Dispositions in Natural Science Laboratories: The Roles of Individuals and Contexts in Writing Transfer[1]

Neil Baird, Bowling Green State University, and Bradley Dilger, Purdue University

Abstract: Writing transfer scholarship is more systematically investigating the influence of dispositions, which are internal qualities that influence how individuals react to learning contexts. In this article, we consider dispositions in science laboratories, which are important contexts for WAC/WID instruction, especially at institutions where these courses serve majors and other students simultaneously. Drawing on data from a larger longitudinal study of writing transfer in the major at a state comprehensive university, we offer case studies of two science laboratories developed from interviews with students and faculty, supported by analysis of student writing and instructional materials. Faculty approaches to teaching scientific writing varied in their engagement of "verification" and/or "inquiry" approaches to instruction, and also in ways they attempted to motivate prior knowledge, prepare students for future contexts, and help them develop scientific identities. Students' responses also varied, and dispositions strongly influenced the degree of success of pedagogical goals. Our findings contribute to efforts to identify the dispositions critical for writing instruction and to diversify the specific WAC/WID contexts where writing transfer is being considered.

Introduction

In recent writing transfer scholarship, a consensus is emerging about the value of writing-related dispositions as a framework for better understanding writing transfer. Dispositions are individual attitudes that influence the motivation of intellectual traits. In the case of writing transfer, they shape decisions writers make regarding prior skills, experience, and knowledge as they move between contexts. For example, writers might have prior knowledge about a specific genre from coursework, but will they be motivated to draw on it in internships? Understanding the interplay between dispositions and context, rather than privileging the influences of the contexts and environments of writing, can provide a richer understanding of how writers adapt writing-related knowledge across contexts. However, classroom studies of dispositions often focus on curricular interventions rather than students. As Bromley, Northway, & Schonberg (2016) note, "Despite transfer studies' new interest in dispositions, however, researchers have not given as much attention as they could to studying student perspectives or motivations as indicators of dispositions" (p. 3). In this article, we "take learners' perceptions of their own learning into account" (p. 3) by offering WID-based case studies that we hope drive forward studies of dispositions educated by contexts in several ways: examining how contexts can contribute to the formation of critical dispositions, how multiple dispositions can interact to generate or disrupt engagement with transfer, and how dispositions can shift across contexts.

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During the second year of our three-year longitudinal study investigating the classroom practices, curricular elements, cultural forces, and habits of mind that afford transfer, we recruited participants in the natural sciences to complement our original pool, which heavily favored the humanities and social sciences. At the regional state comprehensive university where our study took place, small programs result in WID courses with high student diversity, often including students from multiple disciplines. As a result, we began working with four student participants representing three majors in two very different writing-intensive laboratory settings: a chemistry course where "inquiry" or "authentic" labs were valued, and a biology course that valued a transition from "verification" or "cookbook" labs to inquiry. Our recruiting thus created a WID-based test case for examining dispositions in relation to their contexts. In this article, we offer case studies of these two contexts, describing how the dispositions of four student participants impact writing transfer in these laboratories. In doing so, we offer nuanced insights into the relationships between dispositions and contexts, and follow others articulating important questions about dispositions and transfer research (e.g. Driscoll et al., 2017).

We begin by summarizing four key insights from transfer research that have shaped our study. We also review conversations about laboratory pedagogy in science education, which mirror debates about authentic and school genres in rhetorical genre studies, to provide context for the two classrooms we describe. We then present our research methods and results. In our results, we begin by describing how our two faculty participants came to value particular laboratory pedagogies. After establishing these classroom contexts, we examine how student dispositions impacted engagement with these laboratory pedagogies, enabling writing transfer for some participants, while hindering it for others. We conclude with methodological considerations for writing transfer researchers and pedagogical considerations for stakeholders in writing programs.

