

# Undergraduate Writing Fellow Conceptions of Writing-to-Learn and Quality of Writing<sup>1</sup>

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**Abstract:** Undergraduate writing fellows play an important role in administering writing assignments in writing-intensive courses. At the University of Michigan, the MWrite program was designed to support the implementation of writing-to-learn (WTL) assignments in STEM courses. Within MWrite, writing fellows are a primary instructional resource for students and help evaluate students' writing. As such, it is important to characterize writing fellows' beliefs about both WTL and writing more generally. In this study we interviewed writing fellows for MWrite courses in biology, chemistry, economics, and statistics about how they conceptualize WTL and writing quality. Our analysis indicates that writing fellows conceptualize WTL as supporting a range of content-focused learning outcomes and as featuring specific rhetorical elements that make WTL assignments successful. Most writing fellows discussed the importance of higher-order characteristics when evaluating the quality of students' writing, but also placed importance on the lower-order characteristics. Our results indicate that the writing fellows are internalizing the MWrite pedagogy with respect to WTL, but that their conceptions of writing quality appear to be informed by their experiences with writing more broadly. These findings support the use of writing fellows during the implementation of WTL in STEM courses that traditionally present barriers to using writing assignments. More generally, they indicate the potential for writing fellows' conceptions to support the aims of the writing fellows program of which they are part.

## Introduction

Writing is a ubiquitous practice that can support numerous instructional goals. The writing assignments incorporated into undergraduate classrooms can typically be identified as either learning-to-write (LTW) or writing-to-learn (WTL). LTW assignments are characterized by their role in developing students' abilities to write in an academic, disciplinary context, whereas WTL assignments seek to increase students' conceptual understanding and disciplinary thinking through writing (Gere et al., 2018; Reynolds et al., 2012; Rivard, 1994). The ability of WTL to support conceptual understanding and disciplinary thinking makes it an ideal pedagogy to incorporate into STEM classrooms where traditional instructional practices can lead to rote learning and

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### *Across the Disciplines*

*A Journal of Language, Learning and Academic Writing*  
10.37514/ATD-J.2023.20.1-2.02

[wac.colostate.edu/atd](http://wac.colostate.edu/atd)

ISSN 554-8244

Across the Disciplines is an open-access, peer-reviewed scholarly journal published on the WAC Clearinghouse and supported by [Colorado State University](http://colorado.edu) and [Georgia Southern University](http://georgia-southern.edu). Articles are published under a [Creative Commons BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/) (Attribution-NonCommercial-NoDerivs) ISSN 1554-8244. Copyright © 1997-2023 The WAC Clearinghouse and/or the site's authors, developers, and contributors. Some material is used with permission.

memorization rather than deep learning. The principles underlying the success of WTL for supporting deep learning derive from cognitive and social theories of writing and learning (Klein & Boscolo, 2016; Klein et al., 2016). From the cognitive perspective, writing is conceptualized as a cognitive process whereby the writer revisits and restructures knowledge as they engage in the writing process to achieve some rhetorical purpose (Bereiter & Scardamalia, 1987; Flower & Hayes, 1981). Furthermore, the act of learning through writing is supported by the sociocultural context, where individuals learn through the writing process by interacting with both others and external representations of knowledge (Klein & Leacock, 2011; Prior, 2006; Vygotsky, 1962). Despite the utility of WTL for supporting students' learning, the research presents mixed results on the efficacy of the pedagogy due to variation in assignment type and implementation strategy, amongst others (Gere et al., 2018; Rivard, 1994). To address this issue, several meta-analyses have focused on identifying what characteristics are associated with effective WTL assignments (Anderson et al., 2015; Gere et al., 2018; Klein, 2015). These analyses identified that WTL assignments which effectively support student learning provide students with meaning-making tasks, incorporate interactive writing processes, support metacognition, and specify writing expectations.

At the University of Michigan, we developed the MWrite program to maximize the effectiveness of WTL in STEM by supporting an assignment design and implementation process informed by the characteristics of effective WTL assignments (Finkenstaedt-Quinn, Petterson, et al., 2021). Our research on students' responses to the MWrite WTL assignments indicates that the assignments support conceptual learning and disciplinary thinking, and that the WTL assignment design elements function to guide student learning (Finkenstaedt-Quinn et al., 2023). The MWrite program also incorporates support structures to help instructors implement WTL assignments into large, introductory STEM classrooms (Finkenstaedt-Quinn, Petterson, et al., 2021) where faculty are known to face a number of barriers for incorporating writing (Finkenstaedt-Quinn, Gere, et al., 2022; Moon, Gere, et al., 2018). The support structures include an automated peer review tool, a faculty seminar, and writing fellows; here we focus on writing fellows.

Writing fellows are undergraduate students who work within a specific course in which they were previously successful to provide guidance to undergraduate students on the writing assignments (Haring-Smith, 1992). Writing fellows are distinct from supplemental instructors, teaching assistants, and content-tutors in that they are situated within a specific course solely to provide students with writing support; the specific role and duties of writing fellows can vary across institutions and is adaptable based on the nature of the course and the instructor's needs (Cairns & Anderson, 2008). The writing fellow model used by MWrite is similar to that described by Gladstein (2008); however, our writing fellows serve as content specialists rather than generalists. As part of the MWrite program, writing fellows work closely with the course instructor to ensure that the assistance they provide to students is aligned with the instructor's goals for the WTL assignments. In addition, the writing fellows receive training from writing center faculty on how to provide students with feedback in alignment with the goals of WTL. What distinguishes the MWrite writing fellows from the traditional role of writing fellows is that they primarily provide students with assistance on the disciplinary content targeted by each WTL assignment rather than on the mechanics of writing, both as students are responding to the assignments and on students' final written products (Cairns & Anderson, 2008). Additionally, they are primarily working in STEM courses, where it is less common to utilize writing fellows. The unique nature of the MWrite writing fellows' role—that they work closely with course instructors, writing center faculty, and students, all with a focus on supporting conceptual learning—makes them an important group to study within the MWrite program. Preliminary evidence in Petterson et al. (2022) indicates that students find the writing fellows a helpful resource as they respond to the WTL assignments. However, additional research is needed to characterize the role writing fellows play in MWrite and similar programs.

## Conceptions About Writing in Instruction

A person's conceptions of writing can shape how they evaluate and provide feedback to writing. With the large role that writing fellows play in assisting students in responding to the WTL assignments and helping to evaluate students' responses, it is important to understand the conceptions that writing fellows have about writing. It is also important to consider how writing fellows' beliefs compare to those of instructors. Yet, there is a lack of research characterizing writing fellows' conceptions of writing. Due to their unique role, undergraduate writing fellows may hold liminal perspectives and attitudes towards writing; they have more experience with writing than their fellow peers but have less experience with writing than writing experts, such as faculty, might have. Writing fellows' beliefs about writing may be informed by the conceptions of the faculty they work with, the writing center, or their own classroom experiences.

The existing research examining conceptions related to evaluating writing primarily focuses on instructors' conceptions, with an emphasis on writing instructors'. Additionally, some research in this area includes studies on teaching assistants' (TAs) and students' conceptions. The existing research indicates a shift towards instructors placing a greater value on higher-order concerns, but that they do still consider lower-order concerns when evaluating students' writing (Anson & Anson, 2017; Connors & Lunsford, 1993; Dixon & Moxley, 2013; Lunsford & Lunsford, 2008; Stern & Solomon, 2006). A study by Freedman (1979) evaluated writing instructors' conceptions of writing errors on four different components: content, organization, sentence structure, and mechanics. They found that experts seemed to place more value on higher-order concerns when rating essays, such as content errors, but still valued the importance of lower-order concerns, such as proper sentence structure and mechanics. Anson and Anson (2017) analyzed instructor comments to students' writing in a first-year writing course. They found that instructors tended to place more emphasis on audience, organization, and purpose than on the characteristics of grammar, good spelling, and flow when evaluating essays. In another study focused on instructors for a first-year writing course, Dixon and Moxley (2013) similarly identified that instructors placed an emphasis on higher-order concerns, where instructors' evaluation of student writing was guided by a common rubric.

