociocultural theory, activity theory, situated cognition, and distributed cognition have also become part of the literature on WTL. Empirical research has investigated the effects of the social and technological elements of writing, with regard to their effects on learning: instruction and facilitation; audience and audience feedback; collaboration; computer supported collaborative writing; and other computer applications. Much of this research has comprised multi-faceted design experiments or

qualitative studies; further experimental research is needed to investigate the effects of specific variables.

The fifth trend has concerned the kinds of learning that can arise from writing. Initial work on WTL focused on epistemic writing, which concerned learning the concepts, and sometimes the reasoning, of academic disciplines, most frequently science, history, math and literature. However, writing in the professions is also a context for learning. Along with this, reflective writing has come to the fore. This goes beyond epistemic learning, to include the formation of professional identity.

Undoubtedly, the state of the art of writing-to-learn research shows that most methodological and conceptual efforts have been spent analyzing the epistemic function of writing, while the reflective aspect has been analyzed qualitatively, in terms of personal experience, with results that are interesting, but difficult to generalize. The future of writing-to-learn research is not difficult to foresee: The trends presented in this article provide many suggestions for studying how writing can become a more fruitful tool for elaborating and producing knowledge. However, another possible objective could be that of considering the second and less frequently investigated instrumentality of writing: writing as a tool for making people aware of their personal possibilities, both inside and outside of the academic context. Analyzing the functions of writing in relation to a different meaning of learning may represent a challenge for future research.

Acknowledgements

We would like to thank Dr. Charles Bazerman for his helpful comments on an earlier draft of this manuscript. We also thank Ms. Jennifer C. Wang for her assistance in the preparation of this manuscript.

References

Akerlind, G. S. (2008). Growing and developing as a university researcher. *Higher Education, 55*, 241-254. http://dx.doi.org/10.1007/s10734-007-9052-x

Akkus, R., Gunel, M., & Hand, B. (2007). Comparing an inquiry-based approach known as the Science Writing Heuristic to traditional science teaching practices: Are there differences? *International Journal of Science Education, 29*, 1745-1765. http://dx.doi.org/10.1080/09500690601075629

Alamargot, D., & Chanquoy, L. (2001). *Through the models of writing.* Dordrecht, The Netherlands: Kluwer. http://dx.doi.org/10.1007/978-94-010-0804-4

Applebee, A. (1984). Writing and reasoning. *Review of Educational Research, 54*, 577–596. http://dx.doi.org/10.3102/00346543054004577

Atasoy, S. (2013). Effect of writing-to-learn strategy on undergraduates' conceptual understanding of electrostatics. *The Asia-Pacific Education Researcher, 22*, 593-602. http://dx.doi.org/10.1007/s40299-013-0062-4

Baker, E. A. (2010). *The new literacies*. New York, NY: Guilford Press.

Bakhtin, M. M. (1986). *Speech genres and other late essays. V. W. McGee* (Trans). Austin, Tx: University of Texas Press.

Bangert-Drowns, R. L., Hurley, M. M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research, 74,* 29-58. http://dx.doi.org/10.3102/00346543074001029

Bazerman, C. (1981). What written knowledge does: Three examples of academic discourse. *Philosophy of the Social Sciences 11,* 361–388. http://dx.doi.org/10.1177/004839318101100305

Bazerman, C. (1988). *Shaping written knowledge: The genre and activity of the experimental article in science.* Madison, WI: University of Wisconsin Press.

Bazerman, C. (2009). Genre and cognitive development: Beyond writing to learn. In Bazerman, Bonini, & Figueiredo (Eds.), *Genre in a changing world* (pp. 279-294). Fort Collins, CO: The WAC Clearinghouse.

Bazerman, C., Little, J., Bethel, L. Chavkin, T., Fouquette, D., & Garufis, J. (2005). *Reference guide to writing across the curriculum.* West Lafayette, IN: Parlor Press and the WAC Clearinghouse.

Beaufort, A. (2008). Writing in the professions. In C. Bazerman (Ed.), *Handbook of research on writing* (pp. 221-235). New York: Erlbaum.

Benus, M. J., Yarker, M. B., Hand, B. M., & Norton-Meier, L. A. (2013). Analysis of discourse practices in elementary science classrooms using argument-based inquiry during whole-class dialogue. In M. Khine, & I. Saleh (Eds.) *Approaches and strategies in next generation science learning* (pp. 224-245). Hershey, PA: Information Science Reference. doi:10.4018/978-1-4666-2809-0.ch012 http://dx.doi.org/10.4018/978-1-4666-2809-0.ch012

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Berkentotter, C., & Huckin, T. N. (1993). Rethinking genre from a sociocognitive perspective. *Written Communication, 10*, 475-509. http://dx.doi.org/10.1177/0741088393010004001

Berthold, K., Nückles, M., & Renkl, A. (2007). Do learning protocols support learning strategies and outcomes? The role of cognitive and metacognitive prompts. *Learning and Instruction, 17*, 564-577. http://dx.doi.org/10.1016/j.learninstruc.2007.09.007

Biber, D.& Vasquez, C. (2008). Writing and speaking. In C. Bazerman (Ed.) *Handbook of research on Writing: History, society, school, individual, text* (pp. 535-548). New York: Lawrence Erlbaum Associates.

Boscolo, P. (1996). The use of information in expository text writing. In C. Pontecorvo, M. Orsolini, B. Burge, & L. B. Resnick (Eds.), *Children's early text construction* (pp. 209-227). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Boscolo, P. (2014). Two metaphors for writing research and their implications for writing instruction. In B. Arfé, J. Dockrell, & V. W. Berninger (Eds.), *Writing development in children with hearing loss, dyslexia, or oral language problems. Implications for assessment and instruction* (pp. 33-42). New York: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780199827282.003.0003

Boscolo, P., & Carotti, L. (2003). Does writing contribute to improving high school students' approach to literature? *L1 – Educational Studies in Language and Literature, 3,* 197-224. http://dx.doi.org/10.1023/B:ESLL.0000003685.30925.c4

Boscolo, P., & Mason, L. (2001). Writing to learn, writing to transfer. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 83-104). Dordrecht, The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0740-5_6

Braaksma, M., Rijlaarsdam, G., & Janssen, T. (2007). Writing hypertexts: Proposed effects on writing processes and knowledge acquisition. *L1 Educational Studies in Language and Literature, 7,* 93-122.

