Future of Writing & Writing Instruction

In the Disciplines and Professions

White Paper

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v.6.0 (Last Revised on March 3, 2025 10:47 AM)

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Executive Summary

Problem

Over the past 60+ years, extensive research has been conducted on understanding and improving writing instruction. However, despite these efforts, a significant challenge remains, namely the lack of scalable solutions to help college graduates meet the standards of written proficiency.

Vision

We envision a future where technology complements human authorship, making writing more accessible while maintaining its essential role in developing critical thinking and communication skills. We believe that appropriately harnessed, AI-enhanced writing environments can enhance the writing process and make it more fluid, democratic, and inclusive. Strategically deployed, AI can lower the cognitive and motivational barriers that have stood in the way of scaling writing education.

Approach

Our approach builds on research-based principles that form the foundation for integrating technology both for writing and writing instruction in ways that enhance rather than replace human authorship Our approach focuses on:

- Supporting writers as they translate notes into prose without adding new ideas; the writer maintains control of the ideas but with a reduced cognitive load for exploring how they can be linguistically realized
- Enhancing the iterative process of drafting and reviewing by making the writer's invisible composing decisions visible
- Helping instructors and administrators develop writing assignments and assignment sequences with an integrated library of writing genres

By strategically integrating AI with research-based approaches, we aim to bridge the long-standing scalability gap in writing instruction while maintaining the thoughtful engagement that characterizes meaningful human writing

Introduction

According to psychologist Steven Pinker," writing is and always has been hard" compared to speech. In conversation, listeners are present and identifiable; in writing, readers are often "unknown, invisible, [and] inscrutable."[1] Since writers are displaced from their readers in time and space, they must convey context through their ability to anticipate mutual and unshared knowledge with their readers using their linguistic know-how.[2]

To organize this anticipatory knowledge and know-how strategically, writing involves many integrated cognitive, social-cognitive, and linguistic processes, including "attention, motor, visual, executive functioning, memory, and language, as well as writing knowledge, processes, and skills."[3] These interconnected processes involve the writer's cognitive resources to function alone and cooperatively. They also compete. For example, with finite time to deadlines, attention to sentence production, grammar, and spelling deducts time from planning and organization, and vice versa.

There have been no scalable breakthrough solutions for helping college graduates and young professionals improve their writing.

Despite these challenges, the rewards of writing are significant. Writing endows communication with extended planning time across multiple sittings, creating the capacity to take language "offline" without conversational constraints. The unconstrained time to plan with language affords a refinement of thought unobtainable in unplanned speech or conversation.[4] However, writing tasks can quickly exhaust the writer's cognitive resources, making writers feel overwhelmed and their capacities overextended.[5] This cognitive burden gives rise to a fundamental motivational problem. When a task is as challenging as writing, the time to learn to manage it and the effort to execute it must be justified. Edmondson characterizes writing as "back-breaking," "mind-breaking," and "lonely."[6] This is why writing researchers and educators across K-12 and post-secondary education have long understood that instruction in writing has small odds of success without addressing students' motivation to write.[7]

Disconnect Between Writing Research and Student Performance

Significant research has been conducted on writing processes and effective writing instruction since the 1970s.[8] However, the number of scientifically controlled studies that have identified effective writing instruction is "slim,"

1 Pinker, quoted in Levitt, 2023.
2 Brandt, 2011.
3 Hayes, 2012, cited in Graham and Harris, 2019, p. 25
4 Olson, 2016, p. 15.
5 McCutchen, 1996.
6 Edmondson, 2016, p. xiii.
7 Hayes, 1996; Boscolo & Gelati, 2019.
8 See the edited handbooks and research summaries of Bazerman and Prior, 2004; Graham & Perin, 2007; Bazerman et. al., 2008; Graham, MacArthur & Fitzgerald, 2013; MacArthur, Graham, & Fitzgerald, 2015; MacArthur, Graham, & Fitzgerald, 2016; and Graham, MacArthur & Hebert, 2018.

and the results of these few studies are inconsistent.[9] Nonetheless, there are some practices with consistent benefits that teachers, unfortunately, are not systematically implementing in K-12 classrooms.[10] The most constructive of these practices is to ask students to write more frequently in class. Several studies across these grades have replicated that giving students more time to write in class improves writing quality, reading comprehension, and subject matter learning. However, in a study published in 2011, Applebee and Langer found that U.S. middle school and high school students were writing only 1.6 pages of prose per week and 2.1 pages for the rest of their subjects combined.[11]

Moreover, this scant writing consisted mainly of summary rather than more complex analytic writing.[12] This lack of challenging writing assignments in American classrooms is attributed to workload issues—the more writing, the more feedback burdens on the teacher.[13] The lack of writing practice helps to explain why less than 25% of eighth and 12th-grade American students scored "proficient" in writing.[14]

This problem cascades to the post-secondary level. Beyond a lack of practice in classroom writing, there have been no scalable breakthrough solutions for helping college graduates and young professionals improve their writing. Complaints from employers about the poor quality of college graduate writing registered in the 1964 issue of Harvard Business Review[15] still register today. The modern workplace outputs endless streams of emails and reports, and businesses continue to invest billions of dollars in remedial writing training for their employees.[16]

The Past of Writing

Writing has continuously evolved over history to lighten the burden of writers based on the emerging technologies that underlie it. The invention of papers, pens, and inks liberated writing from the earlier methods involving inscriptions on clay tablets or bones. To lure professionals away from long-hand, the Remington Typewriter Company in the 1870s promised speed and mechanical standardization. "To save time," their advertising pitched, "is to lengthen life."[17] In 1985, the New York Times technology columnist Peter Lewis reviewed a new generation of word processors, "each promising to transform a personal computer and printer into a magical super typewriter."[18]

Until recently, much of the drudge eliminated by writing technologies has had to do with increasing the speed and accuracy of placing marks on the page or screen. Typewriters supported the mechanical transfer of charac-

9 Barshay, 2019.
10 Barshay, 2014.
11 Applebee & Langer, 2011.
12 Applebee & Langer, 2011.
13 Barshay, 2014.
14 National Center for Education Statistics, 2012.
15 Fielden, 1964.
16 Moore, 2016.
17 Polt, 2015, p. 8.
18 Lewis, 1985.

ters on a physical page. Digital technologies began to detect and correct common errors automatically at the word and phrase level, from spelling to grammar. Machine learning introduced automatic completion and text prediction.