Studies focused on STEM instructors' evaluation of writing also demonstrate that instructors value higher-order concerns, but indicate that STEM instructors may favor lower-order concerns during the actual practice of evaluating students' writing (Moon, Gere, et al., 2018; Smith, 2003; Taylor & Patton, 2006). Smith (2003) used think-aloud interviews to compare how engineering instructors and writing instructors evaluated student samples of technical writing. They found that the two types of instructors evaluated writing similarly across three categories: content, comprehension, and form. Both groups of instructors placed the greatest emphasis on content evaluations, with differences across the categories in frequency rather than standards of evaluation. In addition, the engineering faculty demonstrated a greater focus on local issues, whereas the writing instructors focused more on global issues. In interviews with STEM faculty, Moon, Gere, et al. (2018) described faculty as conceptualizing good science writing as being clear, precise, and crafting a persuasive argument. STEM faculty also identified the importance of considering the reader during the act of writing, a process in which they did not think students engaged (Moon, Gere, et al., 2018). However, neither Smith (2003) nor Moon, Gere, et al. (2018) analyzed faculty's actual practices of evaluating writing. Taylor and Patton (2006) addressed this gap in a study focused on civil engineering faculty's evaluation practices. They identified a misalignment between the types of comments faculty identified as ideal to provide on students' writing and those that they provided students, in that they claimed to value higher-order comments but typically provided lower-order ones in practice. The focus on lower-order concerns in STEM instructors' feedback has been documented in other studies (Ekoniak & Parette, 2018; Szymanski, 2014).

In addition to instructors, teaching assistants (TAs) can play a large role in evaluating students' writing. This may especially be the case in large STEM classrooms where instructors cannot easily evaluate their students' writing without additional support. Taylor (2007) found that TAs in mechanical engineering gave primarily lower-order feedback but shifted to more higher-order, content-focused comments when using a grading rubric. In an introductory biology context, Hill et al. (2018) also identified that TAs focused on lower-order concerns rather than content in their feedback. However, conversely Taylor (2007), identified that this focus was due in part to the grading rubric with which TAs were provided. The focus on lower-order concerns, as well as the potential misalignment between what instructors value in students' writing and how that writing is evaluated, could have adverse effects on the utility of writing assignments for supporting student learning, especially for WTL. Writing fellows, in general, can address this concern, as their role is isolated to providing feedback on writing. While research on how undergraduate students evaluate writing demonstrates that they place a greater emphasis on lower-order than higher-order concerns (Johnson et al., 2017), Laist (2021) indicates that higher order concerns are important to their conceptualization of "good" writing. In addition, research comparing student and instructor practices indicates that undergraduates begin developing expert-like evaluation practices as they progress through college (Anson & Anson, 2017; Charney et al., 1995). Thus, with their unique role and the specialized training writing fellows receive in providing feedback on writing, it is important to understand writing fellows' conceptions of writing and how those conceptions align with the aims of programs for which they are fellows.

## Description of the MWrite Program

### Program Overview

This study examines the conceptions held by writing fellows who are part of the MWrite program at the University of Michigan. The MWrite program, described in Finkenstaedt-Quinn, Petterson, et al. (2021), is housed within the university's center for writing and works with faculty to facilitate the development and implementation of WTL assignments, primarily in large, introductory STEM courses. The MWrite program started in 2016 and has since worked with 18 faculty across 12 departments to support the incorporation of WTL in 65 courses (e.g., Biology, Chemistry, Climate Science, Economics, Materials Engineering, Physics, and Statistics). Faculty who participate in the MWrite program receive initial support and training through participation in a faculty seminar. During the semester of WTL implementation, they are supported by a team of course-specific writing fellows and MWrite staff on an as needed basis.

The WTL assignments are specifically designed to help increase students' content knowledge on a designated topic rather than improve students' writing ability. The MWrite WTL assignments are designed such that students compose their writing in response to rhetorical elements—a designated audience, context, and genre—given by the assignment prompt. Students also go through peer review and revision, which provide additional opportunities for learning. The rhetorical elements can increase the meaning-making inherent to the WTL tasks by situating the assignment in the course, and the peer review and revision elements are interactive writing processes that support metacognition (Gere et al., 2018; Gupte et al., 2021; Petterson et al., 2022). Previous research examining the efficacy of the MWrite WTL assignments has found that they can help increase students' conceptual understanding in STEM (Finkenstaedt-Quinn et al., 2017; Finkenstaedt-Quinn et al., 2020; Finkenstaedt-Quinn, Polakowski, et al., 2021; Halim et al., 2018; Moon, Zotos, et al., 2018; Schmidt-McCormack et al., 2019; Shultz & Gere, 2015). Additionally, WTL assignments have been found to support and elicit students' argumentation and reasoning skills (Moon et al., 2019; Watts et al., 2020).

## Description of the Writing Fellows

The MWrite writing fellows are undergraduate students associated with a specific MWrite course whose role is to support faculty with implementing WTL assignments and to support students as they respond to the assignments. The most common way that writing fellows are selected is through course instructor nominations; they are chosen because they were previously successful as a student in the course and demonstrated good communication skills. Additionally, some writing fellows self-nominate themselves due to their interest in the position.

The writing fellows receive training via a course run by the writing center in collaboration with the MWrite program. The training course is discussion-based and covers the pedagogy behind the WTL assignments. Importantly, writing fellows read and respond to the WTL assignments that are administered in the course for which they are a fellow. This helps the writing fellows review the content targeted by the assignment and provides them with the opportunity to reflect on the areas with which students may struggle. Additionally, writing fellows get a chance to participate in peer review through reading and evaluating each other's work; through this process they learn about what aspects comprise constructive and helpful peer review and experience the activity through the eyes of the student. Writing fellows also attend regular meetings with the course instructor. Typically, instructors bring draft versions of the WTL prompt and peer review criteria to the meetings for the writing fellows to review. During the meetings, the writing fellows can provide suggestions on aspects of the prompt that could be modified to improve clarity. The writing fellows can also ask the course instructor specific questions about content targeted by the prompt or how to respond to student questions. Additionally, the course instructors review the grading criteria for the assignments with the writing fellows.

Writing fellows interact with students in two primary ways. They hold office hours and respond to student questions. Students are instructed to first ask the writing fellows questions related to the WTL assignments prior to asking an instructor, so writing fellows handle a majority of questions that arise. Students are encouraged to visit writing fellows' office hours as frequently as they want. Some faculty require students to meet with a writing fellow at least once during the semester, while others offer extra credit for attending writing fellows' office hours at least once. Student questions primarily focus on the concepts and content targeted by the assignments. After students submit their drafts, writing fellows evaluate students' responses according to the content-focused grading criteria established by the course instructors. The level of feedback and type of evaluation they provide on students' responses varies across course and stage of the WTL assignment (i.e. initial draft, peer review, revision). However, feedback and evaluation is primarily content focused (e.g. identifying missing or incorrect content, critiquing the evidence students use to construct an argument).

## Guiding Theory

Our examination of writing fellows' conceptions of writing is guided by the Theory of Integrated Domains in Epistemology (TIDE) (Muis et al., 2006). TIDE puts forth the idea that a person holds both domain-general and domain-specific beliefs. The underlying principles for the theory are that personal epistemology beliefs develop based on one's social experiences and the ways that one interacts with their world. The model contains three levels of epistemological beliefs. The broadest level of these beliefs are general beliefs, which begin to develop from birth and can change throughout one's life.

Within the context of academic research and this work, general beliefs as a construct are not examined. The next level of beliefs are academic beliefs; these beliefs develop through participation in formal education settings, such as school. Since formal school settings are inherently sociocultural,

academic beliefs develop as part of this sociocultural context. In the context of this article, the academic beliefs are classified as domain-general. Domain-general beliefs may exist across the writing fellows due to shared experiences of taking STEM courses and the writing fellows course (e.g. writing in STEM courses is uncommon). The third and most narrow level of the TIDE framework is domain-specific beliefs. Domain-specific beliefs can vary depending on the academic context and circumstances, such as major or interactions with the instructor for whom they are a writing fellow (e.g. writing in economics generally takes the form of short reports).