Breuer, E., Newman, S., & Newman, J. (in press). Learning to write as a professional: Engineers and health professionals in the United Kingdom and Germany. In M. Betrancourt, G. Ortoleva, & S. Billett (Eds.), *Writing for professional development.* Leiden: Brill. http://dx.doi.org/10.1163/9789004264830_014

Britt, M. A., & Rouet, J.F. (2012). Learning with multiple documents: Component skills and their acquisition. In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning: Dispositions, instruction, and learning processes* (pp. 276-314). Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139048224.017

Britton, J. (1982a). *Writing-to-learn and learning to write. In Pradl, G. M. (ed.), Prospect and retrospect: Selected essays of James Britton*. Boynton/Cook Publishers, Inc., Montclair, NJ, pp. 94-111. (Reprinted from The Humanity of English: NCTE Distinguished Lectures 1972).

Britton, J. (1982b). Shaping at the point of utterance. In G. M. Pradl (Ed.), *Prospect and retrospect: Selected essays of James Britton* (pp.139-145). Montclair, NJ: Boynton/Cook.

Britton, J., Burgess, T., Martin, N., McLeod, A., and Rosen, H. (1975). *School councils research studies: The development of writing abilities (11-18)*. Macmillan Education, London, Great Britain.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational researcher, 18*(1), 32-42. http://dx.doi.org/10.3102/0013189X018001032

Cantrell, R. J., Fusaro, J. A., & Dougherty, E. A. (2000): Exploring the effectiveness of journal writing on learning social studies: A comparative study, *Reading Psychology, 21,* 1-11. http://dx.doi.org/10.1080/027027100278310

Carlson, P., & Berry, F. C. (2008). Using computer-mediated peer review in an engineering design course. *IEEE Transactions on Professional Communication, 51,* 264-279. http://dx.doi.org/10.1109/TPC.2008.2001254

Cattaneo, A., & Boldrini, E. (in press). Individual and collaborative writing-to-learn activities in vocational education: An overview of different instructional strategies. In M. Betrancourt, G. Ortoleva, & S. Billett (Eds.), *Writing for professional development.* Leiden: Brill. http://dx.doi.org/10.1163/9789004264830_011

Carter, M. (2007). Ways of knowing, doing, and writing in the disciplines. *College Composition and Communication, 58,* 385-418.

Carter, M., Ferzli, M., & Wiebe, E. (2004). Teaching genre to English first-language adults: A study of the laboratory report. *Research in the Teaching of English, 38*, 395-419.

Carter, M., Ferzli, M., & Wiebe, E. N. (2007). Writing to learn by learning to write in the disciplines. *Journal of Business and Technical Communication, 21*, 278-302. http://dx.doi.org/10.1177/1050651907300466

Cerdán, R., & Vidal-Abarca, E. (2008). The effects of tasks on integrating information from multiple documents. *Journal of Educational Psychology, 100*, 209-222. http://dx.doi.org/10.1037/0022-0663.100.1.209

Chen, C. H., & She, H. C. (2012). The impact of recurrent on-line synchronous scientific argumentation on students' argumentation and conceptual change. *Educational Technology & Society, 15,* 197-210.

Chen, Y. C., Hand, B., & McDowell, L. (2013). The effects of writing-to-learn activities on elementary students' conceptual understanding: Learning about force and motion through writing to older peers. *Science Education, 97*, 745 – 771. http://dx.doi.org/10.1002/sce.21067

Childers, P. B., Gere, A. R., & Young, A. (Eds.). (1994). *Programs and practices: Writing across the secondary school curriculum.* Boynton/Cook Pub.

Choi, A., Hand, B., & Norton-Meier, L. (2014). Grade 5 students' online argumentation about their in-class inquiry investigations. *Research in Science Education, 44,* 267-287. http://dx.doi.org/10.1007/s11165-013-9384-8

Christensen, L. M. (1999). Critical literacy: Teaching reading, writing, and outrage. In C. Edelesky (Ed.), *Making justice our project* (pp. 209-225). Urbana, IL: National Council of Teachers of English.

Chuy, M., Scardamalia, M., & Bereiter, C. (2012). Development of ideational writing through knowledge building. In E. L. L. Grigorenko, E. Mambrino, D. D. D. Preiss (Eds.) *Writing: A Mosaic of New Perspectives* (pp. 175-190). Psychology Press.

Comber, B., Thomson, P., & Wells, M. (2001). Critical literacy finds a" place": Writing and social action in a low-income Australian grade 2/3 classroom. *The Elementary School Journal, 101*, 451-464. http://dx.doi.org/10.1086/499681

Correnti, R., Matsumura, L. C., Hamilton, L. S., & Wang, E. (2012). Combining multiple measures of students' opportunities to develop analytic, text-based writing skills. *Educational Assessment, 17,* 132-161. http://dx.doi.org/10.1080/10627197.2012.717035

Craik, F. I. M., and Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behaviour 11,* 671-684. http://dx.doi.org/10.1016/S0022-5371(72)80001-X

Craik, F. I. M., and Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General, 104*, 268-294. http://dx.doi.org/10.1037/0096-3445.104.3.268

Cronin, B. (2004). Bowling alone together: Academic writing as distributed cognition. *Journal of the American Society for Information Science and Technology, 55,* 557-560. http://dx.doi.org/10.1002/asi.10406

De La Paz, S. (2005). Effects of historical reasoning instruction and writing strategy mastery in culturally and academically diverse middle school classrooms. *Journal of Educational Psychology, 97*, 139-156. http://dx.doi.org/10.1037/0022-0663.97.2.139

De La Paz, S., & Felton, M. K. (2010). Reading and writing from multiple source documents in history: Effects of strategy instruction with low to average high school writers. *Contemporary Educational Psychology, 35,* 174-192. http://dx.doi.org/10.1016/j.cedpsych.2010.03.001

De La Paz, S., & Graham, S. (1997). Effects of dictation and advanced planning instruction on the composing of students with writing and learning problems. *Journal of Educational Psychology, 89,* 203-222. http://dx.doi.org/10.1037/0022-0663.89.2.203

De La Paz, S., & Wissinger, D. R. (2015). Effects of genre and content knowledge on historical thinking with academically diverse high school students. *The Journal of Experimental Education, 83*(1), 110-129. http://dx.doi.org/10.1080/00220973.2013.876228

Demirbag, M., & Gunel, M. (2014). Integrating argument-based science inquiry with modal representations: Impact on science achievement, argumentation, and writing skills. *Educational Sciences: Theory & Practice, 14,* 386-391. http://dx.doi.org/10.12738/estp.2014.1.1632

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The evolution of research on computer-supported collaborative learning. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder & S. Barnes (Ed.), *Technology-enhanced learning: Principles and products* (pp. 3-19). Netherlands: Springer. http://dx.doi.org/10.1007/978-1-4020-9827-7_1

Donald, M. (1991). *Origins of the modern mind*. Cambridge, MA : Harvard University Press.