As newly invented writing technologies promise to cut transcription time, they often face backlash, typically the unsubstantiated fear that lightening the labor of the writing process somehow degrades the authenticity and quality of the written product.[19] For example, University of Delaware professor Marcia Peoples Halio observed that students using "user-friendly" Macintosh computers "committed more punctuation, spelling and grammar errors … and wrote shorter, less complex sentences."[20] The notion that easing the transcription costs of writing degrades it is a recurring trope extending back to earlier writing technologies. Still, over time, the newer technology gradually seeps into the general public as a superior extension of the technology it seeks to disrupt: the quill as the superior reed pen, the typewriter as the superior quill, and the word processor as the superior typewriter. As the technology matures and generations turn over, according to Baron, the new technology becomes the new focal lens from which to view, even assimilate the older technologies.[21]

Emergence of Generative AI

The recent surge of generative AI marks a significant watershed in the evolution of writing technologies and the writing process. Throughout the history of writing tools, technology has focused on improving the efficiency and convenience of transcription. Generative AI is the first technological breakthrough that promises to accelerate not just the transcription of words but the generation of ideas. Before generative AI, writers had to supply the draft for the automated tools to review. Generative AI promises to assist in the production of the draft, along with the tools to review it. Because it appears to intrude on the human and creative aspects of writing, generative AI has stirred much discussion and consternation.

No sooner had generative AI startled the world in the fall of 2022 than social commentators issued dire predictions that AI would deprive rising generations of the intellectual and emotional growth that writing affords.[22] They predicted epidemics of fraudulent authorship, the erosion of critical thinking, the dissolution of academic integrity, the widening of equity gaps, the weakening of human connection, the homogenization of writing, and an onslaught of unprecedented ethical dilemmas. While these concerns are real and persist today, they frame the relationship between human writers and AI as adversarial. At the same time, many writing instructors have pursued a complementary relationship between AI and writing. Some suggest that AI poses no serious threat to writing assignments when teachers keep their

19 Baron, 2009.
20 Lowis, 1992.
21 Baron, 2009.
22 Peritz, 2022.

assignments detailed and customized.[23] Others have devised engaging writing assignments integrating generative AI as objects of reflection for students' critical thinking.[24]

Next Steps

This white paper presents a forward-looking vision of the future of writing that embraces technologies, including AI, without dehumanizing the writing process. In particular, instead of focusing on what current AI may or may not be or what future technologies can or cannot do, we are interested in what the future of writing ought to be and how technologies should play a productive role in that future.

We envision a responsible future that embraces AI in writing without dehumanizing the writing process.

We envision a future where technology will complement human authorship by granting writers more time to reflect on the intentionality and accountabilities of their composing choices. We envision a future where technology will broaden access to diverse populations of human writers, who, unlike machines, uniquely understand the immediate, personal, and historical context in which they seek to express themselves. We envision a future where technology will become a supportive partner in the development of critical thinking, which is fundamental to human learning. We believe that technology-enhanced writing tools, designed and deployed thoughtfully and strategically, can enhance our ability to write without displacing the human writer from the helm.

Moreover, we aspire to a broader learning and training ecosystem where technologies empower instructors across disciplines and professions to design and implement more effective writing assignments, enable program administrators to analyze writing development patterns across the curriculum, and allow institutions to scale writing instruction without compromising quality or increasing labor. Through innovative AI-enhanced tools and data-driven insights, we see opportunities to scale writing instruction to a broad spectrum of courses—from first-year composition courses to advanced courses in the disciplines, from community college courses focusing on workplace writing skills to corporate and executive training courses. We believe that meaningful advancement in writing must support not just individual writers, but the entire community of educators and administrators who guide and sustain writing education, helping students and professionals become life-long learners of writing.

The Threat to Writing "Thoughtfully" in the Age of AI

Writing is a thoughtful activity. It affords the opportunity to think things through, make decisions, learn about and solve problems, coax insight from data, calm situations, or disrupt them. All writing—from academic to workplace—requires thoughtfulness,[25] often captured in the expression "critical

23 Graham, 2022.
24 e.g., Dejeu, 2024.
25 Maimon et al., 2022.

thinking." Critical thinking is the ability to comprehend, explore, organize, and express complex ideas, sift, synthesize, and evaluate evidence, and apply this accumulated knowledge to construct and refute reasoned arguments across disciplines and subject matter domains.[26] Critical thinking, in this sense, spans both a method of inquiry and a means of discovery, helping writers clarify their thinking and apply that clarity to engage iteratively and deeply with the material they are working with. In educational settings, the development of critical thinking often occurs organically within writing assignments in specific disciplines.[27] These assignments prompt students to analyze disciplinary concepts, evaluate evidence, and construct well-reasoned arguments, fostering writing proficiency and deepening their critical thinking capabilities within their field. The future of writing with AI must not conflate the thoughtful engagement of the writer, which is indispensable, with the human toil that is dispensable and that machines can mitigate. In other words, at every reasonable opportunity, AI must ensure that the writer's thoughtfulness is sustained and never buried under or distracted by layers of toil.

The future for writing with AI must never conflate the thoughtful engagement of the writer with the unnecessary toil that machines can mitigate.

What makes writing human has never been solely or even essentially about the arrangement of words on the page or screen. It has more to do with who stands behind those words, who stakes their reputation on them, and who is willing to defend every composing decision. Authorial decision-making is more complex and requires more thoughtful engagement than sequencing words. As machines increasingly become capable of the generative aspects of writing, it is critical for human authors to own the decision-making behind the actions of their machine. Ownership of composing decisions has been a goal of writing education since its inception. However, the cognitive demands of writing can easily obstruct novice writers' development of ownership over their composing choices and even their awareness that decisions are being made.

As we detail below, we propose we propose an ethical approach to AI that allows writers to convert their paragraph-size notes, representing their ideas, into readable grammatical sentences without changing or expanding on the meaning of the notes. This assistance helps writers rapidly prototype/evaluate their thinking by wrapping a readable syntax or visual format around it. This assistance requires restraining the AI to minimize the potential distraction of extrapolating beyond the notes or even hallucinating. Limiting the production unit to a paragraph or less ensures that the writer can quickly spot unwanted extrapolations or hallucinations should they arise. More importantly, this approach further alleviates the 'creep' of sentence craft—a threat to the writer's sustained thoughtful engagement—where writers tend to leap ahead to the final stages of sentence polishing, even when ideas remain fluid and sentence polish is premature. Such forward leaps are

26 Quitadama & Kurtz, 2007.
27 Bean & Melzer, 2021.

tempting distractions for writers, especially when they are struggling with the major ideas and organization of their writing.

