Mediators and Moderators in Individual and Collaborative Writing to Learn

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Abstract: Research on writing to learn is conceptually rich and pedagogically important. This special issue contributes to our growing knowledge about the variables that mediate and moderate the effects of writing on learning. One group of studies addresses individual writing; it adds to the growing evidence for the effects of several moderators, including cognitive, metacognitive, and personal utility prompts in journal writing (Wäschle et al.); and discipline-specific prompts for argument writing (Van Drie et al.). The individual-level studies also suggest moderator roles for discipline-general strategies of argumentation (Smirnova); and open-ended informational writing assignments (Wilcox et al.). Additionally, the Wäschle et al. study provides the strongest evidence for a specific sequence of mediation: Prompted journal writing to comprehension to interest to critical reflection. The second set of articles focusses on collaborative writing (Corcelles & Castelló; Ortoleva and Bétrancourt). It suggests moderating roles for discipline-specific analytic strategies, and peer interaction; and suggests mediating roles for exploratory discourse and group regulation. Further experimental research on collaborative writing is needed to conclusively test hypotheses about specific mediator and moderator variables. The studies in this special issue, like many recent studies, are incommensurable with some influential theories of writing to learn. Rather, individual and collaborative studies converge to suggest that writing to learn may be conceptualized as a guided process of cognition and self-regulation.

Keywords: Cognitive processes, collaborative learning, mediator variables, writing strategies, writing to learn.

1.   Introduction

In this article, I have been asked to reflect on the papers in this special issue, focusing on the effective ingredients of the writing interventions with respect to learning outcomes. The present set of articles provide an ideal context for examining this issue. They comprise a microcosm of current research on writing to learn, including both individual and collaborative writing; paper and electronic media; discipline-specific and discipline-neutral strategies; secondary and tertiary education; and qualitative and quantitative research methods. Several of the papers here represent two recent approaches, which have quickly become dominant: One approach comprises discipline-specific modes of argument writing (e.g., Corcelles & Castelló, this issue; Van Drie, Braaksma & Van Boxtel, this issue; Smirnova, this issue); the other approach employs learning journals with cognitive and metacognitive scaffolding (e.g., Wäschle, Gebhardt, Oberbusch, & Nückles, this issue).

In the first section of this paper, I will discuss what it means to try to identify effective ingredients in research on writing to learn. The second section will focus on individual writing, and what these articles contribute to our understanding of effective ingredients in writing to learn. The third section will focus on what these articles contribute to our understanding of collaborative writing as a learning activity. The fourth and fifth sections will discuss the current state of knowledge about moderators and mediators in writing to learn, and identify questions that have emerged from this special issue.

For the purpose of this article, effective elements in writing to learn will be considered to be mediating processes. If variable X affects M, and M affects Y, then M is the mediator of the X-Y relationship (Baron & Kenny, 1986; MacKinnon, Fairchild & Fritz, 2007). Concerning writing to learn, X would be writing; it may affect M (some psychological or social process), which in turn could affect Y, which is learning. Mediational analysis has traditionally used the following three criteria: The independent variable must affect the dependent variable; the independent variable must affect the mediator variable; and the mediator variable, when entered into a statistical model such as regression, must reduce the variance accounted for by the independent variable (Baron & Kenny, 1986). The analysis is carried out using a series of multiple regressions, or structural equation modelling. More recently, some authors have argued that only one criterion, the mediated path, must be met, rather than all three criteria (Zhao, Lynch & Chen, 2010). In qualitative research, a roughly analogous kind of analysis can be made.

Other kinds of relationships could also be considered to represent effective ingredients in writing to learn. A moderator variable is one that increases or reduces the effects of an independent variable on a dependent variable. For example, in writing intensive units of study, one moderator is the assignment of metacognitive writing

prompts, which increases the effect of writing on learning (Bangert-Drown, Hurley & Wilkinson, 2004).

This commentary will divide the articles into two groups: Writing to learn as an individual process, and writing to learn as a collaborative process. The reason for this division is that for individual writing to learn, psychological processes would be possible mediators; while for collaborative writing to learn, both psychological and social processes would be possible mediators.