Drabick, D. A., Weisberg, R., Paul, L., & Bubier, J. L. (2007). Keeping it short and sweet: Brief, ungraded writing assignments facilitate learning. *Teaching of Psychology, 34*, 172-176. http://dx.doi.org/10.1080/00986280701498558

Durst, R. K. (1987). Cognitive and linguistic demands of analytic writing. *Research in the Teaching of English, 21,* 347-376.

Elbow, P. (1973). *Writing without teachers*. New York: Oxford University Press.

Elbow, P. (1981). *Writing with power.* New York: Oxford University Press.

Emig, J. (1977). Writing as a mode of learning. *College Composition and Communication, 28*, 122-128. http://dx.doi.org/10.2307/356095

Engeström, Y. (2009). The future of activity theory: A rough draft. In A. Sannino, H. Daniels & K. D. Gutiérrez (Eds.), *Learning and expanding with activity theory* (pp. 303-328). Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511809989.020

Englert, C. S., Mariage, T. V., & Dunsmore, K. (2006). Tenets of sociocultural theory in writing instruction research. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of research on writing* (pp. 208-221). New York: The Guilford Press.

Fahnestock, J., & Secor, M. (1991). The rhetoric of literary criticism. In C. Bazerman & J. Paradis (Eds.), *Textual dynamics of the professions: Historical and contemporary studies of writing in professional communities* (pp. 77–96). Madison: University of Wisconsin Press.

Felton, M., Garcia-Mila, M., & Gilabert, S. (2009). Deliberation versus dispute: The impact of argumentative discourse goals on learning and reasoning in the science classroom. *Informal Logic, 29,* 417-446.

Ferretti, R. P., MacArthur, C. A., & Okolo, C. M. (2001). Teaching for historical understanding in inclusive classrooms. *Learning Disability Quarterly, 24,* 59-71. http://dx.doi.org/10.2307/1511296

Fisher, D. (2007). CMS-based simulations in the writing classroom: Evoking genre through game play. *Computers and Composition, 24,* 179-197. http://dx.doi.org/10.1016/j.compcom.2006.06.004

Flower, L. & Hayes, J. R. (1981a). A cognitive process theory of writing. *College Composition and Communication, 32,* 365-387. http://dx.doi.org/10.2307/356600

Flower, L., & Hayes, J. R. (1981b). Plans that guide the composing process. In M. F. Whitman, (Ed.), *Writing: The nature development, and teaching of written communication (Volume 1,* pp. 39- 58). Hillsdale, NJ: Lawrence Erlbaum Associates.

Freedman, A., & Smart, G. (1997). Navigating the current of economic policy: Written genres and the distribution of cognitive work at a financial institution. *Mind, Culture, and Activity, 4*, 238-255. http://dx.doi.org/10.1207/s15327884mca0404_3

Fulwiler, T. & Young, A. (1982). *Language connections: Writing and reading across the curriculum*. Urbana, Illinois: National Council of Teachers of English.

Galbraith, D. (1992). Conditions for discovery through writing. *Instructional Science, 21,* 45-71. http://dx.doi.org/10.1007/BF00119655

Galbraith, D. (1996). Self-monitoring, discovery through writing and individual differences in drafting strategy. In Rijlaarsdam, G., van den Bergh, H., and Couzjin, M. (Eds.), *Theories, models and methodology in writing research* (pp. 121-141). Amsterdam, The Netherlands: Amsterdam University Press.

Galbraith, D. (1999) Writing as a knowledge-constituting process. In M. Torrance & D. Galbraith (Eds.), *Knowing What to Write: Conceptual Processes in Text Production* (pp. 139–159. Amsterdam, The Netherlands: Amsterdam University Press.

Galbraith, D. (2009). Writing about what we know: Generating ideas in writing. In R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.), *The Sage handbook of writing development* (pp. 48-64). Los Angeles, CA: SAGE Publications. http://dx.doi.org/10.4135/9780857021069.n4

Galbraith, D., Ford, S., Walker, G. & Ford, J. (2005). The contribution of different components of working memory to knowledge transformation during writing. *L1 – Educational Studies in Language and Literature, 5,* 113–145. http://dx.doi.org/10.1007/s10674-005-0119-2

Gelati, C., Galvan, N., & Boscolo, P. (2014). Summary writing as a tool for improving the comprehension of expository texts: An intervention study in primary school. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in writing, Vol. 28: Writing as a learning activity* (pp. 191-216). Leiden, The Netherlands: Brill.

Gere, A. R. (Ed.). (1985). *Roots in the sawdust: Writing to learn across the disciplines*. Urbana: IL: National Council of Teachers of English.

Gil, L., Bråten, I., Vidal-Abarca, E., & Strømsø, H. I. (2010). Summary versus argument tasks when working with multiple documents: Which is better for whom. *Contemporary Educational Psychology, 35*, 157-173. http://dx.doi.org/10.1016/j.cedpsych.2009.11.002

Gillespie, A., Graham, S., Kiuhara, S., & Hebert, M. (2014). High school teachers' use of writing to support students' learning: a national survey. *Reading and Writing, 27,* 1043-1072. http://dx.doi.org/10.1007/s11145-013-9494-8

Gingerich, K. J., Bugg, J. M., Doe, S. R., Rowland, C. A., Richards, T. L., Tompkins, S. A., & McDaniel, M. A. (2014). Active processing via write-to-learn assignments: Learning and retention benefits in introductory psychology. *Teaching of Psychology, 41*, 303-308. http://dx.doi.org/10.1177/0098628314549701

Glogger, I., Holzäpfel, L., Schwonke, R., Nückles, M., & Renkl, A. (2009). Activation of learning strategies in writing learning journals. *Zeitschrift für pädagogische Psychologie, 23*, 95-104. http://dx.doi.org/10.1024/1010-0652.23.2.95

Glogger, I., Schwonke, R., Holzäpfel, L., Nückles, M., & Renkl, A. (2012). Learning strategies assessed by journal writing: Prediction of learning outcomes by quantity, quality, and combinations of learning strategies. *Journal of Educational Psychology, 104,* 452-468. http://dx.doi.org/10.1037/a0026683

Goody, J., & Watt, I. (1963). The consequences of literacy. *Comparative studies in society and history, 5,* 304-345. http://dx.doi.org/10.1017/S0010417500001730

Graham, S., & Hebert, M. (2011). Writing to read: A meta-analysis of the impact of writing and writing instruction on reading. *Harvard Educational Review, 81*, 710-744. http://dx.doi.org/10.17763/haer.81.4.t2k0m13756113566

Graham, S., McKeown, D., Kiuhara, S., & Harris, K. R. (2012). A meta-analysis of writing instruction for students in the elementary grades. *Journal of Educational Psychology, 104*, 879-896. http://dx.doi.org/10.1037/a0029185

Greene, S. (1993). The role of task in the development of academic thinking through reading and writing in a college history course. *Research in the Teaching of English, 27,* 37–48.