Four Insights from Writing Transfer Scholarship

Writing transfer has received much recent attention, with regular articles in journals like *CCC* (Blythe & Gonzales, 2016; Brent, 2012) and a special issue of *Composition Forum* (Wardle, 2012a). Many recent transfer studies, focusing on first-year writing, draw on Russell (1995), who strongly questioned the notion of a course which offered transferable "general writing skills instruction," and Smit (2004), who pointed out the difficulty of teaching for transfer, though he acknowledged it was possible. Transfer-focused approaches to teaching first-year writing have shaped contemporary pedagogy (Dew, 2003; Downs & Wardle, 2007; Reiff & Bawarshi, 2011; Wardle, 2007, 2009; Yancey, Robertson, & Taczak, 2014), including a textbook (Wardle & Downs, 2017) now in its third edition. These scholar-teachers, like many in the sciences considering lab pedagogy, have echoed Russell and Smit in asking how the school genres common to FYW contexts influence transfer both into and out of FYW. Beaufort (1999, 2007), whose longitudinal work has followed students out of FYW and into the major, has helped researchers broaden attention to transfer beyond FYW, shaping the work of scholars such as Read and Michaud (2015) in professional writing and Devet (2015) for writing center studies.

Four important insights from research have guided our work and shaped our study of transfer, including the case studies on science lab writing pedagogy we offer here. First, **transfer researchers must consider which actors, agents, and contexts—or which combinations of them—are best-suited for studying transfer**. Driscoll et al. (2017) suggest a broad approach to data collection:

> A fuller picture of writing transfer may include the context (curriculum, writing program); the courses (instructor, interactions in course, classroom community); the

> texts (genre, rhetorical situation, affordances and constraints); and the writers (dispositions, experiences, prior knowledge, external influences). (III, para. 3)

This formulation echoes Tuomi-Gröhn and Engeström (2003) in considering not only writing tasks and the individuals who undertake them, but the activities and contexts in which they work—an approach endorsed by the "Elon Statement on Writing Transfer" (2015). Though writing research is more likely to focus on contexts (Yancey, Robertson, & Taczak, 2014), influential individual frameworks attend to learned behaviors which influence transfer, using the terms "habits of mind" (NCTE, 2011) in addition to "dispositions" (Costa & Kallick, 2014). Approaches which are more context-sensitive prioritize the interactions between learners and their environments, especially contexts new to writers or learners—that is, the workplaces, classes, or other activities into which prior skills, experience, and knowledge are transferred.

Driscoll (2011) and Driscoll and Wells (2012) have made strong contributions to using dispositions as a key mechanism to consider individual influences in a manner which balances attention to relevant contexts. Working from sources in educational psychology (e.g. Bronfenbrenner & Morris, 2006; Perkins, Tishman, Ritchhart, Donis, & Andrade, 2000), Driscoll and Wells describe dispositions as "individual, internal qualities that may impact transfer," (2012, para. 1), identifying four which can affect writing transfer: value, attribution, self-regulation, and self-efficacy. Expectation of value suggests that "if students don't value what they are learning or don't see how what they are learning will be useful to them in the future, they will not engage in mindful abstraction" ("What Do I Value," para. 1). Attribution, or the ways students attribute causes to the events that impact them, suggests that students identify the causes of successes or failures as outside their control. For example, students who consistently attribute blame for poor grades to teachers or classmates, rather than questioning their effort or achievement, are less likely to engage in rich forms of writing transfer. Self-regulation, the ability to set learning goals, evaluate progress, and make changes accordingly, can affect how students revise writing-related knowledge in new contexts. Finally, self-efficacy, or students' beliefs in their capabilities, suggests that "in order for students to do the work that successful transfer requires, they first have to hold developmentally generative beliefs about their ability to do that work and to accomplish their goals" ("Am I Capable," para. 2). These dispositions have the ability to shape not only the motivation of prior knowledge, but reactions to classroom practices, curriculum, or course content. In our methods section, we offer more detail about the roles they played in our analysis.

Second, like many transfer scholars, **we consider how the formation of individuals' identities, including the development of professional identities and personas, influence learning to write, especially the decision-making about prior knowledge necessary for transfer**. Indeed, many college courses expressly adopt goals directed toward the development of professional identities through assignments which involve "apprenticeship genres" (Carter, Ferzli, & Wiebe, 2007). This takeup is sometimes facilitated via "mediated" (Beach, 2003) experiences which simulate extra-curricular contexts, though degrees of authenticity vary widely. For some students, this experience is painful, given not only the problems lack of content and genre knowledge can cause, but the disappointment of recognizing their prior knowledge is not as valuable as they imagined it would be. Of course, identity exceeds writing classrooms, and transfer as well. Roozen (2009) shows how both educational and extra-educational identification can shape writers' processes and their motivations of prior knowledge. We have seen this behavior in the courses described here, as well as other first-year and upper-division writing courses (Baird & Dilger, 2017), as writers wrestle with the difficulty of changes often associated with learning new professional identities. This is not surprising, given the complexity of writing-identity relationships, and their recursive nature (Adler-Kassner & Wardle, 2016, part 3, pp. 48–58). For writing transfer, two lessons emerge: acknowledging the variation in writers' ability or willingness to undergo the

shifts in identity which may result from engaging prior knowledge, and recognizing that novices often need support to successfully assume expert roles through writing.