2. Writing as an Individual Learning Process

This section will focus on the articles in which writing, which is expected to contribute to learning, is completed individually. This group includes the following papers: Wäschle, Gebhardt, Oberbusch and Nückles on journal writing in science education; Van Drie et al. on writing in history; Smirnova on writing to learn instruction in L1 and L2 and historical reasoning; and Wilcox, Yu, and Nachowitz on epistemic complexity in adolescent writing.

These articles can be considered against the background of current theories of writing to learn. Historically, there have been a few key theories about the psychological processes through which writing leads to learning. Very briefly, the first theory is that writing allows an implicit disposition to be shaped by the current topic and task, and to become conscious (Britton, 1982; Galbraith, 2009). The second theory is that writing leaves a stable, external trace that the writer can review, and take as an object for further analysis and elaboration (Olson & Oatley, 2014; Young & Sullivan, 1984). The third theory is that writing invites the formation of rhetorical goals, sometimes specific to a given text genre, which require writers to elaborate relationships among ideas and solve content problems (Applebee, 1984; Bereiter & Scardamalia, 1987). The current papers are of particular interest against this background, because they are typical of recent approaches to writing to learn. I will suggest that they stand outside of these past theories, and to some extent, challenge them.

The paper by Wäschle et al. on journal writing in science is part of a large and successful program of research that has been conducted during the past decade, largely by scholars from the University of Freiburg. Previously, a meta-analysis had compared research intensive and non-research intensive units of study, showing that writing contributes significantly to learning, with small effect sizes; however, this meta-analysis also showed that metacognitive writing prompts are a moderator variable that reliably increases the effect of writing on learning (Bangert-Drowns et al., 2004). The Freiburg group subsequently demonstrated several effects using randomized, controlled experiments: Cognitive writing prompts contribute to learning; metacognitive writing prompts contribute to learning; and the effects of these prompts are moderate to large in size. Additionally, the researchers showed that cognitive and metacognitive operations during writing are each mediators, which contribute significantly to learning

(e.g., Glogger, Schwonke, Holzäpfel, Nückles & Renkl, 2012; Hübner, Nückles & Renkl, 2010). The article by Wäschle et al. confirms yet again the effect of the cognitive and metacognitive writing prompts. This article also extends previous research by showing that prompts concerning personal relevance increase learner engagement (Schmidt, Maier and Nückles, 2012). With respect to mediation, it shows that journal writing contributes to comprehension, which leads to interest, which in turn leads to critical reflection. Thus, this program of research continues to demonstrate (a) that specific moderator variables contribute to learning; and (b) that these moderators act through corresponding, specific mediator variables.

Two other papers represent a second strand of research on writing to learn that has evolved quickly over the past decade. This strand involves teaching strategies to students, which they can use for inquiry and argument writing in specific disciplines. This kind of approach has proven to be effective in several subjects, including history (e.g., De La Paz & Felton, 2010; see MacArthur, 2014 for a review), literature (Kieft, Rijlaarsdam, & van den Bergh, 2006; Lewis & Ferretti, 2011), and science (Hand, Wallace & Yang, 2004; McNeill & Krajcik, 2009). In this research, the assumption is that forms of inquiry and argumentation differ from discipline to discipline.

Van Drie et al. taught students a strategy for writing in history, which focused on evaluating historical significance. To my knowledge, this is the first study to make a controlled comparison between teaching a writing strategy based on discipline-specific interpretive concepts versus teaching a general argumentation strategy. The results confirmed that the discipline-specific strategy improved students' historical reasoning, although it did not affect their overall learning or holistic text quality. This pattern of treatment-inherent effects, in which the intervention affects only dependent measures which closely match the intervention itself, is one that is common in writing to learn research (Hebert, Gillespie & Graham, 2013). However, it should be noted that this study involved a tightly matched comparison group, which was also taught a writing strategy, so this was a particularly stringent hypothesis test.