Challenges of Writing in Higher Education

Writing instruction in higher education has evolved significantly to address its fundamental purpose—developing writers who can adapt and continue learning about writing throughout their lives. The path to achieving this lifelong learning capacity differs between institutional contexts. Four-year institutions emphasize disciplinary variations and introduction of theoretical frameworks for transfer.[28] In contrast, two-year colleges, as Tinberg explains, must balance multiple urgent needs: preparing students for transfer, developing workplace writing skills, and addressing basic writing needs within compressed timeframes.[29]

The fundamental purpose of writing instruction in higher education is to help develop adaptable, lifelong learners of writing.

Despite these contextual differences, three critical objectives unite contemporary writing instruction to foster this lifelong learning capacity.

- Develop students' ability to participate effectively in academic and professional discourse communities, teaching them to understand and engage with the conventions, expectations, and genres specific to different fields.
- Build students' capacity to analyze and respond to diverse contexts of writing, enabling them to recognize how purpose, audience, and context shape effective communication.
- Cultivate metacognitive awareness about writing choices and their effects, helping students understand not just how to write, but why certain strategies are effective in particular situations.

These interconnected goals reflect the Boyer Commission's vision of undergraduate education[30] and align with the contemporary understanding of writing as a complex social and cognitive activity. By focusing on these elements rather than merely teaching prescribed forms or rules, writing instruction prepares students to navigate the diverse writing challenges they will encounter throughout their academic, professional, and personal lives.

However, despite decades of research and evolving pedagogical approaches, two fundamental issues—the cognitive complexity of writing and the challenge of skills transfer across contexts—remain central challenges for writing instruction. Understanding these challenges across different types of institutions and advances in research to address them provides crucial context for examining the future of technology-enhanced approaches in writing instruction.

28 Downs & Wardle, 2007.
29 Tinberg, 1997.
30 The Boyer Commission on Educating Undergraduates in the Research University, 1998.

The cognitive complexity of writing and the challenge of skills transfer across contexts remain central challenges for writing instruction.

The cognitive complexity of writing presents a fundamental challenge at the individual level. Research by scholars like Flower and Hayes[31] showed that even basic writing tasks require orchestrating multiple cognitive processes simultaneously, including planning, translating ideas into text, and reviewing. Bereiter and Scardamalia further demonstrated skilled writers use the act of writing itself to develop new insights through the recursive mental work required, rather than simply transferring existing thoughts to paper.[32] This more sophisticated approach demands that writers simultaneously manage their evolving ideas, their developing understanding, and their audience's needs—adding further layers of cognitive complexity to the task. Supporting students in developing this more cognitively demanding but ultimately more rewarding approach to writing remains a challenge of writing instruction.

Early assumptions that basic writing skills would naturally transfer to different contexts proved incorrect. The challenge of transfer—how writing skills carry over across different contexts—manifests at the curriculum and program level. For instance, Carroll's longitudinal research demonstrated that writing development is neither linear nor automatically transferable, with students often struggling when faced with new disciplinary genres and expectations.[33] In response, colleges and universities shifted toward explicitly supporting transfer and disciplinary specialization. While four-year colleges focused on disciplinary conventions and academic discourse communities,[34] two-year colleges addressed both academic and vocational writing demand, focusing on skills that could transfer to workplace contexts as well as four-year institutions.[35]

Contemporary approaches acknowledge these persistent difficulties while trying to implement more sophisticated transfer strategies and better integration with disciplinary majors. The central challenge remains in effectively coordinating instructional strategies across diverse disciplinary contexts and multiple years of coursework.

Principles Central to Addressing the Writing Problem

Our strategy for tackling the challenge of writing revolves around the following core principles, which are firmly grounded in empirical research on writing pedagogy and cognitive processes. These research-derived principles inform our approach to designing effective writing tools for students and writers.

31 Flower & Hayes, 1980, 1981.
32 Bereiter and Scardamalia, 1987.
33 Carroll, 2002.
34 Wardle & Downs, 2011.
35 Tinberg, 1997.

Principle 1: Cognitive load reduction enhances writer engagement

High cognitive load can overwhelm working memory. Reducing the load frees up cognitive resources to hold on to the big picture while fine-tuning sentences, improves problem-solving and enhances motivation and engagement. Across the many cognitive components of the writing process,[36] empirical research suggests that translation and transcription are a noteworthy Achilles' heel. Using think-aloud protocols of experienced adult writers writing sentences about their jobs, Kaufer et al. were surprised to find that sentence craft quickly leads writers down rabbit holes: Translating ideas into prose is choppy and turbulent, not the smooth or seamless process one might expect. Writers compose sentences in bursts, which are shaky and error-prone deliberations involving halts and pausing. Sentence parts are proposed, accepted, or discarded before new parts are entertained. The bursts last six or seven words before pausing for two seconds or longer. The pauses reflect freezes (e.g., "What do I say next?") or revisions in midstream (e.g., "I want to say…I mean that…not sure now") that cause grammatical disfluencies.[37]

Word processors reduced much of the tedium of transcription by allowing writers to move, copy, and paste text instantly. However, rote transcription (including the orthographic motor skills to produce text) does not cause the rabbit holes seen in translating ideas into prose. Hayes and Chenoweth[38] asked writers to transcribe text from one computer window to another, and they found no evidence of the burst-and-pause cycles of the translation that goes into sentence craft. In a later study, Hayes and Chenoweth[39] found that the bursts and pauses of sentence craft are not related directly to the so-called "complexity" of the planned ideas and meanings. They found the same burst-and-pause cycles arising from trivial sentence manipulations, such as converting passive into active sentences. Hayes concluded that the bursts and pauses of sentence craft most likely reflect the limits on working memory for the chunks that make up a sentence.[40]

Principle 2: Extended prewriting activity is essential

Prewriting activities, including brainstorming, outlining, and note-taking, help writers develop and organize their ideas. The think-aloud protocols of Hayes and Flower[41] and the study of Glynn et al.[42] suggest that generating effective writing requires significant allocations of time for planning and organization. However, prewriting time often inadvertently slips away in competition with other later processes. Even when writers implicitly understand the importance of prewriting, the time they assign to it is often compromised because of the cognitive load (see principle 1) and resulting time sink of drafting, i.e., sentence crafting.

36 Hayes and Flower, 1980; Flower and Hayes, 1981.
37 Kaufer et al., 1986.
38 Hayes & Chenowith, 2006
39 Hayes & Chenowith 2007.
40 Hayes, 2009.
41 Hayes & Flower, 1980.
42 Glynn et al., 1982.

Although principles 1 and 2 are analytically distinct, they are closely connected in practice. Writers know that their deliverables must be presented as well-formed sentences. Should sentence drafting become too rough a slog, writers place their priorities there to ensure there is something to submit by the deadline. Much-needed planning time for the overall organization is sacrificed.