Third, **writing transfer involves adapting skills, experience and knowledge as writers move between, consider, or are influenced by different contexts**. Writing knowledge is seldom reused or moved between contexts without modification. Rather, transfer requires mindful abstraction, the careful consideration of what can be transferred as-is, what must be modified, and what needs to be excluded. This has given rise to terms for transfer such as "repurposing" (Roozen, 2010), "recontextualization" (Nowacek, 2011), and "transformation" (Brent, 2012), and is reflected in contemporary definitions of transfer which reject static models of knowledge movement ("Elon Statement on Transfer," 2015). Indeed, we have inventoried over 20 metaphors for "adaptive transfer," as DePalma and Ringer (2011) describe it—each with a slightly different understanding of how transfer occurs, is learned, and can be taught. That is, different types of adaptation are appropriate for different contexts, and are highlighted by different researchers. Wardle (2007) memorably describes how an adaptive sense of transfer impacts research design, as scholars should be "looking for apples when those apples are now part of an apple pie" (p. 69): because transfer often involves writers modifying knowledge on the fly, data collection and analysis may be more challenging in transfer research than other areas of writing research.

Adaptive frameworks for transfer have considerable pedagogical implications, too, not only for first-year writing, but for other contexts, including the scientific writing we study here. Nowacek's study of linked courses (2011) highlights the impacts—positive and negative—of prior genre knowledge. Instructors should consider the rhetorical elements of transfer, seeing their students as "agents of integration" who must actively demonstrate the value of their writing in new contexts. DePalma and Ringer also underscore the need for writing instruction which respects students' agency (2011). They suggest instructors should have more generous attitudes about error in the adaptation of knowledge, directly integrate reflection on the adaptation of prior knowledge into writing assignments, and shift the aims of instruction to allow students to question conventions and generic practices, rather than expecting simple mastery (2013).

This brings us to our fourth and final point: **classroom practices are powerful influences on transfer**. In the same way that direct engagement with other elements of writing powerfully shapes students' behavior, talk about transfer—or lack thereof—is also influential. Faculty in the disciplines can cue transfer of knowledge from prior contexts, if an institution-wide culture of writing provides the practical and theoretical support that encourages explicit teaching of writing (Gorzelsky, Haynes, Jones, & Driscoll, 2017, pp. 118–119). Not surprisingly, classroom practices loom large in our findings, and carry over into the tentative implications we offer below.

Prior Knowledge and Approaches to Teaching in Science Laboratories

Our attention to writing transfer in the context of science laboratories was shaped by conversations with faculty and student participants regarding the role laboratory work played in the development of students' professional identities. Faculty participants recalled their own experiences learning to write lab reports, and shaped their teaching accordingly. Both underscored the importance of laboratory experiences for students, and expressed concern over the costs of materials and facilities—especially given the limited resources at Western. However, their approaches diverged considerably, mirroring the lack of consensus seen in practice: that is, though "inquiry" or "discovery" approaches which explicitly attempt to simulate scientific inquiry seem to have the edge based on research, "verification" or "worksheet" labs which seek to scaffold student learning remain common (Eubanks, 2015). Further reflecting issues in the field, our faculty participants

echoed its language, using the more marked terms "authentic" and "cookbook" labs, though they did not adopt the hostile tone seen in some scholarship (e.g. Monteyne & Cracolice, 2004).

The central questions in this scholarly debate about laboratory work revolve around its difficulty, the necessity of developing technical skills useful for scientific practice, and the pedagogical approaches best suited to the development of scientific identity and content knowledge. Defenders of verification labs suggest that inquiry methods falsely assume students enter laboratory settings with accurate scientific knowledge, and argue that verification labs better provide the scaffolding needed to learn this knowledge (Ault, 2002). Horowitz (2008) suggests verification labs recognize and reward the intrinsic difficulty and intellectual value of following laboratory procedures. Even advocates for inquiry-based methods acknowledge that the trial-and-error all but required in an inquiry setting is resource-intensive, both in terms of students' time, facilities needed, and expenses for consumables (French & Russell, 2006).