The study by Smirnova (this issue) on writing to learn in L1 and L2 in history, provides further support for the conception that reasoning strategies mediate learning in the content areas. The learning strategies in this article (e.g., argument structure and its evaluation; identification of logical fallacies) are more generic than those in the Van Drie et al. article. A limitation on this study is that there is no control group, so we cannot draw firm conclusions on the effects of the specific intervention. However, the results suggest the important point that the skills involved in writing to learn in history are transferrable from the first language to the second language of the student. This adds support to the longstanding view that higher order academic skills ("cognitive and academic language proficiency" or "CALP") are transferrable from L1 to L2 (Cummins, 2008).

The study by Wilcox et al. on epistemic complexity in adolescent science writing paints a picture of another kind of possible moderator of writing to learn. The authors note that the number of epistemically higher order tasks in their sample of writing

activities, such as argumentation and explanation, was limited. Usually, epistemically higher order texts resulted from informational writing, particularly reflective writing about reading. Interestingly, some epistemically higher order texts were written in response to putatively simple, mechanical writing assignments. The implication of this research appears to be that opportunities for critical thinking during writing are mainly dependent on rich, informational writing tasks. However, this interpretation should be treated with caution, because the study does not present measures of the students' learning; and it is not possible to determine, from the writing samples alone, whether the epistemically complex relationships found in some students' texts were constructed by the students, or paraphrased from other sources. Interestingly, a recent meta-analysis of reading to write found that on most dependent variables, different kinds of writing did not reliably lead to different levels of learning (Hebert et al., 2013). Nonetheless, the fact that the researchers selected participants from schools with exemplary writing performance, but still found relatively limited amounts of writing at advanced epistemic levels, suggests that opportunities for higher level writing might be limited in American schools, and should be increased.

A possible moderator variable of considerable interest is students' previous level of writing achievement. The study by Van Drie et al., showed that the effects of writing on learning did not differ for weaker versus stronger writers. This is consistent with some other studies, which have shown that low achieving writers, students with learning disabilities, and relatively young students, do not differ significantly from more skilled or experienced writers in their ability to learn from writing activities (Bangert-Drowns et al., 2004; De La Paz, 2005). However, other studies have shown interaction effects between writing activities and previous writing achievement or experience (Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Nückles, Hübner, Dümer & Renkl, 2010; Rivard, 2004). This is a moderator variable that requires continuing research.

These two lines of research (cognitive and metacognitive prompting in learning journals; discipline-specific modes of argumentation) both somewhat challenge the most influential models of writing to learn, mentioned above. These studies do not so much contradict these models, as pass them by. The knowledge transforming model (Bereiter & Scardamalia, 1987) is based on the conception that skilled writing comprises a dialectic between content problem solving and rhetorical problem solving; the dialectic is driven by setting rhetorical goals that the writer converts into content subgoals, and setting content goals that the writer converts into rhetorical subgoals. This model is based on the notions that rhetorical and content goals are important in writing, and that they are distinct from one another. In some instances, we can see that this process of rhetorical goal setting driving learning; for example, Gunel, Hand and McDermott (2009) have shown that when secondary students write science booklets to communicate with a young audience (rhetorical goal), the secondary students learn more than when they write for teachers, apparently because they more fully elaborate the meaning of science concepts. However, the papers in this special issue appear not to focus primarily on content goals or rhetorical goals. In the Wäschle et al. study, the

cognitive operations in the learning protocols concern content; however, the metacognitive goals do not focus primarily on content or rhetoric. So in that study, writing to learn involved problem solving in a content space, but it was not triggered by rhetorical goals. Similarly, in the Van Drie et al. study on writing to learn in history, the goals did not concern rhetoric, as much as reasoned interpretation concerning historical significance. The students were not required to be persuasive historians, so much as rational historians. Here too, the knowledge transforming model does not appear to apply.