Principle 3: Genre knowledge provides critical scaffolding for writing activities

Principle 2 ensures that prewriting is allocated ample time but does not by itself assign a coordinated direction and focus to that time. Genre-specific knowledge, as expressed in principle 3, ensures such direction and focus in developing well-formed writing. Genre knowledge allows writers to pin down the expectations of readers, the conventions, tropes, linguistic structures, and author-reader relationships that readers expect to encounter. Genre, in this sense, guides the entire writing process: prewriting, sentence-generating, and revising. Experienced writers recognize that genre is not a straitjacket but a resource for enriching the reader's experience and furthering the writer's goals.[43]

Research on genre has focused on academic and ESL writing. Geisler shows the crucial role of genre in the display of written expertise in disciplines like philosophy.[44] Yet genre knowledge also pervades prewriting knowledge in non-academic contexts—e.g., professional, trade, and literary.[45] Professional and creative writing programs commonly teach these professional, trade, and literary genres in college writing classrooms to prepare students to transition from school to work.

Genre, in sum, oversees the communication and learning goals of the writing and the nature of the writing task, be it a classroom or a professional genre. Genre, as a principle of writing, is non-identical, with the first principle of reducing the cognitive load of writing. However, genre knowledge pins down numerous composing decisions about the nature of the writing that writers would otherwise be burdened to make on their own.

Principle 4: Review and revision are integral components of the writing process essential for effective writing

Writing often requires an iterative process through multiple drafts. Throughout the writing process, writers must review the draft carefully from various perspectives, including consistency, coverage of topics, flow of ideas, persuasiveness of arguments, appropriateness of the voice/tone, etc.

In the process model of reviewing proposed by Flower et al.,[46] drafting and reviewing are considered significantly different stages of writing. Drafting deals with planning and translating ideas. Reading during this stage is mainly confined to checking and repairing errors. Reviewing, on the other hand,

43 Swales, 1990; Swales & Freak, 2000; Hyland, 2004, 2009, 2012.
44 Geisler, 1994.
45 Kaufer & Butler, 2000.
46 Flower et al., 1969.

is a complex, constructive process that builds on reading comprehension. Unlike drafting, it is not about reading to check or correct a draft while translating ideas into text. It is about reading to evaluate a completed draft as a finished product and simulating the mental experience that the completed draft delivers to its projected target readers. Evaluation in the review stage transforms reading into a form of testing, where the text is judged against a broader, more rigorous set of standards. This process goes beyond simple fault-finding. It becomes a generative activity that can lead to the discovery of new standards and revision strategies to meet them.

Both novice and expert writers read and check the text in the drafting stage. However, reading to evaluate in the review phase requires significant writing practice and skill. Bridwell[47] analyzed 6,129 revisions in 100 randomly selected sets of informative/argumentative essays written by twelve-grade students. He found that 30% of the revisions in the high-quality essays relied on revisions made across drafts, while only 4% of the revisions in the low-quality essays crossed drafts. Reading within the review phase of writing becomes an opportunity for re-seeing and re-negotiating everything about how a draft should evolve. This extensive re-envisioning is hard to muster when the cognitive cost of reviewing prose is too high. Imagine a draft of a 6-page project proposal. Without a substantial and time-consuming investment in reading and re-reading the draft, we cannot tell how ideas are organized or whether or not a line of argument has been established or is logical and sound.

Principle 5: Explicit instruction in metacognitive writing strategies facilitates the grasp of threshold concepts

Research on writing education has evolved significantly in understanding how to address the challenges of transfer of writing skills.[48] In particular, two key interconnected approaches have emerged as effective in addressing these challenges. First, the threshold concepts framework, an approach advanced by Adler-Kassner and Wardle,[49] building on Meyer and Land's work,[50] identifies fundamental concepts students must grasp to develop as writers—concepts that require transformative though sometimes uncomfortable shifts in understanding what writing is. Second, research has increasingly highlighted the crucial role of metacognitive awareness in writing development. Driscoll and Cui's longitudinal study revealed that 78% of transfer is "invisible" to students, highlighting the need for explicit instruction in metacognitive strategies.[51] Work by Winslow & Shaw have shown how teaching these strategies can promote both near and far transfer.[52] Tardy's research further demonstrates how developing the metacognition of student

47 Bridwell, 1980.
48 Adler-Kassner & Wardle, 2020.
49 Adler-Kassner & Wardle, 2015.
50 Meyer & Land, 2003.
51 Driscoll & Cui, 2021.
52 Winslow & Shaw, 2017

writers improves both their specific genre knowledge and their broader genre awareness.[53]

These complementary approaches—supporting the development of key threshold concepts and explicit teaching of writing and rhetorical strategies to promote metacognitive awareness—work in tandem and provide a framework for addressing the persistent challenges in writing education. By helping students understand fundamental concepts about writing while developing their ability to consciously recognize and apply their knowledge across contexts, these approaches offer promising pathways for improving writing instruction and supporting student development.

Principle 6: Meaningful sequencing of writing assignments within and across courses supports transfer

Research on writing transfer has established assignment sequencing as a critical factor in fostering writing knowledge across academic contexts.[54] Students don't simply acquire generic writing abilities but rather develop context-specific practices that must be carefully scaffolded. Nowacek's concept of students as "agents of integration" (Chapter 2) suggests that thoughtful assignment sequencing can help them become more intentional agents in recognizing and adapting their prior writing knowledge.[55] The Teaching for Transfer model[56] provides evidence that carefully sequenced assignments, particularly those building in systematic reflection, can significantly enhance students' ability to transfer writing knowledge across contexts. Good assignment planning means more than just putting easier tasks before harder ones. The goal is to create connections between assignments that help students build practical writing skills while also helping them understand how they can apply what they learn in different situations.

However, even though we now know more about how to teach writing effectively across courses and curricula, it is a challenge to implement a sequence of writing assignments that meaningfully build on each other across courses, years, and disciplines. That is why the meaningful sequencing of writing assignments is essential for effective writing education at the institutional level.

Principle 7: Support for disciplinary instructors in developing and assessing writing assignments strengthens pedagogical practice

Wardle argues that simply arranging writing tasks in a particular sequence, even when the later tasks mirror earlier ones, is insufficient to ensure transfer to new writing situations.[57] Her research shows that students need extra scaffolds to support transfer, including direct feedback from instructors, opportunities to interact with peers, and experience reading and writing within the specific content area of discipline of the writing.