Those who advocate more inquiry- or discovery-oriented approaches emphasize the importance of scientific sense-making and identity (Karelina & Etkina, 2007), sometimes using the term "scientific literacy" (e.g. Gormally, Brickman, Hallar, & Armstrong, 2009). Stout (2011) uses different language, but points to similar skills, targeting deep understanding of scientific concepts which can be reflected in writing. For proponents of inquiry, the shortcomings of verification labs arise because of the small amount of writing and the limited use of genres that simulate disciplinary forms such as lab notebooks and scientific reports. Many also describe a transition over time from verification to inquiry labs, as if the matter has been settled unequivocally thanks to empirical work (Eubanks, 2015), or because of national science education standards (Meyer, Hong & Fynewever, 2008). Inquiry labs, then, are positioned as more conducive to motivating prior knowledge, and preparing for future contexts—often through the development of scientific identity.

However, despite the sometimes acerbic language, research shows a continuum between verification and inquiry approaches to laboratory work—one reflected in our case studies. Rezba, Auldridge, and Rhea (1999) suggest a four-part scale: confirmation (verification), structured inquiry, guided inquiry, and open inquiry. Among others, Bopegedara (2011) describes a progressive pedagogy which moves from verification toward open inquiry by explicitly teaching skills such as keeping laboratory notebooks and the value of knowledge such as physical layout of the lab. Attention to writing, instructor guidance in the laboratory, and synchronization of laboratory and lecture content can also provide support (Brownell, Kloser, Fukami, & Shavelson, 2012). In other words, the sharp differences between approaches which appear to shape the scholarly conversation are often bridged in classroom practices, in much the same way that in composition studies literal arguments between expressivism and cultural studies, or debates about the role of social and political engagements in the classroom, aren't necessarily realized in pedagogy. As in other disciplines that value problem-focused teaching and learning, "balance between structure and openness" is broadly possible (Craig, Lerner, & Poe, 2008, p. 285).

Though language familiar to transfer scholars, even the term "transfer" itself, is not always used in these conversations, researchers discuss both takeup of prior knowledge and its future motivation in school, work, and other contexts. For example, Goodey & Talgar (2016) refer to a desire to ensure students are prepared for workplaces where research design is required. They investigate this ability with methods that include interviews of students in courses one semester following an initial assessment. Multiple sources across scientific disciplines point to the role laboratory work, if properly structured and implemented, can play in the development of "twenty-first century skills," noting the urgency of improving scientific education; Gormally, Brickman, Hallar, & Armstrong (2009) explicitly connect these outcomes and attention to "transfer."

So in summary, we see dispositions as a method for balancing the important roles of individuals in transfer studies with the considerations of contexts which are necessary to understand writing environments. Paying attention to the identification which often takes place in writing, especially writing in the disciplines, and assuming that most transfer is adaptive, has shaped our research design and cued us to consider students' roles in shaping their learning. Finally, scholarly conversations about writing laboratory reports may not always explicitly engage "transfer," refer to prior knowledge, or suggest teaching should actively facilitate future recall, application, integration, or repurposing. Even so, issues writing transfer scholars identify as important are relevant for these contexts too.

Research Methods

Data for this article comes from our longitudinal, interview-driven writing transfer study of sixteen students beginning to write in their major. Our overall study is driven by the question, "What are the classroom practices, curricular elements, habits of mind, and cultural forces which influence writing transfer for students writing in the major?" Over a three-year period, we examined this question through a series of interviews with students and the fifteen faculty members who taught their courses. Here we focus on six student and two faculty participants from the natural sciences, asking, "How do student dispositions impact writing transfer in science laboratories?"

Our study took place at Western Illinois University, a regional state comprehensive that enrolled 10,000 students in the semester data collection concluded (May, 2014). Many of Western's students are first-generation, some from surrounding rural counties but many from a neighboring large city. About a third follow the approach championed by the state, beginning their studies at community colleges and transferring to Western after earning associate degrees. Though Western has a three-tier writing requirement, the absence of a central writing program limits oversight and professional development opportunities, and commitments to writing vary widely between programs and when comparing courses taught by different faculty. As a result, faculty outside the composition program (which is housed in English) tend to draw upon lore and past experiences when approaching writing instruction, and students' engagement with writing varies as well.