In the TIDE framework, all three levels of the framework are interconnected; that is, general beliefs can influence academic (domain-general) beliefs, which can influence domain-specific beliefs. All of these beliefs are subject to change over time and are based on the individual's experience. Concerning writing, students' approaches are known to develop as they become more enculturated in their discipline; their views may shift to becoming more expert-like and more aligned with their particular academic discipline (Charney et al., 1995). Thus, we might expect writing fellows to hold a mix of domain-general and domain-specific beliefs. In the context of this research, we aim to capture writing fellows' beliefs at one point during their academic experience as an undergraduate student during their tenure in the MWrite program.

## Research Questions

To our knowledge, existing research has not explicitly examined how writing fellows in STEM courses conceptualize WTL or the quality of writing. It is important to examine writing fellows' conceptions about WTL and characteristics of quality writing, as writing fellows serve as a main instructional support for students and their beliefs could influence how they interact with students and comment on students' responses to WTL assignments. Research focused on the MWrite writing fellows can provide insight into how writing fellows' conceptions are shaped in alignment with structured writing fellows programs and how that can support the goals of the program. The MWrite writing fellows in particular are unique as they receive training through the writing center to be content-focused writing tutors specifically for WTL assignments. In addition, they are situated within a specific disciplinary course and interact closely with the course instructor. Thus, it is important to examine MWrite writing fellows' conceptualizations of WTL and writing quality. This study is guided by the following research questions:

1. How do writing fellows conceptualize writing-to-learn?
2. What characteristics do writing fellows identify as important when considering the quality of writing?

## Methods

This study is intended to be an initial, exploratory study with the aim of capturing the MWrite writing fellows' lived conceptions of WTL and quality of writing. As such, the study utilized a qualitative approach where undergraduate MWrite writing fellows were interviewed about how they conceptualize WTL and the characteristics they consider when evaluating the quality of writing. In the context of MWrite, writing fellows are a primary support structure for students as they complete the WTL assignments. Thus, it is important to understand the conceptions writing fellows hold about writing.

## Data Collection

In this study, writing fellows were recruited to participate in the interviews via convenience sampling during the Fall 2017 and Winter 2018 semesters. Writing fellows were offered full credit for one of

the assignments in the writing fellows course if they chose to participate in the interview. Writing fellows were recruited from four of the MWrite courses being held during the two semesters during which data collection occurred: biology, chemistry, economics, and statistics. All four of the courses were large enrollment introductory level courses. Data collection consisted of semi-structured interviews with 47 new and returning writing fellows. Prior to beginning the study, data collection and analysis was approved by the IRB at the University of Michigan.

A semi-structured interview protocol was constructed and discussed by the research team. The interview protocol was piloted with two students who had experience as writing fellows. The two students who participated in the pilot interviews stated that all of the questions were understandable and answerable. There were two final versions of the interview protocol, one for new writing fellows and one for returning fellows. The nature of the questions was similar in both versions of the protocol, only the wording of the questions pertaining to student' experiences as writing fellows varied. The interview protocol for the new writing fellows can be found in Appendix A, and the interview protocol for the returning writing fellows can be found in Appendix B. The researcher who interviewed the writing fellows (JSM) was not involved in the training or hiring of the writing fellows. However, the researcher did interact with the chemistry writing fellows in a managerial capacity as part of the WTL implementation in the chemistry course, which may have influenced how the chemistry writing fellows responded during the interview. The interviews with the writing fellows were audio recorded and lasted 40 to 65 minutes. The interviews were transcribed verbatim via an outside transcription service. Table 1 presents the breakdown of the interviewed writing fellows by new versus returning and course for which they were a writing fellow while being interviewed.

**Table 1. Distribution of the number of interviewed writing fellows per course and their corresponding experience level.**

	Biology	Chemistry	Economics	Statistics	Total
New (1 semester)	8	5	2	1	16
Returning (2 or more semesters)	4	5	6	16	31
Total	12	10	8	17	47

## Data Analysis

An open-coding method was used to analyze the interviews. The initial codes were developed using an inductive approach by reviewing writing fellows' interview responses. The units of analysis for coding were considered to be transitions between speakers (e.g. when the interviewee responded to a new question or follow-up question from the interviewer), and multiple codes could be applied to each unit of analysis. To refine the initial codes and their definitions, two researchers (JSM and FW) coded the same interview transcript separately then met and discussed how they applied the coding scheme, leading to modifications of the initial coding scheme. Both researchers agreed on the final coding scheme before proceeding with independently coding 20% of the interviews. The final version of the coding scheme can be seen in Appendix C. The researchers then met and discussed the codes, resolving disagreements through consensus-building discussions until the codes that were applied to the interviews were agreed on by both authors. The discussions when developing and applying the coding scheme add to both the credibility and dependability of the analysis (Lincoln & Guba, 1985). In alignment with the procedure described by Gibbs (2007), the remainder of the interviews (n= 31) were coded by one researcher (JSM). This was followed by thematic analysis (JSM and SFQ) to investigate what patterns emerged from coding (Braun & Clarke, 2006). During thematic analysis, the research team discussed the developing themes to lend further credibility to the analysis. Furthermore, one researcher (SFQ) characterized how the themes, and conceptions specific to those themes, aligned with the levels of the TIDE framework based on whether they were particular to writing fellows from specific disciplines (possibly indicating domain-specific beliefs) and whether

they aligned with the goals of the MWrite program (possibly indicating domain-general beliefs). The research team then discussed the characterization to confirm the assigned alignment.

## Results and Discussion

With the role that writing fellows play in providing feedback to students' writing, it is important to understand how they think about writing. Our study focuses specifically on characterizing the conceptions about WTL and quality of writing that are held by MWrite writing fellows. Examining the conceptions of the MWrite writing fellows provides an initial understanding of how writing fellows' conceptions may or may not align with the aims of the program. This understanding can indicate the potential influences on writing fellows' conceptions (e.g. from the training they receive as writing fellows, their general academic experiences, and their disciplinary experiences) and provide insight on the direction for future studies on how writing fellows develop their conceptions of writing. Examining which of the MWrite writing fellows' beliefs may be domain-general versus domain-specific is especially of interest due to the MWrite writing fellows' location in primarily STEM courses, where writing fellows are less frequently used. While the role that writing fellows play in classrooms can differ by institution and instructor, this study may also inform the general understanding of writing fellows' conceptions. First, we present our analysis of writing fellows' conceptions of WTL. Second, we describe the characteristics that writing fellows consider important when evaluating the quality of writing. Both of these are important to characterize as the first may inform how writing fellows interact with students during the WTL process and the second may inform how writing fellows respond to students' writing.

### Conceptions of Writing-to-Learn

The writing fellows' conceptions of WTL fell into two categories: 1) conceptions regarding characteristics of WTL assignment design that effectively support learning and 2) conceptions of different types of learning that WTL assignments can support. Writing fellows' conceptions about WTL assignment design were similar across writing fellows, whereas there were some potential distinctions between writing fellows about the types of learning supported by WTL.

#### *Important WTL assignment design characteristics for supporting learning*

The writing fellows noted three design characteristics when describing how they conceptualized WTL: the peer review and revision elements of the MWrite WTL process, the contexts given in the WTL prompts, and the audiences given in the WTL prompts. These design characteristics align with the focus in MWrite generally and the writing fellows course specifically. Writing fellows from all the disciplines discussed the importance of the peer review and revision processes of the MWrite WTL assignments. One of the commonly stated reasons given by the writing fellows for the importance of peer review and revision was that the two stages could facilitate a deeper understanding of the content. One writing fellow exemplifies this understanding in their interview:

Writing Fellow #17: It really shows whether you know the material or not when you have to look at somebody else's work and provide feedback on that, so like in terms of other, say like ... writing assignments is usually like, you are given a prompt, you write it, you turn it in, you get your grade, and that's it. Versus this, WTL this, you have your initial draft, your peer review, your revision, so it really forces you to know the concepts well, and if you don't get the concept there's multiple chances for you to learn the concept essentially. (Statistics, New)



The writing fellows' conceptions about the benefits of peer review and revision align with the emphasis placed on peer review and revision in the MWrite program, which demonstrates how the goals of the MWrite program are reflected in the thinking of the writing fellows. As students do not always have previous experience with peer review and revision or recognize the associated learning benefits (Gupte et al., 2021; Nicol et al., 2014), it is important that the MWrite writing fellows are seeing the value of peer review and revision for WTL so that they may discuss the benefits when interacting with students. In addition, the writing fellows' conceptions of peer review and revision align with STEM faculty beliefs that peer review and revision can support learning (Finkenstaedt-Quinn, Gere, et al., 2022), which shows that writing fellows may have more developed, expert-like beliefs regarding the two writing practices.