Gunel, M., Hand, B., & Gunduz, S. (2006). Comparing student understanding of quantum physics when embedding multimodal representations into two different writing formats: Presentation format versus summary report format. *Science Education, 90*, 1092-1112. http://dx.doi.org/10.1002/sce.20160

Gunel, M., Hand, B., & McDermott, M. A. (2009). Writing for different audiences: Effects on high-school students' conceptual understanding of biology. *Learning and Instruction, 19,* 354-367. http://dx.doi.org/10.1016/j.learninstruc.2008.07.001

Haas, C., & Witte, S. P. (2001). Writing as an embodied practice: The case of engineering standards. *Journal of Business and Technical Communication, 15,* 413-457. http://dx.doi.org/10.1177/105065190101500402

Hand, B., Gunel, M., & Ulu, C. (2009). Sequencing embedded multimodal representations in a writing to learn approach to the teaching of electricity. *Journal of Research in Science Teaching, 46,* 225-247. http://dx.doi.org/10.1002/tea.20282

Hand, B., Wallace, C. W., & Yang, E. M. (2004). Using a Science Writing Heuristic to enhance learning outcomes from laboratory activities in seventh-grade science: Quantitative and qualitative aspects. *International Journal of Science Education, 26,* 131-149. http://dx.doi.org/10.1080/0950069032000070252

Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composition and self-regulation*. Cambridge, MA: Brookline Books.

Hartley, J., & Tynjälä, P. (2001). New technology, writing and learning. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 161-182). Dordrecht, The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0740-5_10

Hartman, G. H. (1978). Blessing the Torrent: On Wordsworth's later style. *Publications of the Modern Language Association of America, 93,* 196-204. http://dx.doi.org/10.2307/461955

Hayes, J. R., & Flower, L. (1980). Identifying the organization of the writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Hillsdale, NJ: Erlbaum.

Hayes, J. R. (2012). Modeling and remodeling writing. *Written communication, 29,* 369-388. http://dx.doi.org/10.1177/0741088312451260

Hebert, M., Gillespie, A., & Graham, S. (2013). Comparing effects of different writing activities on reading comprehension: A meta-analysis. *Reading and Writing, 26,* 111-138. http://dx.doi.org/10.1007/s11145-012-9386-3

Hebert, M., Graham, S., Rigby-Wills, H., & Ganson, K. (2014). Effects of note-taking and extended writing on expository text comprehension: Who benefits? *Learning Disabilities--A Contemporary Journal, 12*(1), 43-68.

Hewitt, J., & Scardamalia, M. (1998). Design principles for distributed knowledge building processes. Educational Psychology Review, 10, 75-96.Holyoak, K. J., & Morrison, R. G. (2012). *The Oxford handbook of thinking and reasoning*. New York: Oxford University Press. http://dx.doi.org/10.1023/A:1022810231840

Hoover, L. A. (1994). Reflective writing as a window on pre-service teachers' thought processes. *Teaching and Teacher Education, 10*(1), 83–93. doi:10.1016/0742-051X(94)90042-6 http://dx.doi.org/10.1016/0742-051X(94)90042-6

Huang, S. Y. (2011). Reading "further and beyond the text": student perspectives of critical literacy in EFL reading and writing. *Journal of Adolescent & Adult Literacy, 55*, 145-154. http://dx.doi.org/10.1002/JAAL.00017

Hübner, S., Nückles, M., & Renkl, A. (2010). Writing learning journals: Instructional support to overcome learning-strategy deficits. *Learning and Instruction, 20,* 18-29. http://dx.doi.org/10.1016/j.learninstruc.2008.12.001

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

Johnson, D. W., & Johnson, R. (1985). Classroom conflict: Controversy versus debate in learning groups. *American Educational Research Journal, 22,* 237-256. http://dx.doi.org/10.3102/00028312022002237

Johnson, D. W., & Johnson, R. T. (2002). Learning together and alone: Overview and meta-analysis. *Asia Pacific Journal of Education, 22,* 95-105. http://dx.doi.org/10.1080/0218879020220110

Kellogg, R. T. (2008). Training writing skills: A cognitive developmental perspective. *Journal of writing research, 1,* 1-26. http://dx.doi.org/10.17239/jowr-2008.01.01.1

Kember, D. (Ed.). (2001). *Reflective Teaching and Learning in the Health Profession*. Oxford: Blackwell. http://dx.doi.org/10.1002/9780470690550

Kember, D., McKay, J., Sinclair, K., & Wong, F. K. Y. (2008). A four-category scheme for coding and assessing the level of reflection in written work. *Assessment & Evaluation in Higher Education, 33*, 369-379. http://dx.doi.org/10.1080/02602930701293355

Keys, C. W., Hand, B., Prain, V., & Collins, S. (1999). Using the Science Writing Heuristic as a tool for learning from laboratory investigations in secondary science. *Journal of Research in Science Teaching, 36,* 1065-1084. http://dx.doi.org/10.1002/(SICI)1098-2736(199912)36:10<1065::AID-TEA2>3.0.CO;2-I

Kieft, M., Rijlaarsdam, G., & van den Bergh, H. (2006). Writing as a learning tool: Testing the role of students' writing strategies. *European Journal of Psychology of Education, 21,* 17-34. http://dx.doi.org/10.1007/BF03173567

Kieft, M., Rijlaarsdam, G., & van den Bergh, H. (2008). An aptitude-treatment interaction approach to writing-to-learn. *Learning and Instruction, 18*, 379-390. http://dx.doi.org/10.1016/j.learninstruc.2007.07.004

Klein, P. D. (1999). Reopening inquiry into cognitive processes in writing-to-learn. *Educational Psychology Review, 11,* 203-270. http://dx.doi.org/10.1023/A:1021913217147

Klein, P. D. (2000). Elementary students' strategies for writing-to-learn in science. *Cognition and Instruction, 18,* 317-348. http://dx.doi.org/10.1207/S1532690XCI1803_2

Klein, P. D. (2004). Constructing scientific explanations through writing. *Instructional Science, 32,* 191-231. http://dx.doi.org/10.1023/B:TRUC.0000024189.74263.bd

Klein, P. D. (2014) Knowledge construction in collaborative science writing: Strategic simplicity, distributed complexity, and explanatory sophistication. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in Writing: Vol. 28, Writing as a Learning activity* (pp. 300-326). The Netherlands: Brill.