Western's writing requirements begin with two composition courses, one in the first year and a second for sophomores. All courses which fulfill General Education requirements are expected to be writing-intensive, though in practice writing is often minimal. Finally, in their majors, students satisfy a Writing Instruction in the Disciplines (WID) requirement designed to teach the forms and values of disciplinary writing. To receive WID designation, courses must assign disciplinary writing, such writing must comprise a significant portion of students' grades, and instructors need to spread writing across the semester, offer feedback, and allow students opportunities to revise. But as in general education, WID requirements vary. While some are effective, too many push the teaching of disciplinary writing to the margins by focusing on content or methods, or through over-reliance on school genres, or because of curricular timing: it's not unusual to see capstone courses or concluding internships serve double duty as WID requirements.

To collect data, we engaged student participants in several different types of interviews over at least one year and sometimes as long as three years. Literacy history (Brandt, 1998) and process-tracing interviews (Roozen, 2010) helped us understand participants' previous writing environments and evaluate their dispositions in relation to prior writing skills, experience, and knowledge. For each of these interviews, students brought relevant writing to share and discuss—prior writing, current drafts, final drafts, instructor comments, and rubrics—which we used to build a portfolio. We made extensive use of discourse-based interviews (Odell, Goswami, & Herrington, 1983), recognizing this approach as the key means for gaining access to tacit knowledge about

writing transfer. We also conducted member-check interviews (Alsup, 2010) with participants at the end of their first year in the study.

We deepened our understanding of student participants' writing contexts through interviews with the faculty who taught their WID courses. These interviews provided insight into the motivations of faculty by investigating their writing lives, classroom practices, and engagement with curricular structures, while simultaneously illuminating department cultures. The two faculty members in this article completed two hour-long interviews and shared documents such as syllabi, handouts, core assignments, and rubrics. This array of student interviews, faculty interviews, and a portfolio of relevant documents offers a rich data set of over 160 interviews and 300 documents, creating numerous opportunities for triangulation.

As we explain in our literature review, the structure of lab reports and laboratory work, including the notion of "cookbook labs," emerged as a theme in interviews with chemistry professor Matthew Orrick and biology instructor Darryl Helf, suggesting further study. Among our six students from the natural sciences, four had enrolled in courses from Helf and/or Orrick. (Faculty and student names used here are pseudonyms, and some information has been changed to protect participant confidentiality. Student pseudonyms were self-selected.)

- **Dr. Matthew Orrick**: An assistant professor in chemistry who defined his approach to labs as inquiry. Reacted negatively toward verification labs, believing they do not help students assume scientific identities.
- **Dr. Darryl Helf**: A long-time professor of biology who began his course with verification labs but ended with an inquiry lab. Believed in the value of verification labs to structure specific kinds of experiences for students.
- **Elbow**: Latino, first-generation, community college transfer majoring in forensic chemistry. Student in both Orrick's and Helf's courses.
- **Alison**: Continuing-generation, community college transfer majoring in zoology. Student in Helf's course.
- **Karina**: First-generation student who completed her composition requirement at Western, majoring in forensic chemistry. Student in Orrick's course.
- **Steve**: Continuing-generation student who completed his composition requirement at Western, majoring in biochemistry. Student in Helf's course.

We shape the account here around the two students Elbow and Alison for two reasons. First, Elbow and Alison share several similarities that facilitate comparison: they were both community college transfers, high-achieving students, and student workers on campus. Second, though Steve and Karina were similarly high-achieving, they shared a relative lack of interest in their courses with Orrick and Helf, reflected in limited engagement with these courses in both interviews and writing assignments they completed. Including Steve and Karina in our data set was important in refining our analysis, even though in the interest of space we do not tell their full stories here.