Beyond incorporating peer review and revision, the writing fellows in all the disciplines also discussed how the context and audience components of the WTL prompts are important. These components are also in alignment with the MWrite WTL prompt design (Finkenstaedt-Quinn, Petterson, et al., 2021) and it is promising that the writing fellows identified these components without prompting. Writing fellows described how the context and situations in the WTL prompts serve to make the content relevant to students' lives. The writing fellows' views align with those of students in MWrite courses, who described how the WTL prompt contexts helped them identify the relevance of the course content, which in turn supported their interactions with the assignments (Gupte et al., 2021; Petterson et al., 2022). It is beneficial that the writing fellows are also recognizing how contexts emphasize content relevance, as they can help students build these connections if students themselves are not identifying them. Identifying relevance is important for supporting the affective domain of learning, which in turn can support learning as a whole (Stuckey et al., 2013). In providing this support, the writing fellows can support the overarching goals of the MWrite program.

The writing fellows also discussed why they viewed writing for an audience as an important characteristic of WTL. For the writing fellows, the exercise of writing for an audience was thought to be especially useful for students' future careers. One writing fellow stated:

Writing Fellow #36: Our economy is constantly changing. It's constantly interconnected with other parts of the world, and I think being able to apply these very basic principles, because the principles in Econ are essentially very basic to economics. It's the intro level class. Applying them to the real world is really, really going to help them as they move forward in their careers as I think writing plays a very crucial in this because you're writing about a topic you're having to explain it to someone in a way ... The audience that they are writing to knows nothing about economics, so when they're writing these essays, they're writing with that in mind. (Economics, Returning)

This is in contrast with the intent behind incorporating a specific audience in the WTL prompts, i.e. that students will more critically consider how they were writing about content. While the writing fellows' reasoning for the importance of providing a specific audience does not align with the reasoning guiding the MWrite WTL prompt design, they still identify the audience component of the WTL prompts as important. This indicates that while the writing fellows' conceptions of WTL are influenced by the MWrite program, their conceptions are more nuanced and complex. Additionally, it indicates that writing fellows' conceptions of WTL extend beyond the training they receive and points to the potential for other influences, such as prior academic writing experiences. Writing fellows' conceptions on the role the audience could serve as an additional motivator that could be used to explain the usefulness of WTL assignments to students. Relatedly, a common refrain from the writing fellows was that outside of WTL, writing assignments in STEM disciplines were not very common. The WTL assignments thus may serve an important function in providing students valuable experience with writing in the STEM disciplines in general, and not just writing for specific audiences.

The writing fellows' conceptualizations of WTL as including peer review and revision, a context to which students apply their knowledge, and writing for an audience aligns with the emphasis placed in the MWrite program and writing fellows course on those characteristics of the MWrite WTL assignments. In addition, the way the fellows described the benefits of the three characteristics indicates that the writing fellows understand why the characteristics are components of the assignments and how they support learning. The appearance of the beliefs across the writing fellows and their alignment with the MWrite program principles strongly indicates that the beliefs are domain-general in nature and arise from writing fellows' role and experience in the MWrite program, more so than from discipline-specific experiences with writing. This is beneficial as it means the writing fellows can emphasize the design characteristics when interacting with students, which may better support students' learning. These results speak to the applicability of MWrite's model of immersing writing fellows in a structured writing-intensive program. Specifically, such writing fellows may take on the principles guiding that program, thereby enhancing their own utility.

### *Types of Learning Supported by WTL*

The writing fellows also identified different types of learning supported by WTL assignments in their conceptualization of WTL. Every writing fellow said that participating in WTL encourages students to develop a deeper understanding of the content. The following quote from a writing fellow illustrates how the writing fellows valued the potential for WTL assignments to increase conceptual understanding.

Writing Fellow #15: The phrase Writing-to-Learn, I think, means improving your understanding of a concept, or like at least perceived understanding of a concept, through your own writing. (Biology, New)

This conception is important as it aligns with the fundamental learning objectives of WTL and MWrite more specifically. That writing fellows have this conception is another indicator that being part of the MWrite program was effective at conveying the important aspects of the WTL pedagogy to students. The conception also aligns with research on WTL, both generally (Gere et al., 2018; Reynolds et al., 2012) and in terms of research coming out of the MWrite program specifically (Finkenstaedt-Quinn et al., 2017; Finkenstaedt-Quinn et al., 2020; Finkenstaedt-Quinn, Polakowski, et al., 2021; Halim et al., 2018; Moon, Zotos, et al., 2018; Schmidt-McCormack et al., 2019).

While writing fellows across all the disciplines said that WTL supports conceptual learning, writing fellows in biology and chemistry more often mentioned that WTL can help students identify content that they might not understand. As described by one writing fellow, the WTL process allows students to identify content they do not understand and then develop their understanding of that content:

Writing Fellow #41: I feel like writing to learn is, I alluded to this a little bit, but it's learning while you're writing. It's using a writing assignment or using writing in any form to articulate what you think is happening and to be able to identify places that you really don't understand what's going on and to then go back and revise and be able to do what you need to do to be able to better articulate that particular point. (Chemistry, Returning)

This belief may arise from the fact that one of the primary forms of writing often found in STEM courses is laboratory reports, the purpose of which is to develop the skills of reporting and synthesizing data, rather than increase the content knowledge of the writers. Thus, the writing fellows identified how the WTL assignments can support learning through writing in a way not commonly present in STEM courses. This insight shows the importance of incorporating the WTL assignments specifically in STEM courses, as WTL provides a type of writing assignment alternate

from the more common laboratory reports, which might appeal to students; furthermore, this point could be useful when recruiting STEM faculty to participate in MWrite.

Writing fellows across the four courses all expressed some variation of the belief that WTL assignments can be used to help students build connections between various aspects of course content. The first type of connection that the writing fellows identified is that WTL can help students make connections between the concepts targeted within individual assignments. The writing fellows also stated that WTL can help students build connections between the concepts targeted in WTL assignments and related course concepts. The writing fellows recognized that when students make connections between the content targeted by the WTL prompts and content presented in the course, it can support meaningful learning for the students. One writing fellow stated:

Writing Fellow #19: I think writing to learn is exactly what it is, you're writing to learn a concept. You're writing about a concept in a real world format, like the writing to learn assignments are set up. And you're doing that to learn to better retain the information that you're learning in class. It gives you a different format or application of the concepts you're learning in class. By doing it, you get a problem and you use statistical significance to draw a conclusion. You do that in class, but now it's challenging you to write out your ideas and apply it to a different situation. (Statistics, New)

Students have similarly reported building connections between concepts as a perceived benefit of MWrite WTL assignments (Gupte et al., 2021; Petterson et al., 2022). This belief additionally aligns with MWrite research examining students' written responses to WTL assignments which demonstrated that students successfully wrote about the connections between the concepts (Finkenstaedt-Quinn et al., 2020; Schmidt-McCormack et al., 2019).

The chemistry writing fellows exhibited two related beliefs not frequently discussed by the writing fellows from the other disciplines. The chemistry writing fellows stated that the WTL assignments can help improve students' reasoning skills. The chemistry writing fellows also more often discussed that students' responses to WTL assignments are "not right or wrong." This most likely is because they were writing fellows for an organic chemistry course, which places a heavy emphasis on how students are reasoning (e.g. the concepts they are using to reason) rather than if students arrive at a "correct" response (Graulich, 2015), indicating a disciplinary influence on their beliefs.