53 Tardy et al., 2020.
54 Yancey et al., 2014; Wardle, 2007.
55 Nowacek 2011.
56 Yancey et al., 2014.
57 Wardle, 2007

Hence, if we want to accomplish the goal of effective writing instruction in higher education, it is critical to support instructors in the disciplines to develop engaging and meaningful writing assignments, as well as to support them in assessing writing assignments. This support must be systematic and sustained, focusing on helping faculty understand writing pedagogy within their disciplines and on developing effective strategies for both designing and assessing writing assignments—and all this without an onerous investment of their time/effort. We must ensure that writing assignments across the curriculum provide the contextual scaffolding that Wardle's research identifies as crucial for developing transferable writing skills.

Future of Writing & Writing Instruction—Our Approach

For the past twenty-five years, guided by some of these principles, we have explored how digital tools incorporating Natural Language Processing and interactive visualization might alleviate writers' cognitive load and enhance their writing process.[58] These experimental digital writing environments were designed to offer automatic feedback, thereby maintaining a writer's engagement without the need for supervision from teachers. Our involvement in this research long predates the rise of generative AI. At the same time, we have discovered that strategic deployment of generative AI complements our vision of placing the human writer at the forefront of the writing process while democratizing access to the writing process for a broader population.

AI makes writing more "effective" by focusing the actions of writing on actions that can only be entrusted to a human.

It is important to note that our vision of the future of writing presented here is a work in progress, based on our reflection through the iterative design, implementation, and evaluation of these digital tools. These tools have played a critical role in our thinking, which continues to evolve.

Restrained Generative AI

Early drafting is often painful because it takes place in a mental fog. Writers usually cannot understand their preliminary thoughts until they see them realized as sentences. They write not to express their refined thought but to examine their early thinking, warts and all. However, writers often fall down the rabbit hole of sentence craft at this early stage and mistakenly begin to polish sentences when they should be engaging them only well enough to construct a visible prototype of their thinking. Novice writers can get so bogged down in the morass of sentence craft that they rarely experience the successes and pleasures of higher-level thinking and problem-solving that writing can deliver.

One responsible use of AI offers writers a tool to convert their notes into prose without adding ideas. The AI is restrained to mirror in prose the quality

58 Kaufer & Ishizaki et. al., 2003; Ishizaki & Kaufer, 2011, 2020; Wetzel et. al. 2021. Brown & Wetzel, 2023; Laudenbach, 2024.

of the writer's notes. Should the writer's notes be hazy and not well-thought-through, the AI-produced prose should reflect that haziness. Should those notes be more precise and thorough, the AI-produced prose should reflect that precision and thoroughness. The AI ensures that the sentences produced stay within the bounds of the human writer's original ideas. In this light, restrained generative AI creates language to help writers rapidly prototype and test notes on their paragraph-sized ideas and organization. It turns notes into a paragraph, making the notes easier to read, study, evaluate, and learn from.

AI can further make the writing process accessible and more inclusive.

Restrained generative AI can narrow the psychological distance between ideas and expression and relax the bottlenecks that have kept them siloed. It can make writing more fluid while reducing pain points. It can make the writing process accessible and more inclusive, particularly for underprivileged students with limited access to writing instruction, as well as second-language learners. Generative AI is the first technological breakthrough that promises to accelerate not just the transcription of words but also the translation of the writer's ideas from notes to grammatical English sentences.

Restrained Analytic AI

Evaluation in the review/revision process is a complex and constructive activity that builds on reading comprehension. When reading for comprehension, a reader automatically checks if the text meets basic goals like truthfulness and logical consistency. However, when reading to evaluate, the writer must consciously impose additional, more demanding criteria on the text, such as clarity or persuasiveness.

Writers compose in bursts of words, but the product of those bursts aggregate into larger, often invisible structures (e.g., key ideas, lines of argument, coherence chains) that writers must monitor and review as they write. Serial reading and rereading are the typical ways writers recover and monitor the development of these structures. As Flower and Hayes[59] observe, during the review process, "writers choose to read what they have written either as a springboard to further translating or to systematically evaluate and revise the text." However, iteratively reading and rereading drafts to keep track of key ideas, lines of argument, and coherence relations is labor-intensive, often exhausting. Writers can revert to skimming and scanning to expedite the review process but these techniques sacrifice accuracy.[60]

AI has the potential to do much of this metacognitive bookkeeping in the review process, but only if it is guided to do so. Instead of relying solely on AI's training knowledge alone to assess the quality of the writing, we can guide the AI based on research findings on what makes writing more effective for a specific writing type. We can guide it to track the development of key ideas and arguments across a text as a composition teacher would

59 Flower & Hayes, 1981, p. 374.
60 Rogers & Lasky-Fink, 2023, pp. 36-38.

have learned to do after grading thousands of essays. We can guide it to track the logical progression of ideas and lapses in that progression, such as the misalignment of old and new information that can disrupt flow. We can guide it to track coherence across paragraphs based on research on how human readers perceive coherence. For example, research suggests that lexical overlaps across paragraphs in a text correlate to the perceived quality of the text.[61] We can then guide AI to focus on lexical overlaps across paragraphs to assess the quality of the text.

Making the Invisible Visible

Another way to reduce the cognitive load is to visualize invisible features of writing. The practice of visualization, or the use of visual representations to communicate data and information, has a long history. Its roots can be traced back to the era of cave paintings, marking the earliest known use of visuals to convey information. As science began to flourish in the 18th and 19th centuries, the use of visual representation grew in tandem, becoming an integral part of scientific communication. This trend continued into the late 20th century with the advent of computational visualization.

Computational writing environment that make visible the invisible aspects of writing help students build writing knowldge through hands-on exploration.

The benefits of visualization are manifold. For one, visual representations can simplify complex information, making it easier for individuals to comprehend and internalize key concepts. These visual depictions of data and information can expedite decision-making processes by providing a clear overview and facilitating the comparison of different options. Additionally, visual content commands attention more effectively than text, increasing engagement and interest.

We believe that visualizing the invisible features of writing, such as key points, lines of argument, coherence relations, and the information density of sentences, can significantly enhance the writer's ability to review and revise their drafts. Visualizing these features at a glance through AI promises to ease time-consuming monitoring activities, including reading, re-reading, skimming, and scanning.

Tools to Think With

Developing metacognitive awareness in writing presents a significant challenge in composition pedagogy, particularly because expert writing practices often involve implicit knowledge that remains invisible to novice writers. To address this challenge, we draw on the concept of "tools to think with"—pioneered by Seymour Papert in educational technology—to create computational environments that make abstract writing concepts concrete and manipulable. Just as Papert's work made mathematical concepts tangible through interactive tools, computational approaches to writing instruction can make visible the typically invisible aspects of rhetorical strategies and argumentative structures that writers employ.