Analysis of data began with reviews of the transcripts for these six participants, identifying passages where they reflected on working in laboratories or writing laboratory reports. We coded these interview transcripts for dispositions, applying value, attribution, self-regulation, and self-efficacy (Driscoll & Wells, 2012) as codes. Our case study approach and the interrater reliability difficulties Driscoll et al. (2017) experienced suggested collaborative coding (Smagorinksy, 2008), even though our data set was fairly large (thirty interview transcripts covering four student and two instructor participants, as well as the classroom materials they referred to). Like many other transfer researchers, we drew upon several transfer types identified by Salomon and Perkins (1989) during coding and analysis. We coded not only for backward-reaching transfer—the motivation of prior knowledge, but forward-reaching transfer, where learners are cued to consider

how knowledge might be used in the future. Negative transfer was also important: when learners turn to knowledge even though it is not valued in a new context—for example, when a college student tries a learning strategy appropriate for high school. Comparing disposition codes with transfer types allowed us to identify when dispositions seemed generative, enabling transfer, and which seemed disruptive, hindering it. Analyzing documents such as syllabi, assignments, and students' lab reports, especially those with instructors' commentary, helped us resolve any differences in coding while developing our understanding of the classroom practices and curricular structures represented by interviews. We wrote summaries for each participant to better compare participants' experiences, considering both differences between students and gaps between students' accounts of their coursework and the intentions of faculty as reflected in interviews and course materials.

The case studies which follow were developed from that analysis. For both faculty participants, we discuss how they shape their respective WID courses as verification and/or inquiry, given their prior writing experiences, lab pedagogies, and transfer goals. We describe their approaches to writing lab reports, including expectations for engagement with scientific literature, and the relationships of lab work to forward- and backward-reaching transfer. Then we turn to student participants, discussing how their dispositions shaped engagement with these pedagogies. To do so, we highlight some of the prior experiences that shaped students' dispositions and then examine how these dispositions impact engagement with the labs and writing of their WID courses. The individual nature of dispositions suggests a case study approach, and our goal in presenting data as case studies is to offer thick descriptions that capture the complexity of dispositions and transfer.

Dr. Matthew Orrick: Inquiry Labs and the Development of Identity

When first assigned to teach his department's WID course, Dr. Matthew Orrick researched Western's WID requirement. "It essentially meant that you have to write a paper in your field that people aren't going to laugh at, so I said students need to write lab reports that reflect that." Unfortunately, though he asked, senior faculty in his department offered few specifics. "Nobody really helped me. They're like, 'Oh yeah, we write lab reports. They're a few pages, really detailed." Perceiving his department to be of little help, Orrick turned to prior knowledge: "I'm teaching the WID course as the class I took when I was a senior in undergrad, " he explained. This writing experience included 15- to 20-page lab reports that Orrick found "more detailed and more scientific" and had "more experiments and more data to analyze" than his colleagues' "few pages." Though he didn't write much during coursework (his first three years of graduate school), subsequent years focused on writing as faculty offered more direct mentoring. As a graduate student, Orrick struggled with conciseness and scientific voice. When asked how his supervisors helped him through these difficulties, Orrick highlighted their comments. "My supervisors let me know. Yeah, they would murder it with a red pen." He attributed much of his writerly development to this intense feedback, and consciously adapted a similar style for his WID course, integrating his experience as a senior with the commenting style of his graduate supervisors.

Given his perceptions of the ways WID courses and associated labs were taught in his department, and the prior experiences he valued, Orrick designed his WID course around a series of inquiry labs and assigned lab reports modeled after scientific papers published in peer-reviewed journals. In interviews, Orrick argued that inquiry labs were superior to verification labs, using the marked term "cookbook:"

Cookbook labs don't help [students]. "Cookbook" comes from the way you use it. It's like baking a cake. Eggs, flour, stir it, bake it, and you did it. They're not very useful for scientists. Nothing ever happens that's wrong. If you don't observe what you are doing, if you don't pay attention to the

details, you're not going to be very good. You have to take your time, you have to know what you are seeing, and you have to understand why you are seeing it. That's how you get to the next level of doing science.

Orrick saw little value in verification labs because they did not help students develop the scientific identities of chemists, the "next level" which included the skills of observation, paying attention, and understanding results. For him, inquiry labs facilitated this development more effectively. Even so, Orrick's approach to inquiry labs contained elements of verification labs. Due to cost of materials, he was unable to allow students to design their own experiments. As a result, he provided the contexts and goals for experiments, and suggested procedures, as is common for verification labs, but moved toward inquiry through high expectations for interpretation of results. "Inquiry labs are more of a discovery process," he told us, using another term often used in the literature, "so there's a lot less of giving students what they need to know. You walk into the lab. You know what you're supposed to do. You know the end goals. But, how to get there is not as clear as it should be. I feel like that is a more real-life environment."