Less related to the objectives of WTL, writing fellows from all disciplines expressed how WTL could help students improve their ability to communicate ideas effectively. The following quote from a writing fellow illustrates how they felt that WTL helps students learn to communicate to others outside of their discipline:

Writing Fellow #1: I think it helps cause I think the scenarios we give them also ... because they're like real life scenarios. This past one was a memo you were sending to your boss. I feel like that helps because out in the real world, you have to ... writing is involved in everything. From like emails to memos to research reports and all that. I feel like it's a good way to get those skills as well. (Biology, New)

As this belief appeared across writing fellows, but does not explicitly align with the goals of the MWrite program, it may arise from the more general academic experiences of writing fellows. The economics writing fellows demonstrated the belief that supporting communication skills through writing was not novel to the WTL assignments. It is possible that this belief arises from the fact that much of the traditional writing done in economics is directed towards readers who are not economics

experts. Since it is a normative practice in economics to write to a non-expert, the economics WTL assignments would not provide students with a novel experience.

Related to this, chemistry and economics writing fellows more often discussed the potential of WTL to improve students' writing skills than the biology and statistics writing fellows. In addition, the chemistry writing fellows were much more likely to state that WTL can help increase students' awareness of different forms of writing.

Writing Fellow #42: I think getting exposure to the different forms of writing that they are being exposed to now helps them see that there isn't just one form of writing. It's not always essay format or anything like that. They kind of get that in the M-Write assignments. Then in a lab report or something like that they see that there's, in a lab report or something like that, they see a more scientific approach to it. (Chemistry, Returning)

Many students perceive technical writing, e.g. laboratory reports, as the primary form of writing they experience in STEM courses (Finkenstaedt-Quinn, Garza, et al., 2022; Ford, 2006), and this finding illustrates how WTL assignments can help expose students to different forms of writing in STEM, and chemistry specifically. Additionally, this focus for the economics writing fellows may arise from the importance of writing for non-specialists in economics. These types of beliefs about other potential benefits of the WTL assignments could be harnessed to appeal to STEM faculty who are unsure about using writing in their courses.

The writing fellows' conceptions about the types of learning that WTL could support demonstrates a focus on conceptual learning and disciplinary thinking in alignment with the goals of WTL generally and the MWrite WTL assignments specifically. In addition, some of the writing fellows also expressed the potential for WTL to support learning outcomes more in line with LTW (e.g. writing and communication skills), which indicates that their beliefs about WTL go beyond the training they received. This mix of conceptions demonstrates that writing fellows hold beliefs about the utility of writing pedagogies similar to those held by STEM faculty who use writing (Moon, Gere, et al., 2018). While the writing fellows' beliefs about the design characteristics of WTL assignments all appeared to align with the MWrite WTL design, some of the beliefs about the types of learning supported by the MWrite WTL assignments did not align with the goals of the MWrite program for incorporating writing. This indicates that while the writing fellows' conceptions about the types of learning supported by WTL most likely arise from their experiences in the MWrite program, their conceptions may also be influenced by writing fellows' more general academic experiences. While many of the beliefs were discussed by writing fellows across the four courses, and are thus likely domain-general, some of the conceptions were only held by a subset of the writing fellows and may be domain-specific beliefs (e.g., the chemistry writing fellows beliefs that WTL can support the development of reasoning skills and that responses are not necessarily right or wrong). This may demonstrate that, to a certain extent, the writing fellows are becoming enculturated in the disciplinary ways of thinking and knowing for the disciplines in which they are writing fellows. Our findings indicate that writing fellows may take on conceptions in alignment with the goals of the program they are affiliated with, which has implications for how the training writing fellows receive may influence their conceptions of writing. The writing fellows also appear to retain or develop discipline-specific beliefs that can be leveraged when interacting with faculty or developing WTL assignments in specific disciplines.

### **Conceptions of Characteristics Important to Quality of Writing**

We also investigated writing fellows' conceptions about the characteristics they identified as related to writing quality, including conceptions about higher-order and lower-order concerns. In addition,

the characteristics identified by the writing fellows were found across writing fellows in all four disciplines.

### *Higher-Order Concerns*

A key higher-order concern for writing fellows was that the writing should be explicitly related to the objectives and context given in the assignment prompts. Specifically, the writing fellows felt that students' responses should focus on addressing the objectives set by the assignment, and that in doing so students would demonstrate their understanding of the designated topic. The writing fellows discussed how the written response should contain accurate and correct information necessary to address the prompt. One writing fellow described the importance of correct conceptual information in writing:

Writing Fellow #26: These assignments are trying to hammer in on particular skills and knowledge basis in the course, so the prompts are structured so that we're asking for this mechanism or this definition. Students that are using that vocab term and then very explicitly giving that definition typically, I would say, write better papers because that's what we're looking for. That's the point of this, to really practice those definitions and those mechanisms. (Biology, New)

However, the writing fellows also specified that writing should only contain information relevant to the original purpose of the writing. The following excerpt illustrates how one writing fellow expressed that it is important for writing to directly respond to the original question(s) in the prompt.

Writing Fellow #32: The biggest issue for me is just clarity. Sometimes, I read things that just ... It just feels like they're not answering the question, and I think that's the biggest thing. I should be able to know that you're answering my question directly. (Biology, Returning)

The conception that writing should be clear is similar to that expressed by STEM faculty and a feature that STEM faculty identified as a common weakness in students' writing (Moon, Gere, et al., 2018). Additionally, as Smith (2003) described, engineering and writing faculty find the relevance of content an important consideration when evaluating writing. The alignment between faculty and writing fellows on the value of clarity and content relevance is important, as it indicates that the writing fellows will be attentive to features valued by course instructors and may more broadly support the merit of utilizing writing fellows in STEM courses.

Not only did the writing fellows discuss the content that should be included, but also that writing should contain an argument structure that provides correct claims and backs them up by providing accurate evidence. The following excerpt from a writing fellow illustrates how they view the importance of structuring an argument:

Writing Fellow #40: I suppose good writing is writing that can accurately and clearly convey the argument or idea that's being put forward. So if it's argumentative writing, if you're trying to support a claim, then you present the evidence clearly and there's a logical flow to that evidence. You can present this claim as true because of this, this, and this, so to speak. (Chemistry, Returning)

Relatedly, writing fellows also identified that it is a feature of higher quality writing when the writer describes why certain information is important or how something occurs. For example, one writing fellow said:

Writing Fellow #45: Just saying this reaction happens, but not why, when ... to me that would leave a reader hanging and that seems like poor writing. (Chemistry, Returning)

Thus, writing fellows believe that writers should be incorporating content that directly addresses the assignment prompt and use the content to address the problem or context presented in the assignment. The ability to structure an argument and support it with evidence is also viewed as a key aspect of writing by both STEM and writing faculty (Moon, Gere, et al., 2018; Smith, 2003). Writing fellows' beliefs about the importance of an argument structure and connecting content to the argument aligns with writing fellows' conception of the context as an important feature of WTL. The alignment between a good argument structure and incorporating relevant content with writing fellows' conception of the importance of the contexts given in the WTL prompts may indicate that writing fellows' conceptions of quality of writing are also informed by their participation in the MWrite program. However, further research is warranted as it could be a belief arising from the writing fellows' broader academic writing experiences.

Inherent in writing fellows' description of a good argument structure was that responses should contain a global argument structure in which individual arguments combine to form a cohesive and persuasive argument that is informative for the reader. For writing fellows, this manifested as a clear, organized structure, which can affect how well the responses address the assignment goals. One writing fellow described the structure they look for in a piece of writing:

Writing Fellow #11: I would say good writing is something that, in terms of technicalities, it would be something that has a good structure, an interesting opening, and then laying out in the first paragraph something how the rest of their paper's going to look like, because I personally like structure if you're being guided as to what information I'll be expecting up next. Then a re-summarization of everything at the final end conclusion or the takeaway that they've gotten from writing these three main points. (Economics, Returning)

The organizational structure of writing has also been identified as a characteristic that students consider important for "good" writing (Laist, 2021). While the organization of the writing is not necessarily emphasized in the WTL assignments or the writing fellows course, it can be important for clearly addressing an assignment's objectives and may relate to awareness of the writer's audience. Both were considerations writing fellows identified as important.