Klein, P. D., Boman, J. S., & Prince, M. P. (2007). Developmental trends in a writing to learn task. In M. Torrance, D. Galbraith, & L. Van Waes (Eds.), *Writing and Cognition: Research and Application* (pp. 201-217). Amsterdam: Elsevier.

Klein, P. D., Ehrhardt, J. S. (2013, April). *Effects of writing goals and distribution of subgoals on cognitive load and science learning*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Klein, P. D., Haug, K. & Arcon, N. (2015, August). *Argument writing as discovery: Effects on cognitive load, reasoning, and learning in science*. Paper presented at the Argument-Based Inquiry Conference. Spokane, Washington.

Klein, P. D., & Kirkpatrick, L. C. (2010). A framework for content area writing: Mediators and moderators. *Journal of Writing Research, 2,* 1-46. http://dx.doi.org/10.17239/jowr-2010.02.01.1

Klein, P. D., & Leacock, T. L. (2012). Distributed cognition as a framework for understanding writing. In V. W. Berninger (Ed.), *Past, present, and future contributions of cognitive writing research to cognitive psychology* (pp. 133-152). New York: Psychology Press/Taylor & Francis Group.

Klein, P. D., Piacente-Cimini, S., & Williams, L. A. (2007). The role of writing in learning from analogies. *Learning and Instruction, 17,* 595-611. http://dx.doi.org/10.1016/j.learninstruc.2007.09.006

Klein, P. D., & Samuels, B. (2010). Learning about plate tectonics through argument writing. *The Alberta Journal of Educational Research, 56,* 196-217.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. New Jersey: Prentice-Hall.

Kostouli, T. (2009). A sociocultural framework: Writing as social practice. In R. Beard, D. Myhill, M. Nystrand, & J. Riley (Eds.), *The SAGE Handbook of Writing Development* (pp. 98-116). Los Angeles, CA: SAGE Publications Ltd. http://dx.doi.org/10.4135/9780857021069.n7

Kress, G., Jewitt, C., Ogborn, J., & Tsatsarelis, C. (Eds.). (2001). *Multimodal teaching and learning: The rhetorics of the science classroom*. London: Continuum.

Kurunsaari, M., Tynjälä, P., & Piirainen, A. (in press). Students' experiences of reflective writing as a tool for learning in physiotherapy education. In M. Betrancourt, G. Ortoleva, & S. Billett (Eds.), *Writing for professional development.* Leiden: Brill. http://dx.doi.org/10.1163/9789004264830_008

Langer, J. A., & Applebee, A. N. (1987). *How writing shapes thinking: A study of teaching and learning.* National Council of Teachers of English, Urbana, IL.

Leijten, M., Van Waes, L., Schriver, K., & Hayes, J.R. (2014). Writing in the workplace: Constructing documents using multiple digital sources. *Journal of Writing Research, 5,* 285-337. http://dx.doi.org/10.17239/jowr-2014.05.03.3

Leopold, C. & Leutner, D. (2012). Science text comprehension: Drawing, main idea selection, and summarizing as learning strategies. *Learning and Instruction, 22,* 16-26. http://dx.doi.org/10.1016/j.learninstruc.2011.05.005

Leopold, C., Sumfleth, E., & Leutner, D. (2013). Learning with summaries: Effects of representation mode and type of learning activity on comprehension and transfer. *Learning and Instruction, 27,* 40-49. http://dx.doi.org/10.1016/j.learninstruc.2013.02.003

Leu, D. J., Kinzer, C. K., Coiro, J. L., & Cammack, D. W. (2004). Toward a theory of new literacies emerging from the internet and other information and communication technologies. In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading* (5th ed., pp. 1570-1613). Newark, DE: International Reading Association.

Lewis, W. E., & Ferretti, R. P. (2009). Defending interpretations of literary texts: The effects of topoi instruction on the literary arguments of high school students. *Reading & Writing Quarterly, 25,* 250-270. http://dx.doi.org/10.1080/10573560903120656

Lewis, W. E., & Ferretti, R. P. (2011). Topoi and literary interpretation: The effects of a critical reading and writing intervention on high school students' analytic literary essays. *Contemporary Educational Psychology, 36,* 334-354. http://dx.doi.org/10.1016/j.cedpsych.2011.06.001

Linnakylä, P. (2001). Portfolio: Integrating writing, learning and assessment. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 145-160). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Linton, D. L., Pangle, W. M., Wyatt, K. H., Powell, K. N., & Sherwood, R. E. (2014). Identifying key features of effective active learning: the effects of writing and peer discussion. *CBE-Life Sciences Education, 13,* 469-477. http://dx.doi.org/10.1187/cbe.13-12-0242

Luke, A. (2012). Critical literacy: Foundational notes. *Theory into practice, 51,* 4-11. http://dx.doi.org/10.1080/00405841.2012.636324

MacArthur, C. A. (2014). Strategy instruction in writing in academic disciplines. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in Writing, Vol. 28: Writing as a Learning Activity* (pp. 149-168). Leiden, The Netherlands: Brill. http://dx.doi.org/10.1163/9789004265011_008

Martínez, I., Mateos, M & Martín, E. (in press). Analysis of effective instructional sequences in upper primary education to enhance content-learning through the integrated use of reading and writing; key components and possible improvements. In R. Fidalgo, K. Harris & M. Braaksma (Eds.), *Design Principles for Teaching Effective Writing.* The Netherlands: Springer.

Martínez, I., Mateos, M., Martín, E., & Rijlaarsdam, G. (2015). Learning history by composing synthesis texts: Effects of an instructional program on learning, reading, and writing processes, and text quality. *Journal of Writing Research, 7*(2), 275-302. http://dx.doi.org/10.17239/jowr-2015.07.02.03

Mason, L. (1998). Sharing cognition to construct scientific knowledge in school context: The role of oral and written discourse. *Instructional Science, 26,* 359-389. http://dx.doi.org/10.1023/A:1003103213786

Mason, L., & Boscolo, P. (2001). Writing to learn, writing to transfer. In P. Tynjälä, L. Mason & K. Lonka (Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 83–104). Dordrecht: Kluwer.