Another often-discussed theory has been the knowledge constituting model (Galbraith, 2009). In this connectionist model, the initial constraints are the writer's implicit disposition, the topic, and the task. Through iterative processes, these give rise to new knowledge. As implied by this model, there is some evidence that spontaneous processes contribute to learning, particularly for writers who are low-self-monitors. It is also plausible that at a neurological level, computation in the brain is implemented in connectionist networks. However, the articles in this volume suggest that at the level at which teachers and students engage with writing, processes are largely deliberative rather than spontaneous. Research on learning protocols clearly demonstrates the importance of metacognition and self-regulation (Glogger et al., 2012; Hübner et al., 2010; Wäschle et al., this issue). Similarly, in the papers on writing in history, the strategies for disciplinary argument were explicitly taught, and they comprised metaconcepts, including "significance" (Van Drie et al. this issue) and "fact versus opinion," (Smirnov, this issue). There could be spontaneous processes occurring at some level, but they are not evident in the instructional design or psychological data reported. Moreover, these papers are representative of much recent research on writing to learn (e.g., De La Paz & Felton, 2010; Lewis & Ferretti, 2011; MacArthur, 2014; Reynolds & Perin, 2009).

3. Writing as a Collaborative Learning Process

In this section, I will focus on two papers: Ortoleva and Bétrancourt (this issue) on collaborative writing and discussion in vocational education; and Corcelles. & Castelló (this issue) on learning philosophical thinking through collaborative writing in secondary education. In these studies, the writing is collaborative in the broad sense that at some time during the learning cycle, writers engage with peers, and this is expected to contribute to learning.

In previous research, collaborative approaches to writing to learn have had a strong record of success. These have included complex interventions in areas such as history (e.g., MacArthur, 2014) and science (Hand et al., 2004). More recently, research has begun to focus on face to face collaboration during writing to learn (e.g., Klein, 2014; Nykopp, Marttunen & Laurinen, 2014). Finally, although computer supported collaborative learning (CSCL) has generally not been seen as part of the writing to learn literature, the predominant medium in CSCL is asynchronous written discussion, so it

can also be considered a category of writing to learn (Dillenbourg, Järvelä, & Fischer, 2009; Stahl, Koschmann & Suther, 2006; Stegmann, Wecker, Weinberger & Fischer, 2012). Collaborative approaches to writing to learn have been conceptualized in terms of several theories, including sociocultural theory (Ortoleva & Bétrancourt, this issue; Russell, 2009), distributed or situated cognition (Dillenbourg, et al., 2009; Klein & Leacock, 2012), and cognitive psychology (e.g., MacArthur, 2014). The present papers, particularly the one by Corcelles and Castelló, are grounded in extensive previous research on several inter-related topics, including collaborative writing (Storch, 2005), the role of discourse in learning (Mercer, 2007), and cooperative learning (Johnson & Johnson, 2009). Against this background, what do these papers show us about the effective elements in writing to learn?

With respect to instruction, the papers by Ortoleva and Bétrancourt, and Corcelles and Castelló, include a set of features that appear to have emerged as an effective approach. Ortoleva and Bétrancourt specifically refer to Tynjala's (2008) Integrative Pedagogy model; several additional studies have documented a set of overlapping instructional practices (e.g., Bazerman, Simon & Pieng, 2014; Hand et al., 2004; Nykopp et al., 2014; MacArthur, 2014). Painting with a broad brush, the typical process is this:

- Students initially learn key disciplinary concepts or strategies through reading or teacher instruction.
- Students receive or generate some information that becomes grist for interpretation, e.g. a professional experience, a science experiment, primary source documents in history, etc.
- Students apply the key concepts or strategies to interpret the information, often with scaffolding.
- Students construct a text, sometimes organized around the key concepts themselves, and sometimes organized around a generic argument structure.
- Students collaborate with peers to plan, draft, and and/or revise this text.
- Students receive feedback from the teacher or peers.
- Students may incorporate this feedback to revise the first text, or construct a subsequent text.

The papers in this volume contribute several insights about instruction. Corcelles and Castelló extend collaborative writing to the domain of philosophy, teaching students the subject-specific inquiry concepts of problematization, argumentation and conceptualization. Having completed my undergraduate degree in psychology and philosophy, I appreciated their lucid approach to making explicit to students the *kind* of activity in which they were supposed to be engaged.

Ortoleva and Bétrancourt have added to the limited literature on writing to learn in the professions, showing that Tynjälä's (2008) Integrative Pedagogy model helps students learn to apply reasoning to concrete cases of practice. They also add to the small literature on students using Wikis as a tool for writing to learn: Their results are

somewhat similar to another recent study, which produced an interaction effect such that blogging was an effective learning activity, but only if the instructor scaffolded it through writing prompts (Petko, Egger & Graber, 2014). Ortoleva and Bétrancourt also extended previous research by showing that this type of writing activity increased students' self-efficacy.