Writing fellows also identified that effectively communicating material to the reader is an important characteristic of writing. For the writing fellows, effective communication means that the reader can understand and gain knowledge upon reading a piece of writing. As the following excerpt illustrates, writing fellows viewed effectively communicating to the reader as a major characteristic of writing quality:

Writing Fellow #10: I think the other thing that will be particularly important to me is how readable and accessible your writing is because you're putting this into the real world. Writing to someone that does not know stats very well, you have to make it readable. (Statistics, New)

Related to this is another characteristic of writing identified by writing fellows: the author's consideration of the intended audience for a piece of writing. A writing fellow describes this awareness of the audience that they think students should have:

Writing Fellow #18: The type of audience is considered while you're writing. Nothing goes above your head, and nothing is too watered down. (Biology, Returning)

This awareness relates to an emphasis that STEM faculty placed on considering the audience as necessary for producing clear writing (Moon, Gere, et al., 2018). An authors' reflection on the audience when composing writing can be especially important for the MWrite WTL assignments, as it impacts the specific terminology and level of detail in the writing, which can, in turn, impact the learning that occurs from engaging in writing. Students reported this type of audience awareness when responding to MWrite WTL assignments (Pettersen et al., 2022). For many writing fellows, considering the audience also translated to presenting correct and accurate information in the writing product. The writing fellows stated that it can be hard for a reader, especially if they are not an expert, to evaluate the accuracy of content in a piece of writing. The importance placed on considering the audience during the act of writing aligns with writing fellows' beliefs about audience as an important characteristic of WTL and may thus arise from their participation in the MWrite program and writing fellows course.

The higher-order concerns writing fellows identified as important characteristics of writing occurred across all writing fellows and primarily aligned with those of STEM and writing faculty on how writing should be evaluated (Moon, Gere, et al., 2018; Smith, 2003; Taylor & Patton, 2006), as well as students' conceptions of what makes up "good" writing (Laist, 2021). There is some alignment with the principles of the MWrite program (e.g. argument structure, audience considerations), but to a lesser extent than writing fellows' conceptions of WTL. This indicates that writing fellows' conceptions of the higher-order concerns of writing are domain-general beliefs that may primarily be guided by their more general academic writing experiences.

### *Lower-Order Concerns*

The writing fellows also discussed lower-order concerns that they felt were important characteristics of writing quality. Many writing fellows mentioned that writing should be free of grammatical and syntax errors. The following quote from a writing fellow emphasizes how higher quality writing was free of errors:

Writing Fellow #20: Good grammar and flow goes a long way, and you'd be surprised the number of students who just don't proofread anything and I'm like, if you had read this out loud once, you would have caught a bunch of these things. (Biology, New)

The writing fellows identified that they view grammatical and syntax mistakes in a final written product as indicating that a writer has not put "effort" into their writing. This sentiment parallels comments made by engineering and writing instructors captured in Smith (2003) on how they evaluate students' technical writing.

Writing fellows also expressed that good writing should be concise. For the writing fellows, concise writing means that shorter pieces of writing can convey content more clearly than longer pieces of writing, in that an excess of words might misconstrue the message, as the following quote illustrates:

Writing Fellow #15: I think good writing is concise. My biggest priority is not including too much, it just gets confusing and wordy and also can come off as like conceited and overly confident. If you're able to convey something concisely, your reader is going to appreciate it and you're going to come off as a better writer if you can do it in less words. (Biology, New)

Similar to conciseness, writing fellows mentioned that writing should be free of redundancies. The characteristic of concise, redundancy-free writing may be due to the word limit given to students in many of the MWrite WTL assignments.

As with the higher-order concerns, the lower-order concerns that writing fellows expressed were common across the writing fellows, which indicates that disciplinary norms are not necessarily influencing writing fellows' evaluation of writing. Additionally, the lower-order concerns are not aligned with specific goals of MWrite and thus may be domain-general beliefs that arise from the writing fellows' general academic experiences. However, the conception that writing should be concise and free of redundancies may arise from the word limit included by many instructors in the MWrite assignments. Our analysis indicates that writing fellows place a greater focus on higher-order concerns, which aligns with the beliefs held by STEM and writing faculty (Moon, Gere, et al., 2018; Smith, 2003; Taylor & Patton, 2006). Their focus on higher-order concerns varies from what has been reported previously in the literature for undergraduate students and TAs, who tend to focus more on the lower-order, surface characteristics when evaluating writing (Hill et al., 2018; Johnson et al., 2017; Taylor, 2007). While writing fellows' conceptions of characteristics related to quality of writing do not appear to be related to their participation in the MWrite program to the same extent as their conceptions of WTL, their focus on higher-order concerns may positively support the emphasis in their training on evaluating students' knowledge and disciplinary thinking. Our analysis indicates the potential of writing fellows to evaluate writing in alignment with how STEM faculty think writing should be evaluated and demonstrates the utility of incorporating writing fellows in STEM courses. However, more research is needed to identify how writing fellows develop their conceptions about quality of writing.

## Limitations

Our findings are specific to the writing fellows that are part of the MWrite program and, due to the qualitative nature of the study, are not intended to be generalizable. However, viewed through an interpretivist lens, localized findings may be informative to the readership and thus make the study worth conducting (Treagust et al., 2014). Our findings may provide insight about writing fellows in other contexts and inform future studies on the MWrite program, such as the influence of writing fellows' conceptions on how they assess students' writing. Since a myriad of factors could influence how an individual perceives writing, it is not possible to characterize the origins of all the writing fellows' conceptions towards writing. In addition, we did not gather information about the undergraduate courses that each writing fellow took, limiting the claims that can be made about how the disciplinary experiences of the writing fellows may have influenced their conceptions of WTL and writing. Furthermore, the instructors of the courses that implemented the WTL assignments were not interviewed as part of this study. Therefore we cannot comment on the influence that the individual instructors may have had on writing fellows' conceptions. There are also limitations in the interview process. Participation in the interviews was voluntary, so there may have been some self-selection bias with the writing fellows who chose to participate. Writing fellows from a subset of the MWrite WTL courses being offered during the time of data collection volunteered to be interviewed, and so the conceptions characterized here may not encompass the full range of discipline-specific beliefs. Additionally, the potential focus on the final draft in writing fellows' conceptions of writing quality may arise from how the MWrite WTL assignments are administered in the courses, where writing fellows often evaluate the revised draft of student writing for accuracy and completion and thus they may have been drawing on their grading experiences during the interview. Alternatively, the responses may be due to how the interview questions were posed and that they were conducted within the context of the MWrite program.



## Conclusions and Implications

Writing fellows can play an important role in incorporating writing into classrooms and supporting students' learning from writing. This is especially true in the MWrite program, as the writing fellows allow for the incorporation of WTL assignments by instructors who might otherwise be hesitant or unable to assign writing in large, introductory STEM classrooms. With the role that writing fellows play in supporting instructors and interacting with students, it is important to expand the research on writing fellows. This study explicitly targets the conceptions that writing fellows for STEM courses hold about WTL and characteristics they view as important to writing quality within the MWrite context.

We identified that writing fellows' conceptions about WTL incorporate beliefs that are in alignment with the training they receive as part of the MWrite program, specifically their beliefs about the design characteristics of WTL assignments and the types of learning that WTL can support. Conceptions related to characteristics important for writing quality were less in alignment with the training they received, where writing fellows considered both higher-order concerns and lower-order concerns as related to writing quality. Overall, writing fellows' conceptions appear to be domain-general, with the exception of some domain-specific beliefs about the types of learning that WTL can support. The primary findings from this study are that:

- Writing fellows viewed peer review and revision to be important features of WTL assignments for supporting learning, as well as incorporating a context and audience in the assignments to guide students' writing.
- Writing fellows identified the primary types of learning supported by WTL to be helping students develop deeper conceptual understanding of course content and engaging students in disciplinary thinking.
- Writing fellows placed a greater emphasis on higher-order concerns over lower-order concerns when considering writing quality, specifically addressing the writing prompt, including accurate and important conceptual information, argument structure, and consideration of audience.