To help students develop attention to detail and interpretive skills, Orrick assigned six labs and required his students to write six full lab reports. The first two received heavy comments from Orrick, similar to his faculty supervisors. The third and fourth received peer review, and the final two were, in his words, "one-and-done." Orrick described peer review as "the most important component" of his course. He told us, "It's when they finally learn that what I'm telling them and what they see are the same thing." Though he wanted to introduce it earlier in the semester, Orrick waited until the third report because students "don't know what a good report looks like during the first eight weeks of the course." For Orrick, then, peer review is a classroom practice that allowed students to begin internalizing the feedback he offered in his first two reports.

Several other classroom practices are important to understanding Orrick's lab pedagogy. He required students to draw upon four or five sources from peer-reviewed journals, rather than their textbooks, in introductions. Not only did he feel textbooks were limited because they lacked the peer review of journal articles, but he thought working directly with the chemical literature helped students learn to think like "similar scientists" who referred to others' work and expected to be cited too. For Orrick, learning how practicing chemists made sense of their results through reading was crucial. "Students love to use textbooks for references, which may be a good thing in a lot of fields, but in chemistry, it's not. You have to write an introduction that doesn't rely on the textbook." Even so, we note the arbitrary number of sources is more typical of school than practitioner genres—another way Orrick's guided inquiry approach includes elements of verification.

Finally, Orrick explicitly activated backward- and forward-reaching transfer. In lectures and mentoring situations, he asked students about pre-requisite classes to engage their prior knowledge. He often shared experiences from his own writing life to help students conceptualize future contexts where their learning might prove useful. Forward-reaching transfer was so important to Orrick that when he learned that many of his students were forensic chemistry majors, he began talking with forensic chemists frequently to learn how their writing style differed from his professional experience. In talking about the importance of backward- and forward-reaching transfer, Orrick noted that his students would be practicing chemists in a semester: "I'm putting them in the shoes they are going to be in in six months."

According to Orrick, then, the learning and writing transfer goals for his approach to lab work help students make sense of experiments like practicing chemists who know to "pay attention to the details" and know how to write about them for an audience of chemists. He attempted to activate the prior chemistry knowledge students needed to draw upon to interpret results. Modeling was an extremely important classroom practice for Orrick: he expected the questions he asked students in

the lab, his written comments, suggestions on peer reviews, and the chemical literature to provide useful models. Orrick not only hoped students would write lab reports that would be more recognizable to practicing chemists, but would learn to ask themselves the questions prompted by his classroom practices. In this sense, his approach to labs follows the "guided inquiry" approach (Rezba et al. 1999)—though Orrick did not always recognize the role verification was playing for him and his students.

Dr. Darryl Helf: Verification Leading to Inquiry

Dr. Darryl Helf was a long-time member of the biology department. He and another faculty member had rotated teaching the WID course we studied every other semester for many years. Even so, Helf and his colleague rarely discussed teaching or the curriculum. "Well, we don't really coordinate that much about what we do," he explained. In contrast to Orrick, whose most formative writing experiences as a chemist occurred as an undergraduate, Helf's came as a graduate student. More specifically, he remembered writing for hours in the lab alongside his graduate advisor. Praising this active mentoring, Orrick recalled, "His style with me and others in the lab was to sit with us at the computer and write, unlike most other students' advisors, who would send you away, write some comments, and send you away again." As Orrick explained:

> My advisor really taught me. He'd have me write to start, and then we would go over things together. We'd spend hours together at the computer talking. He'd say stuff like, "This doesn't accomplish quite what we need it to." And then we'd both think about what we could say instead. It was real collaboration in that sense.

This style of mentoring was clearly important to Helf, and like Orrick, he attempted to recreate his prior experiences for his students. "My writing process was to work with my graduate advisor, and I really see a connection between the work in the laboratory and the writing. I think that's true in my WID course also." In fact, Helf described carefully mentoring students when his labs switched from verification to inquiry as his "greatest triumph" as a teacher, and recalled using lab time to talk with students about their writing much as his advisor did. But unlike Orrick, Helf valued the limited scope of approaching lab work as verification:

> Its undisputed strength is that it's very efficient at giving students certain experiences. [Verification] gets a bad rap, but the reason I do it is so they can focus on the phenomenon they are seeing. It shifts the challenges of the lab from inventing ways to use the equipment to learning a biological system they are not familiar with, like frog leg muscle.