Having noted these contributions, it is important to echo the comments of the authors on the limitations of these studies: Corcelles and Castelló used a very small number of participants; Ortoleva and Bétrancourt used a pretest post-test design with no control or comparison group, and their study produced a mixture of positive and null effects.

A second kind of question is, what have these papers shown us about the mediators of collaborative writing to learn? Corcelles and Castelló (this issue) collected extensive data on student interactions, and related these to transformations in knowledge, both through comparison of two groups, and through documentation of specific discourse processes and the development of meaning that was associated with these processes. Interestingly, the researchers also used observations of what did *not* happen in the discourse to eliminate a certain variable as a possible mediator: i.e., teacher involvement.

Corcelles and Castelló confirmed previous research by demonstrating the importance of effective regulation during learning. This evidence for the importance of collective regulation nicely parallels evidence for the importance of self-regulation in learning through individual writing (e.g., Glogger et al., 2012). With respect to quality of discourse, the researchers confirmed the importance of exploratory talk, as compared to cumulative and dispositional types of talk, and they extended this finding to research on collaborative writing to learn (Mercer, 2007). They also provided additional support for the idea that disciplinary strategies are important for writing to learn, and extended this approach to collaborative writing, and to the domain of philosophy. Finally, they showed that whereas the less productive writing group included most of the ideas from their discussion in their final text, the more productive writing group showed a dynamic relationship between discussion and writing, incorporating ideas from their talk into their text only selectively. This provides an interesting parallel in collaborative writing to Bereiter and Scardamalia's (1987) original description of the verbal protocols of individual writers: Knowledge telling writers produced written texts that nearly matched their verbal protocols; knowledge transforming writers produced texts that represented only a selected fraction of the verbal reasoning that occurred during production.

Ortoleva and Bétrancourt investigated a mediating variable by examining the correlation between the number of words written and the dependent measures of learning; however, the correlation was not significant. It would be interesting to see further analysis of the qualitative features of the students' initial writing, and to track the writers' uptake of any additional ideas from the peer feedback. The authors referred to various models of writing to learn in their introduction, including Galbraith's (2009)

knowledge constituting model, and Bereiter and Scardamalia's (1987) knowledge transforming model. However, it is unclear how their intervention is connected to these theories; rather the intervention seemed to reflect the theory that they most emphasized, that is, sociocultural theory. Their data does not seem to support or refute either of the cognitive theories just mentioned, and instead, stands apart from them.

4. Moderators: What Have We Learned? What Questions Have Emerged?

At the end of this special issue, where are we left in our understanding of the role of instructional moderators? The previous literature has included several meta-analyses that have produced well-replicated findings about instructional moderators in individual writing to learn: Writing itself contributes to learning, with small to medium effect sizes (Bangert-Drowns et al., 2004, Graham & Hebert, 2011). In writing intensive units of study, metacognitive writing prompts are more effective than non-metacognitive writing prompts; longer writing interventions are more effective than shorter interventions; however, shorter writing sessions are more effective than longer writing sessions (Bangert-Drowns et al, 2004). In studies of the effects of writing on reading, teaching writing skills improves reading comprehension; and writing more, relative to writing less, also contributes to comprehension (Graham & Hebert, 2011). On most dependent measures, different genres of writing activities do not differ in their effects (Hebert et al., 2013).

In addition to these meta-analytic results, there are other findings that have been supported by several studies: Teaching cognitive strategies for writing in specific disciplines contributes to learning (MacArthur, 2014); prompting cognitive and metacognitive strategies, as discussed above, does so as well. The current issue reinforces these recent findings by extending them to new subjects (philosophy, health care), and by extending research to motivational and affective variables such as interest and self-efficacy (Wäschle et al., this issue; Ortoleva and Bétrancourt, this issue).