61 Crossley & McNamara, 2016.

Such computational environments serve as cognitive scaffolds by providing multiple analytical perspectives on texts, from visualizations of argument and topical development, to persuasive strategies. By interacting with these concrete representations of their own writing, students can develop mental models for understanding and approaching the writing process. This approach aligns with constructionist learning principles, where knowledge is actively built through hands-on exploration rather than passive reception. When students can see and manipulate typically abstract aspects of writing, they begin to internalize these analytical perspectives, developing the metacognitive awareness that characterizes expert writers.

The ability to make abstract writing concepts concrete and manipulable helps students grasp key threshold concepts in writing —those transformative ideas that fundamentally change how learners understand the discipline. Through interactive visualizations of rhetorical choices and argument structures, students can better understand complex concepts like "writing is a process, "writing is a social and rhetorical activity" or "good writing responds to the needs of its audience." As students deepen their understanding of these threshold concepts, they are able to bridge the gap between theoretical understanding and practical application, developing both the metacognitive awareness and concrete strategies they need to advance as writers."

Connecting the Genres

Research in writing studies has consistently shown that the thoughtful sequencing of writing assignments can enhance students' writing development and their ability to transfer writing knowledge across contexts.[62] However, implementing such sequencing at scale across college curricula remains challenging, particularly with the diverse disciplinary contexts and varied curricular structures across higher education. Though writing program administrators and faculty often recognize the importance of building coherent writing experiences, mapping, coordinating, and sequencing writing assignments across departments, programs, and courses at scale in a research-informed way is a challenging undertaking.

Mapping relationships between genres allows us to inform how assignments across courses and curricula can be sequenced to support students' transfer of writing knowledge.

One promising approach is to develop a digital library of genres that could support computational analysis of academic assignments. Such analysis can reveal meaningful relationships between writing assignments, showing natural learning progressions and identifying gaps in student writing experiences. Central to our approach is the separation of genres from specific assignments. While assignments specify course-specific requirements and expectations, genres encompass more transferable expectations that students can continue to rely on to write similar types of texts across different contexts downstream. Distinguishing writing assignments from genres ensures that genres, unlike assignments, can be represented consistently across different courses and curricula. By mapping relationships between genres, we can

62 e.g., Nowacek 2011, Yancy et al. 2014, Wardle 2007.

analyze connections between different types of writing (e.g., similarities and differences between genres). Understanding these relationships—particularly the similarities and differences between genres—can inform how we sequence assignments across courses and curricula to support students' transfer of writing knowledge.

This systematic approach to organizing and analyzing writing types benefits multiple stakeholders. For example, students gain more coherent and scaffolded writing experiences, faculty receive insights about how their assignments connect to broader writing curricula, and administrators can make data-informed decisions about curriculum design and resource allocation. Writing program administrators can use visualizations of genre relationships to identify strategic points for intervention, such as introducing bridge assignments that connect disparate genres or reinforcing key writing skills through carefully sequenced assignments across disciplines.

Support Instructors & TAs

Research suggests that disciplinary faculty often develop writing assignments with minimal formal support in writing pedagogy. Studies have found that these instructors typically rely on their own experiences as writers and scholars in their fields, having internalized disciplinary conventions without explicit instruction in assignment design.[63] While growing numbers of colleges support Writing Across the Curriculum (WAC) programs that aim to provide faculty development in writing instruction, many institutions still lack such programs, especially community colleges.[64] It does not mean that the solution is to turn disciplinary faculty into writing specialists. Rather, it is to help them understand and leverage the distinct ways that writing operates within their fields. This approach recognizes writing as deeply embedded in disciplinary practice rather than as a set of universal rules that can be applied across all contexts.[65]

To support instructors in developing and assessing writing assignments, we envision an integrated technology-based solution with multiple components. At its core would be a comprehensive library of writing genres with clearly defined expectations. This library would enable intelligent assignment selection that can analyze instructors' discipline-specific assignment descriptions and suggest appropriate matching genres from the library. AI-enhanced review tools outlined above would serve multiple purposes, from generating specific feedback on student writing to facilitating faculty evaluation and TA training. This supportive ecosystem would help scale writing instruction across disciplines while maintaining pedagogical quality and consistency.

Conclusion

The advent of AI yields new opportunities to distinguish the human essentials of authorship from the bookkeeping and overhead that machines can

63 Thaiss & Zawacki, 2006.
64 Thaiss & Porter, 2010.
65 Carter, 2007.

handle. AI does not make writing "easier" in the sense of eliminating the human challenge. AI instead makes writing more "effective" by focusing on the actions of writing that can only be entrusted to a human and offloading non-central bookkeeping actions to a machine.

AI promises to help more of the human race enjoy the fulfillment of expressing themselves and the world in which they cohabit through the written word. Decades of research on writing have helped us understand the challenges of writing and improved ways to teach and motivate it. By making the writing process more effective and satisfying for human beings, we will likely see the gap closing between all we have learned from research and student and workplace performance.

We have suggested that no responsible AI should intrude on the human writer's critical decision-making, judgment, reflection, and accountability. This means, as mentioned above, that in the future of writing, authorship will have less to do with who "produced" the prose and more to do with who takes accountability for it. Those accountabilities require both extreme craft knowledge and analytic knowledge. The writing of the future will require humans to have a more rigorous and systematic knowledge of what makes writing human. With greater machine assistance on the small and routine aspects of writing, writers of the future will have more time to reflect on their subtle messaging strategies and the likely impact on audiences receiving them.

We believe the path forward requires writing experts to lead with a clear vision for writing and instruction—instead of waiting for technologies to chart the course.

Moreover, strategic integration of AI and computational approaches to writing transfer at programmatic levels promises to help bridge the long-standing scalability gap in writing instruction. By providing data-driven frameworks for understanding genre relationships and enabling more coherent sequencing of writing experiences across disciplines, these tools can help institutions implement research-based practices at scale. This multi-level approach—supporting individual writers while providing tools for institutional coordination—creates opportunities to meaningfully connect classroom instruction with broader curricular goals.

For over half a century, we have witnessed recurrent calls to improve the writing skills of students and professionals. While these have been well-meaning efforts to signal the problem, we have not seen scalable solutions that can effectively support writing development for large numbers of students and writers. Emerging computational technologies, including what we now call AI, offer an opportunity to develop such solutions and shape the future of writing. However, we believe the path forward requires writing experts to lead with a clear vision for writing and instruction—instead of waiting for technologies to chart the course.