Mason, L., & Tornatora, M. C. (2014). Analogical encoding with and without instructions for case comparison of scientific phenomena. *Educational Psychology,* (ahead-of-print), 1-22. http://dx.doi.org/10.1080/01443410.2014.953038

Mateos, M., Martín, E., Villalón, R., & Luna, M. (2008). Reading and writing to learn in secondary education: Online processing activity and written products in summarizing and synthesizing tasks. *Reading and Writing, 21,* 675-697. http://dx.doi.org/10.1007/s11145-007-9086-6

Mateos, M., Solé, I., Martín, E., Cuevas, I., Miras, M. & Castells, N. (2014). Writing a synthesis from multiple sources as a learning activity. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in writing, Vol. 28: Writing as a learning activity* (pp. 169-190). Leiden, The Netherlands: Brill. http://dx.doi.org/10.1163/9789004265011_009

McCrindle, A. R., and Christensen, C. A. (1995). The impact of learning journals on metacognitive and cognitive processes and learning performance. *Learning and Instruction, 5*, 167-185. http://dx.doi.org/10.1016/0959-4752(95)00010-Z

McCutchen, D., Teske, P., & Bankston, C. (2008). Writing and cognition: Implications of the cognitive architecture for learning to write and writing to learn. In C. Bazerman (Ed.) *Handbook of research on Writing: History, society, school, individual,* text (pp. 451-465). New York: Lawrence Erlbaum Associates.

McDermott, M. A., & Hand, B. (2013). The impact of embedding multiple modes of representation within writing tasks on high school students' chemistry understanding. *Instructional Science, 41,* 217-246. http://dx.doi.org/10.1007/s11251-012-9225-6

McLeod, S., & Maimon, E. (2000). Clearing the air: WAC myths and realities. *College English, 62,* 573-583. http://dx.doi.org/10.2307/378962

McLuhan, M. (1962). *The Gutenberg galaxy.* Toronto: University of Toronto Press.

McNeill, K. L., & Krajcik, J. (2009). Synergy between teacher practices and curricular scaffolds to support students in using domain-specific and domain-general knowledge in writing arguments to explain phenomena. *The Journal of the Learning Sciences, 18,* 416-460. http://dx.doi.org/10.1080/10508400903013488

Milian, M. (2005). Reformulation: A means of constructing knowledge in shared writing. *L1-Educational Studies in Language and Literature, 5,* 335-351. http://dx.doi.org/10.1007/s10674-005-8560-9

Miller, C. R. (1984). Genre as social action. *Quarterly Journal of Speech, 70,* 151-167. http://dx.doi.org/10.1080/00335638409383686

Moje, E. (2008). Foregrounding the disciplines in secondary literacy teaching and learning: A call for change. *Journal of Adolescent and Adult Literacy, 52,* 96-107. http://dx.doi.org/10.1598/JAAL.52.2.1

Monroe, J. (2002). *Writing and revising the disciplines*. Cornell University Press.

Murray, D. M. (1980). Writing as process: How writing finds its own meaning. In Donovan, T. R., and McLelland, B. W. (Eds.), *Eight approaches to teaching composition* (pp. 3-20). National Council of Teachers in English, Urbana, IL.

Myers, G. (1985). The social construction of two biologists' proposals. *Written Communication, 2/3,* 219-245. http://dx.doi.org/10.1177/0741088385002003001

Nelson, N. (2001). Writing to learn: One theory, two rationales. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 23-36). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Newell, G. E. (2006). Writing to learn. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing* research (pp. 235-247). The Guilford Press.

Newell, G. E., & Winograd, P. (1995). Writing about and learning from history texts: The effects of task and academic ability. *Research in the Teaching of English, 29,* 133-163.

Nückles, M., Hübner, S., Dümer, S., & Renkl, A. (2010). Expertise reversal effects in writing-to-learn. *Instructional Science*, 38, 237-258. http://dx.doi.org/10.1007/s11251-009-9106-9

Nückles, M., Hübner, S., & Renkl, A. (2009). Enhancing self-regulated learning by writing learning protocols. *Learning and Instruction, 19*, 259-271. http://dx.doi.org/10.1016/j.learninstruc.2008.05.002

Nussbaum, E. M., & Kardash, C. M. (2005). The effects of goal instructions and text on the generation of counterarguments during writing. *Journal of Educational Psychology, 97,* 157-169. http://dx.doi.org/10.1037/0022-0663.97.2.157

Nykopp, M., Marttunen, M., & Laurinen, L. (2014). University students' knowledge construction during face to face collaborative writing. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in writing: Vol. 28, Writing as a learning activity* (pp. 277-299). The Netherlands: Brill.

Nystrand, M. (2006). The social and historical context for writing research. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 11-27). New York: The Guilford Press.

Nystrand, M., Gamoran, A., & Carbonaro, W. (2001). On the ecology of classroom instruction. In P. Tynjälä, L. Mason & K. Lonka (Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 57-81). Dordrecht: Kluwer. http://dx.doi.org/10.1007/978-94-010-0740-5_5

Olson, D. R. (1994). The world on paper: *The conceptual and cognitive implications of writing and reading.* Cambridge: Cambridge University Press.

Olson, D. R. (2001). Literate minds: Literate societies. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 1-5). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Olson, D. R. (2014). Schooling and literacy in mind and society. In A. Antonietti, E. Confalonieri, & A. Marchetti (Eds.), *Reflective thinking in educational settings* (pp. 227-242). New York: Cambridge University Press.

Ong, J. (2013). Discovery of ideas in second language writing task environment. *System, 41*, 529-542. http://dx.doi.org/10.1016/j.system.2013.05.001

Ong, W. J. (1982). *Orality and literacy*. New York, NY: Methuen, Inc. http://dx.doi.org/10.4324/9780203328064

Ortoleva, G., & Bétrancourt, M. (2015). Collaborative writing and discussion in vocational education: Effects on learning and self-efficacy beliefs. *Journal of Writing Research, 7*(1), 95-122. http://dx.doi.org/10.17239/jowr-2015.07.01.05

Penrose, A. M. (1992). To write or not to write: Effects of task and task interpretation on learning through writing. *Written Communication, 9,* 465-500. http://dx.doi.org/10.1177/0741088392009004002

Petko, D., Egger, N., & Graber, M. (2014). Supporting learning with weblogs in science education: A comparison of blogging and hand-written reflective writing with and without prompts. *Themes in Science and Technology Education, 7,* 3-17.

Prior, P. (2006). A sociocultural theory of writing. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of research on writing* (pp. 54-66). New York: The Guilford Press.

Reiss, D., Selfe, D., & Young, A. (Eds.) (1998). *Electronic communication across the curriculum.* Urbana, IL: National Council of Teachers of English.