A similar systematic approach is needed with respect to collaborative writing to learn. As noted, the effectiveness of some complex interventions has been well documented (e.g., Hand et al., 2004). At the same time, as the current issue illustrates, many studies of collaborative writing to learn have been qualitative. This qualitative research points to interesting instructional practices and possible psychological and social mediators. However, these studies also show some subset of the following methodological issues: no separate manipulation of possible independent variables, no control group, limited numbers of participants, and sometimes no post-testing of individual learning. It would be desirable to see experimental tests of the following questions: Other things being equal, is collaborative writing more effective than individual writing? Is collaborative writing more effective than oral discussion? Collaboration can take place at various phases of writing, such as planning, drafting, or revision; during what phases or combinations of phases is collaboration effective for learning? Do these variables interact with student characteristics such as educational

level, previous knowledge, or previous writing achievement? These questions also apply to computer supported collaborative learning.

A program of research, similar to that of Johnson and Johnson (2009) in cooperative learning, could answer these questions. For example, several instances of experimental research with separation of independent variables can be found in studies of scripting in CSCL. Stegmann et al. (2012) engaged students in asynchronous online argumentation. In scripted collaboration, students were provided with input boxes that presented prompts corresponding to various kinds of argument moves based on the Toulmin model. In comparison to non-scripted online collaboration, students in the scripted group showed higher formal quality of argumentation, greater elaboration of content in arguments, and higher individual knowledge acquisition (cf., Noroozi, Weinberger, Biemans, Mulder & Chizari, 2013). Studies such as this provide useful models for investigating collaborative writing to learn.

5.   Mediators: What Have We Learned? What Questions Have Emerged?

In considering research on individual writing to learn, both this issue of the *Journal of Writing Research*, and the literature on writing to learn at large, show some disconnection between the most frequently discussed theories of writing to learn and empirical research. As we noted above, the two most influential theories of writing to learn have been Bereiter and Scardamalia's (1987) knowledge transforming model, and Galbraith's (2009)knowledge constituting model. However, for the most part, neither previous studies, nor the current special issue, either confirm or refute these theories. Rather, recent research points in other directions. One direction is the importance of metacognitive and cognitive operations (Wäschle et al, this issue; Glogger, Holzäpfel, Schwonke, Nückles, & Renkl, 2009; Hübner et al., 2010). Somewhat similarly, the most influential social theories, such as sociocultural theory, provide plausible general frameworks for understanding collaborative writing to learn. However, they do not appear to entail specific testable hypotheses, or correspond univocally to the results of specific empirical studies. Instead, empirical research points to the importance of more specific variables in writing to learn, such as group regulation, the teaching and learning of specific disciplinary strategies, and the scripting of argument moves.

In the meantime, if we were to proceed purely from well-replicated empirical findings, to project the simplest, most general statement about writing to learn, it might be this: Writing to learn is guided cognition. That is, writing provides a context, within which students are scaffolded to participate in a process of thinking and learning. In this process, students encounter information, reason about it, and transform it into new knowledge. Educationally, these cognitive processes are typically elicited through certain educational practices: The student begins with a source of information (e.g., work experience, historical source texts science data); a writing activity is used to engage students in reasoning about the content (e.g., writing a learning journal, argument, or wiki); this writing is made conceptually sophisticated through scaffolding

or instruction in concepts or strategies, which may be discipline-specific (e.g., philosophical competencies, historical significance, argument concepts); the task is structured to scaffold self-regulation (e.g., metacognitive prompts; peer collaboration); and the resulting text comprises both the goal and the product. A great deal more could be said about the specifics of this process in various activities and disciplines. However, something like this broad process seems to be common across disciplines and across individual and collaborative writing (e.g., Bazerman et al., 2014; Cantrell, Fusaro & Dougherty, 2000; Hübner et al., 2010; Lewis et al., 2011; McNeill & Krajcik, 2009).

This then raises questions, such as the following: Are some of these processes uniquely supported by writing? How can we further test the mediators posited by current theoretical models, such as the knowledge constituting model and the knowledge transforming model? In the meantime, in spite of some disconnections between theories and empirical research, writing as a learning activity has become a subfield characterized by successful empirical studies, and increasingly effective educational practices.

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