References

Adler-Kassner, L., & Wardle, E. (2015). *Naming what we know: Threshold concepts of writing studies*. Utah State University Press.

Adler-Kassner, L., & Wardle, E. (2020). *(Re)Considering what we know: Learning thresholds in writing, composition, rhetoric, and literacy*. University Press of Colorado.

Applebee, A., & Langer, J. (2011). A snapshot of writing instruction in middle and high schools. *English Journal, 100*(6), 14-27.

Baron, D. (2009). *A better pencil: Readers, writers, and the digital revolution*. Oxford University Press.

Barshay, J. (2014, February 6). Three lessons from the science of how to teach writing. Hechinger Report. https://hechingerreport.org/three-lessons-science-teach-writing/

Barshay, J. (2019, October 14). Scientific evidence on how to teach writing is slim. Hechinger Report. https://hechingerreport.org/scientific-evidence-on-how-to-teach-writing-is-slim/

Bazerman, C., & Prior, P. (Eds.). (2004). *What writing does and how it does it: An introduction to analyzing texts and textual practices*. Routledge.

Bazerman, C. (2017). The psychology of writing situated within social action: An empirical and theoretical program. In P. Portanova, J. M. Rifenburg, & D. Roen (Eds.), *Writing Research Across Borders: International Studies in Writing* (pp. 21-37). University Press of Colorado.

Bazerman, C., Bonini, A., Figueiredo, D., & Court, D. L. (Eds.). (2008). *Handbook of research on writing: History, society, school, individual, text*. Lawrence Erlbaum Associates.

Bean, J. C., & Melzer, D. (2021). *Engaging ideas: The professor's guide to integrating writing, critical thinking, and active learning in the classroom* (3rd ed.). Jossey-Bass.

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

Boscolo, P., & Gelati, C. (2018). Motivating writers. In S. Graham, C. MacArthur, & M. Hebert (Eds.), *Best practices in writing instruction* (3rd ed., pp. 73-107). Guilford Press.

Reinventing Undergraduate Education: A Blueprint for America's Research Universities. (1998). The Boyer Commission on Educating Undergraduates in the Research University. Stoney Brook, NY.

Brandt, D. (2011). *Literacy as involvement: The acts of writers, readers, and texts*. Southern Illinois University Press.

Bridwell, L. S. (1980). Revising strategies in twelfth grade students' transactional writing. *Research in the Teaching of English, 14*(3), 197-222.

Brown, D., & Wetzel, D. (Eds.). (2023). *Corpora and rhetorically informed text analysis: The diverse applications of DocuScope*. John Benjamins.

Carter, M. (2007). Ways of knowing, doing, and writing in the disciplines. *College Composition and Communication, 58*(3), 385-418.

Crossley, S. A., & McNamara, D. S. (2016). Say more and be more coherent: How text elaboration and cohesion can increase writing quality. *Journal of Writing Research, 7*(3), 351-370.

Dejeu, E. (2024). A rhetorical approach for reimagining business writing instruction in the AI age. *Business and Professional Communication Quarterly*. Advance online publication.

Downs, D., & Wardle, E. (2011). Writing about Writing: A College Reader (1st ed.). Bedford/St. Martin's.

Driscoll, D. L., & Cui, W. (2021). Visible and invisible transfer: A longitudinal investigation of learning to write and transfer across five years. *College Composition and Communication, 73*(2), 229-260.

Dryer, D. B., Bowden, D., Brunk-Chavez, B., Harrington, S., Halbritter, B., Yancy, K. B. (2014). Revising FYC Outcomes for a Multimodal, Digitally Composed World: The WPA Outcomes Statement for First-Year Composition. *WPA: Writing Program Administration*, 38(1), 129-143.

Edmundson, M. (2016). *Why write? A master class on the art of writing*. Bloomsbury.

Fielden, J. (1964, May). What do you mean I can't write? *Harvard Business Review*. https://hbr.org/1964/05/what-do-you-mean-i-cant-write

Flower, L., Hayes, J. R., Carey, L., Schriver, K., & Stratman, J. (1986). Detection, diagnosis, and the strategies of revision. *College Composition and Communication, 37*(1), 16-55.

Flower, L. (1989). Cognition, context, and theory building. *College Composition and Communication, 40*(3), 282-311.

Flower, L., & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 31-50). Lawrence Erlbaum Associates.

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication, 32*(4), 365-387.

Geisler, C. (1994). *Academic literacy and the nature of expertise: Reading, writing, and knowing in academic philosophy*. Lawrence Erlbaum Associates.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition, 68*(1), 1-76.

Glynn, S. M., Britton, B. K., Muth, K. D., & Dogan, N. (1982). Writing and revising persuasive documents: Cognitive demands. *Journal of Educational Psychology, 74*(4), 557-567.

Graham, S. (2022, October 24). AI-generated essays are nothing to worry about. Inside Higher Ed. https://www.insidehighered.com/views/2022/10/24/ai-generated-essays-are-nothing-worry-about-opinion

Graham, S., & Harris, K. (2019). Evidence-based practices in writing. In S. Graham, C. MacArthur, & M. Hebert (Eds.), *Best practices in writing instruction* (3rd ed., pp. 16-46). Guilford Press.

Graham, S., & Perin, D. (2007). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools*. Carnegie Corporation of New York.

Graham, S., MacArthur, C. A., & Fitzgerald, J. (Eds.). (2013). *Best practices in writing instruction* (2nd ed.). Guilford Press.

Graham, S., MacArthur, C. A., & Hebert, M. A. (Eds.). (2018). *Best practices in writing instruction* (3rd ed.). Guilford Press.

Hart-Davidson, W. (2023). Ask the expert: How can AI support writing and student learning? MSU Today. https://msutoday.msu.edu/news/2023/ask-the-expert-how-can-ai-support-writing-and-student-learning

Hayes, J. R., & Chenoweth, N. A. (2006). Is working memory involved in the transcribing and editing of texts? *Written Communication, 23*(2), 135-149.

Hayes, J. R., & Chenoweth, N. A. (2007). Working memory in an editing task. *Written Communication, 24*(4), 283-294.

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

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1-26). Routledge.

Horning, A. S. (2002). *Revision revisited*. Hampton Press.

Hyland, K. (2004). *Genre and second language writing*. University of Michigan Press.

Hyland, K. (2009). *Academic discourse: English in a global context*. Continuum.

Hyland, K. (2012). *Disciplinary identities: Individuality and community in academic discourse*. Cambridge University Press.