Reynolds, G. A., & Perin, D. (2009). A comparison of text structure and self-regulated writing strategies for composing from sources by middle school students. *Reading Psychology, 30,* 265-300. http://dx.doi.org/10.1080/02702710802411547

Rivard, L. P. (2004). Are language-based activities in science effective for all students, including low achievers? *Science Education, 88,* 420-442. http://dx.doi.org/10.1002/sce.10114

Rivers, N. A. (2011). Future convergences: technical communication research as cognitive science. *Technical Communication Quarterly, 20*, 412-442. http://dx.doi.org/10.1080/10572252.2011.591650

Robbins, P., & Aydede, M. (2009). A short primer on situated cognition. In M. Aydede & p. Robbins, (Eds.), *The Cambridge handbook of situated cognition* (pp. 3-10).New York, NY: Cambridge University Press.

Roelle, J., Krüger, S., Jansen, C., & Berthold, K. (2012). The use of solved example problems for fostering strategies of self-regulated learning in journal writing. *Education Research International, 12,* 14 pgs. doi:10.1155/2012/751625 http://dx.doi.org/10.1155/2012/751625

Rosaen, C. (1989). Writing in the content areas: Reaching its potential in the learning process. In J. Brophy (Ed.), *Advances in research on teaching, Vol. 1* (pp. 153-189). Greenwich, CT: JAI press.

Rosaen, C. L. (1990). Improving writing opportunities in elementary classrooms. *The Elementary School Journal, 90*, 418-434. doi: 10.1086/461624 http://dx.doi.org/10.1086/461624

Russell, D. R. (1997). Writing and genre in higher education and workplaces: A review of studies that use cultural-historical activity theory. *Mind, Culture, and Activity, 4,* 224–237. http://dx.doi.org/10.1207/s15327884mca0404_2

Russell, D. R. (2009). Uses of activity theory in written communication research. In A. Sannino, H. Daniels, & K. D. Gutierrez (Eds.), *Learning and expanding with activity theory* (pp. 40-52). Cambridge, UK: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511809989.004

Russell, D. R. (2013a). CHAT and students writing. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education* (pp. 73-88). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139035699.005

Russell, D. R. (2013b). Contradictions regarding teaching and writing (or writing to learn) in the disciplines: What we have learned in the USA. *Revista de Docenia Universitaria, 11,* 161-181.

Sampson, V., Enderle, P., Grooms, J., & Witte, S. (2013). Writing to learn by learning to write during the school science laboratory: Helping middle and high school students develop argumentative writing skills as they learn core ideas. *Science Education, 97,* 643-670. http://dx.doi.org/10.1002/sce.21069

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York, NY: Basic Books, Inc.

Schriver, K. (2012). What we know about expertise in professional communication. In V. W. Berninger (Ed.), *Past, present, and future contributions to cognitive writing research to cognitive psychology* (pp. 275-312). New York: Psychology Press.

Schumacher, G. M., and Nash, J. G. (1991). Conceptualizing and measuring knowledge change due to writing. *Research in the Teaching of English, 25,* 67-96.

Schwonke, R., Hauser, S., Nückles, M., & Renkl, A. (2006). Enhancing computer-supported writing of learning protocols by adaptive prompts. *Computers in Human Behavior, 22,* 77-92. http://dx.doi.org/10.1016/j.chb.2005.01.002

Schworm, S., & Renkl, A. (2007). Learning argumentation skills through the use of prompts for self-explaining examples. *Journal of Educational Psychology, 99,* 285-296. http://dx.doi.org/10.1037/0022-0663.99.2.285

Scribner, S., & Cole, M. (1981). *The psychology of literacy*. Cambridge, MA: Harvard University Press. http://dx.doi.org/10.4159/harvard.9780674433014

Segev-Miller, R. (2007). Cognitive processes in discourse synthesis: The case of intertextual processing strategies. In M. Torrance, D. Galbraith, & L. Van Waes (Eds.), *Writing and cognition: Research and application* (pp. 231–250). Amsterdam: Elsevier. http://dx.doi.org/10.1108/S1572-6304(2007)0000020016

Seixas, P. (1993). Historical understanding among adolescents in a multicultural setting. *Curriculum Inquiry, 23,* 301-327. http://dx.doi.org/10.1080/03626784.1993.11076127

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content area literacy. *Harvard Educational Review, 78,* 40-59. http://dx.doi.org/10.17763/haer.78.1.v62444321p602101

Si, J., & Kim, D. (2011). How do instructional sequencing methods affect cognitive load, learning transfer, and learning time? *Educational Research, 2,* 1362-1372.

Siebert, D., & Draper, R. J. (2008). Why content-area literacy messages do not speak to mathematics teachers: a critical content analysis. *Literacy Research and Instruction, 47*, 229-245. http://dx.doi.org/10.1080/19388070802300314

Slotte, V., & Lonka, K. (2001). Note taking and essay writing. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp.131-143). Dordrecht, The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0740-5_8

Smagorinsky, P. (1995). Constructing meaning in the disciplines: Reconceptualizing writing across the curriculum as composing across the curriculum. *American Journal of Education, 103,* 160-184. http://dx.doi.org/10.1086/444095

Smeets, W., & Solé, I. (2008). *How adequate task representation can help students write a successful synthesis*. Zeitschrifts Schreiben. Online.

Spivey, N. N. (1997). *The constructivist metaphor*. San Diego, Ca: Academic Press.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 409-425). New York, NY: Cambridge University Press.

Starke-Meyerring, D. & Paré, A. (2011). The roles of writing in knowledge societies: Questions, exigencies, and implications for the study and teaching of writing. In D. Starke-Meyerring, A. Pare, N. Artemeva, M. Horne, & L. Yousoubova (Eds.), *Writing in knowledge societies* (pp. 3-28). Fort Collins, Colorado: The WAC Clearinghouse Press.

Stotsky, S. (1995). The uses and limitations of personal or personalized writing in writing theory, research, and instruction. *Reading Research Quarterly, 30,* 758-776. http://dx.doi.org/10.2307/748197

Street, B. V. (1984). *Literacy in theory and practice*. New York: Cambridge University Press.

Suhor, C. (1984). Towards a semiotics-based curriculum. *Journal of Curriculum Studies, 16,* 247-257. http://dx.doi.org/10.1080/0022027840160304

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer. http://dx.doi.org/10.1007/978-1-4419-8126-4

Syh-Jong, J. (2007). A study of students' construction of science knowledge: Talking and writing in a collaborative group. *Educational Research, 49,* 65-81. http://dx.doi.org/10.1080/00131880701200781

Taylor, J. C., Therrien, W. J., Kaldenberg, E., Watt, S., Chanlen, N., & Hand, B. (2012). Using an inquiry-based teaching approach to improve science outcomes for students with disabilities:

Snapshot and longitudinal data. *Journal of Science Education for Students with Disabilities, 15,* 27-39. http://dx.doi.org/10.14448/jsesd.04.0003

Thaiss, C. (1986). *Language across the curriculum in the elementary grades*. Urbana Il: The National Council of Teachers of English; and ERIC Clearinghouse on Reading and Communication Skills.