These results are important as they indicate that the writing fellows are internalizing the pedagogy of WTL through their participation in the MWrite program, while their other experiences with writing may also be guiding their conceptions of WTL. The design characteristics writing fellows identified as important align with those incorporated into MWrite WTL assignments, and the nuanced ways in which they describe the role of each design characteristic indicates that they are more than just repeating the training they receive. The findings are similar for writing fellows' conceptions of the types of learning that WTL supports, with some variations that may be attributable to disciplinary emphases. The conceptions of writing fellows in programs other than MWrite may be similarly influenced, where the conceptions are primarily guided by the program of which they are part. Furthermore, the MWrite writing fellows' focus on higher-order concerns is encouraging, as they are the primary instructional support for students when they seek help on the WTL assignments. This indicates that the writing fellows are likely to focus on the higher-order concerns when interacting with students and evaluating students' writing. This has implications beyond the MWrite program regarding how being part of a writing fellows program can influence writing fellows' conceptions, which in turn may influence how writing fellows support students' engagement with the writing assignments during student-writing fellow interactions.

It is also important to consider the conceptions about WTL that writing fellows hold that are not directly related to the training they receive through the MWrite program. For example, some writing fellows described that participating in the WTL assignments can help students develop their

communication skills through explaining specialized disciplinary content to a non-expert. Such conceptions could be drawn upon to inform future WTL prompt development. Additionally, the conceptions writing fellows held about writing quality appeared across fellows, but were not aligned with the aims of the MWrite program to the same extent as their conceptions about WTL. This indicates that writing fellows' other experiences, such as general academic experiences with writing, may play a role in shaping their conceptions related to writing quality. Characterizing writing fellows' conceptions not directly in alignment with programmatic goals can inform how the training writing fellows receive could be changed, as well as whether there are potential conceptions the writing fellows program could harness.

Further research is warranted to identify how writing fellows' conceptions arise, especially those not directly in alignment with programmatic goals, both within MWrite and in other writing fellows programs. For example, research could involve comparing the beliefs of new and returning writing fellows to investigate how individual writing fellows' conceptions of WTL and writing develop over time. Furthermore, given the differences in the characteristics faculty view as important to writing and their actual evaluation practices, a study comparing writing fellows' conceptions of writing quality with what they discuss during their interactions with students and their evaluation practices is merited. The influence of being a writing fellow on their own identity as a writer, generally and within their own discipline, could also be of interest. Interviewing faculty and undergraduate students participating in WTL, in addition to the writing fellows, could offer a more complete picture of what views these groups hold about WTL and writing more generally. In this way, we could develop a better understanding of how participation in a WTL program affects all participants and how the beliefs of faculty, writing fellows, and students impact one another.

## Appendix A: Writing Fellows Epistemology Interview Protocol for New Writing Fellows

Goal of the project: Thank you for coming to this interview. I greatly appreciate your feedback to help my research in the MWrite program. The goal of this study is to learn about the writing fellows experience and to gather feedback about writing fellows viewpoints on writing. When I share this data with anyone, your identity will be protected and I will use a pseudonym when reporting the results. If at any point you would like to stop the interview, you are free to do so. Do you have any questions for me regarding the research study or the consent process?

Here is the consent form. Take your time in reading it and looking the study over. If you agree to participate in this study, then you should sign right here.

### Introductory/Warm-up questions

Questions about their experience as a writing fellow, background information to learn more about them.

1. What is your major?
  - a. What is your minor? (if any)
2. How far along are you in college?
3. What are you plans after you graduate?
  - a. What type of field/career do you envision yourself working in?
4. Why did you decide to be a writing fellow?

5. What course are you a writing fellow for?
6. What do you anticipate the experience of being a fellow to be like?
  - a. What do you anticipate will be the typical activities that you complete as a writing fellow?
7. What kind of help do you anticipate students seeking?
  - a. In what ways do you think that students come to you for help?
  - b. What types of questions do you think students will ask you?
8. If you had to divide the time spent with students on issues of writing vs issues of MSE content, what percentages do you think you will spend on each?
  - a. Course content vs. the amount of writing help
9. Do you think there will be any aspects of being a writing fellow that will be surprising for you?

## Role of Writing

### *Prompt 1: How would you describe good writing?*

Follow-ups:

- What characteristics would you consider make up “good” writing?
- What characteristics would you consider make up “poor” writing?
- When you are writing, how do you consider the audience/readership?
- When you are writing, how does the intended reader affect how you write?

## Role of Writing in the Discipline

### *Prompt 2: What is the role of writing in the course that you are/will be a writing fellow for? (insert the writing fellows’ course here)*

Follow-ups:

- How do your peers (fellow undergraduate students/writing fellows) view writing?
- How do you believe your professors/instructors view writing?
- How has your use of writing in (insert course here) changed as you have progressed through college?
  - Can you describe the ways it has stayed the same?
  - Can you describe the ways it has changed?
    - How do you personally feel about those changes?
- What forms of writing are used in the (insert course area here (science, economics, chemistry, statistics, etc.)) that you are writing fellow for?
- What do you feel is the purpose behind these different types of writing?
- How do you feel these different forms of writing support understanding of the content?

- How do you feel these different forms of writing support the development of becoming a better writer?

**Prompt 3: To what extent has your knowledge in (the course that they teach, insert course area here (science, economics, chemistry, statistics, etc.)) been important to you in your development of being a writing fellow so far?**

- How do you think being a fellow will impact your understanding of the content in (insert course area here)?
- How do you anticipate your understanding of the content in (insert course area here) will change from being a fellow?
- What do you anticipate that you get out of being in the writing fellow course?

## **Role of Writing in Teaching**

**Prompt 4: What do you think writing-to-learn means?**

Follow-ups:

- Are there features that distinguish writing-to-learn from other types of writing that you have encountered? If so, what are they?
- How/when did you encounter writing-to-learn tasks for the first time?
  - Did you encounter it as a student or when you became a writing fellow?
- What, if any, are the benefits of using writing-to-learn tasks?
- What, if any, are the challenges of using writing-to-learn tasks?

**Prompt 5: How do you think people learn (insert course here) best?**

Follow-ups:

- What type of study habits do students employ to learn science?
- What type of teaching methods/practices help students learn science?
  - Examples include: lecture, small group work, assignments, lab reports, etc.

**Prompt 6: As a writing fellow, how do you think you will know when students understand the material?**

Follow-ups:

- How will you figure out whether students understand the material?
- What do students say/ exhibit when they understand vs. when they don't understand?
- Can you describe some of the actions that you take as a writing fellow to increase students' understanding?
  - In what ways do you think these actions help increase student understanding?

## Wrap-Up/Conclusions

- Is there anything else that we haven't covered yet that you would like to mention?

## Appendix B: Writing Fellows Epistemology Interview Protocol for Returning Writing Fellows

Goal of the project: Thank you for coming to this interview. I greatly appreciate your feedback to help my research in the MWrite program. The goal of this study is to learn about the writing fellows experience and to gather feedback about writing fellows viewpoints on writing. When I share this data with anyone, your identity will be protected and I will use a pseudonym when reporting the results. If at any point you would like to stop the interview, you are free to do so. Do you have any questions for me regarding the research study or the consent process?

Here is the consent form. Take your time in reading it and looking the study over. If you agree to participate in this study, then you should sign right here.

## Introductory/Warm-up questions

Questions about their experience as a writing fellow, background information to learn more about them.