Ishizaki, S., & Kaufer, D. (2020). Scalable writing pedagogy for strengthening cohesion with interactive visualization. In *Proceedings of IEEE International Conference on Professional Communication (ProComm, 2020)*. IEEE.

Ishizaki, S., & Kaufer, D. (2011). Computer-aided rhetorical analysis. In P. M. McCarthy & C. Boonthum-Denecke (Eds.), *Applied natural language processing and content analysis* (pp. 276-296). Information Science Reference.

Kellogg, R. T. (2008). Training Writing Skills: A Cognitive Developmental Perspective. Journal of Writing Research, 1(1), 1-26.

Kaufer, D. S., Hayes, J. R., & Flower, L. S. (1986). Composing written sentences. *Research in the Teaching of English, 20*(2), 121-140.

Kaufer, D. S., & Butler, B. (2000). *Designing interactive worlds with words: Principles of writing as representational composition*. Routledge.

Kaufer, D. S., Ishizaki, S., Collins, J. A., & Vlachos, P. (2003). *The power of words: Uncovering the speaker and writer's hidden craft*. Routledge.

Laudenbach, M., Brown, D., Guo, Z., Ishizaki, S., Reinhart, A., & Weinberg, G. (2024). Visualizing formative feedback in statistics writing: A case study of student motivation using DocuScope Write & Audit. *Assessing Writing, 60*, Article 100752.

Levitt, S. (2023, November). Steven Pinker talks to lawyers about bad writing and how to make it better. Jewish News. https://www.jewishaz.com/community/steven-pinker-talks-to-lawyers-about-bad-writing-and-how-to-make-it-better/article_eb499f6c-825b-11ee-9dfb

Lewis, P. (1985, June 25). Just plain word processing. *The New York Times*, p. 55.

Lewis, P. (1992, November 1). Computer words: Less perfect? *The New York Times*, p. 17.

Lindenman, H., Camper, M., Jacoby, L. D., & Enoch, J. (2018). Revision and reflection: A study of (dis)connections between writing knowledge and writing practice. *College Composition and Communication, 69*(4), 581-611.

MacArthur, C. A., Graham, S., & Fitzgerald, J. (Eds.). (2016). *Handbook of writing research* (2nd ed.). Guilford Press.

Maimon, E. P., Belcher, G. L., Hearn, G. W., Nodine, B. F., & O'Connor, F. W. (2022). *Writing in the arts and sciences*. The WAC Clearinghouse. (Original work published 1981)

McCutchen, D. A. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review, 8*, 299-325.

McLeod, S., Miraglia, E., Soven, M., & Thaiss, C. (2001). *WAC for the new millennium: Strategies for continuing writing-across-the-curriculum programs*. National Council of Teachers of English.

Meyer, J. H. F., & Land, R. (2003). Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practicing within the disciplines. In C. Rust (Ed.), *Improving student learning: Theory and practice ten years on* (pp. 412-424). Oxford Centre for Staff and Learning Development.

Moore, K. (2016, March 31). Study: Poor writing skills are costing businesses billions. Inc. https://www.inc.com/kaleigh-moore/study-poor-writing-skills-are-costing-businesses-billions.html

National Center for Education Statistics. (2012). *The nation's report card: Writing 2011* (NCES 2012-470). Institute of Education Sciences, U.S. Department of Education.

Negretti, R. (2012). Metacognition in student academic writing: A longitudinal study of metacognitive awareness and its relation to task perception, self-regulation, and evaluation of performance. *Written Communication, 29*(2), 142-179.

Nowacek, R. S. (2011). *Agents of integration: Understanding transfer as a rhetorical act*. Southern Illinois University Press.

Olson, D. (2016). *The mind on paper: Reading, consciousness, and rationality*. Cambridge University Press.

Peritz, A. (2022, September 6). A.I. is making it easier than ever for students to cheat. Slate. https://slate.com/technology/2022/09/ai-students-writing-cheating-sudowrite.html

Polt, R. (2015). *The typewriter revolution: A typist's companion for the 21st century*. The Countryman Press.

Quitadamo, I. J., & Kurtz, M. J. (2007). Learning to improve: Using writing to increase critical thinking performance in general education biology. *CBE Life Sciences Education, 6*(2), 140-154.

Richardson, S. (2000). Students' conditioned response to teachers' response: Portfolio proponents, take note! *Assessing Writing, 7*(2), 117-141.

Rogers, T., & Lasky-Fink, J. (2023). *Writing for busy readers: Communicate more effectively in the real world*. Penguin.

Sommers, N. (1980). Revision strategies of student writers and experienced adult writers. *College Composition and Communication, 31*(4), 378-388.

Swales, J. M. (1990). *Genre analysis: English in academic and research settings*. Cambridge University Press.

Swales, J. M., & Feak, C. B. (2000). *English in today's research world: A writing guide*. University of Michigan Press.

Tardy, C. M., Sommer-Farias, B., & Gevers, J. (2020). Teaching and researching genre knowledge: Toward an enhanced theoretical framework. *Written Communication, 37*(3), 287-321.

Thaiss, C., & Porter, T. (2010). The state of WAC/WID in 2010: Methods and results of the U.S. survey of the international WAC/WID mapping project. *College Composition and Communication, 61*(3), 524-570.

Thaiss, C., & Zawacki, T. M. (2006). *Engaged writers and dynamic disciplines: Research on the academic writing life*. Boynton/Cook Publishers.

Tinberg, H. (1997). Border Talk: Writing and Knowing in the Two-Year College. National Council of Teachers of English.

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language, 47*(1), 69-90.

Wardle, E. (2007). Understanding 'transfer' from FYC: Preliminary results of a longitudinal study. *WPA: Writing Program Administration, 31*(1-2), 65-85.

Warner, J. (2023, December 8). Why AI will not replace writing instruction. Inside Higher Ed. https://www.insidehighered.com/opinion/views/2023/12/08/ai-wont-replace-writing-instruction-opinion

Wetzel, D., Brown, D., Werner, N., Ishizaki, S., & Kaufer, D. (2021). Computer-assisted rhetorical analysis: Instructional design and formative assessment using DocuScope. *Journal of Writing Analytics, 5*, 292-393.

Winslow, D., & Shaw, P. (2017). Teaching metacognition to reinforce agency and transfer in course-linked first-year courses. In P. Portanova, J. M. Rifenburg, & D. Roen (Eds.), *Contemporary perspectives on cognition and writing* (pp. 191-209). The WAC Clearinghouse; University Press of Colorado.

Yancey, K. B., Robertson, L., & Taczak, K. (2014). *Writing across contexts: Transfer, composition, and sites of writing*. Utah State University Press.

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