Thompson, A. (1990). Thinking and writing in learning logs. In N. Atwell (Ed.), *Coming to know: Writing to learn in the middle grades* (pp. 35-51). Toronto, Canada: Irwin.

Tomas, L., & Ritchie, S. M. (2014). The challenge of evaluating students' scientific literacy in a writing-to-learn context. *Research in Science Education, 44,* 1-18.

Tynjälä, P. (2001). Writing, learning and the development of expertise in higher education. In P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 37-56). Dordrecht, The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0740-5_4

Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review, 3,* 130-154. http://dx.doi.org/10.1016/j.edurev.2007.12.001

Tynjälä, P., Mason, L. & Lonka, K. (2001). Writing as a learning tool: An introduction. In: P. Tynjälä, L. Mason, & K. Lonka (Vol. Eds.), *Studies in Writing: Vol. 7. Writing as a learning tool: Integrating theory and practice* (pp. 7-22). Dordrecht, The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0740-5

Unsworth, L. (2011). *Multimodal semiotics: Functional analysis in contexts of education*. Bloomsbury Publishing.

Uzoglu, M. (2014). Determining the effects of using different writing activities on the academic achievements secondary school 7th grade students and their attitudes towards the course. *Educational Research and Reviews, 9,* 1065-1070. http://dx.doi.org/10.5897/ERR2014.1861

Van Drie, J., & Van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review, 20,* 87-110. http://dx.doi.org/10.1007/s10648-007-9056-1

Van Drie, J., Van Boxtel, C., & Braaksma, M. (2014). Writing to engage students in historical reasoning. In P. D. Klein, P. Boscolo, L. C. Kirkpatrick, & C. Gelati (Eds.), *Studies in writing: Vol. 28, Writing as a learning activity* (pp. 94-119). The Netherlands: Brill. http://dx.doi.org/10.1163/9789004265011_006

Vasquez, V. M. (2014). *Negotiating critical literacies with young children*. Routledge.

Wade, R. C., & Yarbrough, D. B. (1996). Portfolios: A tool for reflective thinking in teacher education? *Teaching and Teacher Education, 12,* 63–79. http://dx.doi.org/10.1016/0742-051X(95)00022-C

Walvoord, B. E., Hunt, L.L., Dowling, H.F., McMahon, J.D., Slachman, V., & Udel,L. (1997). *In the Long Run: A Study of Faculty in Three Writing-Across-The-Curriculum Programs*. Urbana, IL.: National Council of Teachers of English.

Wäschle, K., Gebhardt, A., Oberbusch, E. M., & Nückles, M. (2015). Journal writing in science: Effects on comprehension, interest, and critical reflection. *Journal of Writing Research, 7(1),* 41-64. http://dx.doi.org/10.17239/jowr-2015.07.01.03

Wäschle, K., Lehmann, T., Brauch, N., & Nückles, M. (2015). Prompted journal writing supports preservice history teachers in drawing on multiple knowledge domains for designing learning tasks. *Peabody Journal of Education, 90,* 546-559. http://dx.doi.org/10.1080/0161956X.2015.1068084

Wiley, J. & Voss, J. F. (1996). The effects of 'playing historian' on learning in history. *Applied Cognitive Psychology, 10* (Special issue), S63-S72. http://dx.doi.org/10.1002/(SICI)1099-0720(199611)10:7<63::AID-ACP438>3.0.CO;2-5

Wiley, J., & Voss, J. F. (1999). Constructing arguments from multiple sources: Tasks that promote understanding and not just memory for text. *Journal of Educational Psychology, 91,* 301-311. http://dx.doi.org/10.1037/0022-0663.91.2.301

Wiley, J. B., Steffens, B., Britt, A. M., & Griffin, T. (2014). Writing to learn from multiple-source inquiry activities in history writing as a learning activity. In P. D. Klein, P. Boscolo, L. C.

Kirkpatrick, & C. Gelati (Eds.), *Studies in writing: Vol. 28, Writing as a learning activity* (pp. 120-148). The Netherlands: Brill.

Wineburg, S. S. (2001). *Historical thinking and other unnatural acts: Charting the future of teaching the past.* Philadelphia, PA: Temple University Press.

Wong, B. Y., Kuperis, S., Jamieson, D., Keller, L., & Cull-Hewitt, R. (2002). Effects of guided journal writing on students' story understanding. *The Journal of Educational Research, 95*, 179-191. http://dx.doi.org/10.1080/00220670209596588

Yassin, Y. M., & Yong, B. C. S. (2013). The impact of writing-to-learn activity on learning biology: students' achievement and perceptions. *Journal of Applied Research in Education, 17,* 13-25.

Yeh, K. H., & She, H. C. (2010). On-line synchronous scientific argumentation learning: Nurturing students' argumentation ability and conceptual change in science context. *Computers & Education, 55*, 586-602. http://dx.doi.org/10.1016/j.compedu.2010.02.020

Yildiz, A. (2012). Prospective teachers' comprehension levels of special relativity theory and the effect of writing for learning on achievement. *Australian Journal of Teacher Education, 37,* 15-28. http://dx.doi.org/10.14221/ajte.2012v37n12.1

Young, A., and Fulwiler, T. (Eds.). (1986). *Writing across the disciplines: Research into practice.* Portsmouth, NH: Boynton.

Young, R., & Sullivan, P. (1984). Why write? A reconsideration. In R. J. Conners, L. S. Ede, & A. A. Lunsford (Eds.), *Essays on classical rhetoric and modern discourse* (pp. 215-225). Carbondale, IL: Southern Illinois Press.

Zhang, J. & Norman, D.A. (1994). Representations in distributed cognitive tasks. *Cognitive Science, 18,* 87-122. http://dx.doi.org/10.1207/s15516709cog1801_3

Zhang, J. & Patel, V. L. (2006). Distributed cognition, representation, and affordance. *Pragmatics & Cognition, 14,* 333-341. http://dx.doi.org/10.1075/pc.14.2.12zha

Zhu, X., & Zhang, J. (2005). The influence of "goal-free effect" and "worked examples" on students' writing achievement. *Psychological Science (China), 28,* 1139-1143. (trans. by X. Zhu in personal communication).

Zinsser, W. (1988). *Writing to learn: How to write—and think—clearly about any subject at all.* New York, NY: Harper & Row.