1. What is your major?
  - a. What is your minor? (if any)
2. How far along are you in college?
3. What are you plans after you graduate?
  - a. What type of field/career do you envision yourself working in?
4. What course are you a writing fellow for?
5. Why did you decide to be a writing fellow?
6. What it was like being a fellow?
  - a. What would you describe as the typical activities that you complete as a writing fellow?
  - b. Can you describe the differences in your experience as a writing fellow from last time to this time?
7. What kind of help did students seek?
  - a. In what ways do students come to you for help?
  - b. What types of questions did students ask you?
8. If you had to divide the time spent with students on issues of writing vs issues of MSE content, what percentages would you assign to each?
  - a. Course content vs. the amount of writing help
9. Are there/have there been any aspects of being a writing fellow that have been surprising for you?

## Role of Writing

### *Prompt 1: How would you describe good writing?*

Follow-ups:

- What characteristics would you consider make up “good” writing?
- What characteristics would you consider make up “poor” writing?
- When you are writing, how do you consider the audience/readership?
- When you are writing, how does the intended reader affect how you write?

## Role of Writing in the Discipline

### *Prompt 2: What is the role of writing in the course that you are/will be a writing fellow for? (insert the writing fellows’ course here)*

Follow-ups:

- How do your peers (fellow undergraduate students/writing fellows) view writing?
- How do you believe your professors/instructors view writing?
- How has your use of writing in (insert course area here) changed as you have progressed through college?
  - Can you describe the ways has it has stayed the same?
  - Can you describe the ways it has changed?
    - How do you personally feel about those changes?
- What forms of writing are used in the (insert course area here (science, economics, chemistry, statistics, etc.)) that you are writing fellow for?
- What do you feel is the purpose behind these different types of writing?
- How do you feel these different forms of writing support understanding of the content?
- How do you feel these different forms of writing support the development of becoming a better writer?

### *Prompt 3: To what extent has your knowledge in (the course that they teach, insert course area here (science, economics, chemistry, statistics, etc.)) been important to you in your development of being a writing fellow?*

- How has being a fellow impacted your understanding of the content in (insert course area here)?
- How has your understanding of the content in (insert course area here) changed from being a fellow?
- What did you get out of being in the writing fellow course?

## Role of Writing in Teaching

### *Prompt 4: What do you think writing-to-learn means?*

Follow-ups:

- Are there features that distinguish writing-to-learn from other types of writing that you have encountered? If so, what are they?
- How/when did you encounter writing-to-learn tasks for the first time?
  - Did you encounter it as a student or when you became a writing fellow?
- What, if any, are the benefits of using writing-to-learn tasks?
- What, if any, are the challenges of using writing-to-learn tasks?

### *Prompt 5: How do you think people learn (insert course area here, science, economics, chemistry, statistics, etc.) best?*

- What type of study habits do students employ to learn science?
- What type of teaching methods/practices help students learn science?
  - Examples include: lecture, small group work, assignments, lab reports, etc.

### *Prompt 6: As a writing fellow, how do you know when students understand the material?*

Follow-ups:

- How do you figure out whether students understand the material?
- What do students say/exhibit when they understand vs. when they don't understand?
- What do you say or do as a writing fellow to ask students if they understand or not?
- Can you describe some of the actions that you take as a writing fellow to increase students' understanding?
  - In what ways do you think these actions help increase student understanding?

## Wrap-Up/Conclusions

- Is there anything else that we haven't covered yet that you would like to mention?

## Appendix C: Coding Scheme for Writing Fellows Interviews Codebook

### Poor Writing Characteristics – when the writing fellows were asked about what characteristics they consider “poor” or “bad” writing

- Doesn't answer assignment: when the piece of work does not address the original goal or intent of the assignment; when it is obvious the student is just trying to get as many points as possible
- Incorrect or poor content: the piece of writing includes incorrect or inaccurate content; or content is applied in an inappropriate manner in the wrong situational

- No audience: the piece of writing was not written with a specific audience in mind; includes a lack of definitions or includes too many details that are unnecessary
- Omits the why: writing pieces that fail to convey why a certain piece of writing is important or what is happening
- Poor Argument Structure: relates to forming arguments that aren't backed up with evidence and/or don't make sense; no conclusions or tying points together
- Poor Grammar/Spelling: related to if there are typos, spelling errors, poor sentence structure related to tense, little attention to grammatical rules
- Structure: related to the organization of the whole essay or individual sentences (only code for subcodes)
  - Not concise: when there are extra words included that are not necessary but do not necessarily detract from the overall point or accuracy of an essay
  - Poor organization: when the paragraph/structure of the essay does not seem conducive to the easiest reading
  - Redundancy: author repeats themselves in the paper without a purpose

### **Good Writing: when writing fellows were asked about what they characteristics or attributes they think make up "good" writing**

- Considers audience: good writing is cognizant of the writing
- Effectively communicates to others: when the essay can be read and comprehended easily by others; when the essay makes clear points
- Free of grammatical and spelling errors: when the writing piece has no grammar or spelling errors, mistakes
- Good conceptual understanding: when the essay is able to convey that students have a full understanding of the concepts, when the essay is able to present a new concept or a new way to think about a concept, when it is clear from the essay that the author has an understanding of the concepts; the essay contains correct facts and information
- Multi-step process: when the WFs mentions that students approach writing as a multi-step process, which may include drafting, peer review (or just review), revision, etc.
- Planned writing process: when it is clear that the author spent some time before writing thinking about their writing process and plan
- Well constructed arguments: when arguments are very focused on a specific point; when the writing response addresses all the intended every point of the prompt clearly; supports claims with evidence; able to synthesize concepts in arguments
- Structure: refers to how the essay is organized or structured (only code the following codes)
  - Concise: when the writing is straight and to the point
  - Includes transitions: when there is transitions that are present to flow from idea to idea
  - Organized: when the order the paragraphs and sentences are presented in are logical



## What is WTL: how students conceptualize and view WTL or MWrite (writing fellows tend to use MWrite as interchangeable with WTL)

- Audience is clear: mentions how the audience is laid out in WTL assignments
- Be confident with writing: helps students become more confident when they are submitting writing assignments
- Deeper understanding of content: the process of WTL assignments assists students in developing a deeper understanding of the concepts presented in the WTL assignment; mentions the active process of learning while they are actively constructing their assignment merged with deeper understanding of content
- Identify places you don't understand: WTL assignments can assist with helping students learn what areas they might need to improve on
- Improves communication skills: helps to improve the students' ability to be able to explain concepts to others; non-experts
- Improves writing ability: WTL assignments improve students overall writing ability, regardless of their conceptual knowledge
- Increase awareness about different forms: increases the students' awareness about different types of writing genres
- Makes connections between concepts: how the WTL assignments can help students connect different concepts together
- Makes course connections: how the writing assignments help students make connections to the concepts they learn in any class related to the class they do WTL in or classes with no WTL
- Not right or wrong: there is less clear cut correct or incorrect responses
- Process of WTL is important: writing fellows emphasize how the process (peer review, editing, revision) is important to WTL; WF mentions how the social nature of WTL (including review and revision) is very important to have the most successful response to a WTL prompt
- Real-world connection (only code the following codes):
  - Connects content in prompt: WTL assignments help students see how these concepts could be applied in a real-world connection outside of a classroom
  - Transfers to future jobs: WTL assignments help students to see how the skills learned from participating in WTL can help students realize their importance to future jobs/skills

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## Note

<sup>1</sup> We would like to thank the University of Michigan Third Century Initiative and the National Science Foundation Graduate Research Fellowship Program (Grant No. DGE 1256260) for providing funding for this research. We would like to thank all of the writing fellows who participated in this research. We would like to thank Larissa Sano for her insights about the writing fellows program. We would like to thank Alena Moon for her support and feedback on the development of the interview protocol and Amber Dood for her feedback on the manuscript.

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### Complete APA Citation

Finkenstaedt-Quinn, Solaire A., Schmidt-McCormack, Jennifer A., Watts, Field M., Gere, Anne Ruggles, & Schultz, Ginger V. (2023, December 6). Undergraduate writing fellow conceptions of writing-to-learn and quality of writing. *Across the Disciplines*, 20(1/2), 4-33.  
<https://doi.org/10.37514/ATD-J.2023.20.1-2.02>