For Helf, verification labs reduced the cognitive load for students, helping them better learn animal physiology concepts discussed in pre-lab lectures. In addition, Helf believed these labs taught students how to use equipment, providing a foundation for designing their own experiments. But Helf also recognized the potential of inquiry labs. Explaining their importance, he said they "replicate the process that we actually use in an experiment we are going to publish. They are more genuine, really mapping to what we do for real." Helf thus designed his WID course around ten lab sessions, a series of eight verification labs followed by a two-part inquiry lab. Since his focus on physiology invited students to perform simple, non-invasive experiments on their own bodies, the cost of materials was not the challenge it was for Orrick, so students designed and carried out their own experiments. That is, unlike Orrick, who structured his inquiry labs so students focused on interpreting results, Helf asked students to prioritize planning and facilitating their own experiments in response to research questions they developed.

Helf's approach to writing was very different than Orrick's. After each of the first four lab sessions, students turned in data tables and charts, but did not write full lab reports. Before the fifth lab session, Helf asked for a full lab report covering sessions one through four. This pattern continued, with students submitting data tables and charts after lab sessions five through eight, then concluding with a full lab report for the final two-part inquiry lab. Like Orrick, Helf attempted to move students away from referencing their textbooks, requiring citation of one peer-reviewed article in their inquiry lab report, and for similar reasons: "They've read mostly textbooks. They haven't read much in the way of primary research articles, which is the model for how I want them to write." Even though Helf targeted linking "what [students] did to the larger world," elements of school genres emerge again here, and as we will see below, in our participants' perceptions of Helf's assignments. But in contrast to Orrick, Helf seldom sought to activate backward- or forward-reaching transfer. When asked how he engaged prior writing knowledge, he answered, "I never thought about it. And, I'd have to think about what I would do with the information." Helf's department culture is influential here: recall that he and his colleague seldom coordinate curriculum. But his own experiences also shape this behavior. Whereas Orrick believed his students could become practicing scientists through their undergraduate work, Helf thought they needed the extensive engagement with scientific content graduate school provided in order to develop expertise that would allow them to grow into scientists.

In terms of his learning and writing transfer goals, then, Helf's course provided "an experience that is a good and appropriate experience for preparing them" to develop their scientific identities as graduate students. This explained why he transitioned to an inquiry lab near the end of his course. When asked what challenged students the most in his course, Helf highlighted their difficulty distinguishing between hypotheses and predictions—a key element, for him, in developing a scientific identity. To scaffold this learning, Helf's verification labs helped students "reengineer" their hypotheses and predictions. In the ninth lab, Helf mentored students as they practiced crafting their own hypotheses, predictions, and methods—again, for Helf, critical for scientific sense-making—and in the tenth and final lab, students carried out their own experiments, then described this important work in writing. Mentoring, rather than modeling, emerges as a key practice for Helf, and his lab work moves across Rezba, Auldridge, & Rhea's (1999) spectrum, from verification to structured or perhaps guided inquiry.

Student Dispositions and Orrick's Inquiry Labs

We now turn to the students who worked with Orrick and Helf. For forensic chemistry major Elbow and then biology major Alison, we describe their engagement with the lab pedagogies their teachers developed, considering their histories as writers, then narrate their transitions into disciplinary writing.

In our first interview, Elbow's first-generation status and upbringing emerged quickly, as he described the sacrifices his parents, especially his father, made for his benefit:

> My parents said I'm going to college whether I like it or not. My dad, who is a cabinet maker, is wasting away. He is so tired. His body hurts, his knees. . . he has to get this surgery. And he is on this medication. He is always like, "Go to college. Do whatever you want to do. Make it something so that one day you can work as hard as I do, but with your mind."

Due in part to this pressure to succeed, Elbow was a highly driven student, a valedictorian of his community college who enjoyed schoolwork and took quiet pride in earning good grades—typical of generative value expectancy and self-regulation. The writing portfolio we built for him showed

high marks across a wide range of community college courses—anthropology, biology, criminal justice, English, philosophy, psychology, speech, and theater—reflecting a generative attitude about value for not only science classes but education in general. Though we saw little evidence of lab report writing for Elbow in community college, he had written lab reports in a chemistry class his junior year, and for Helf, too, since zoology was required for forensic chemistry majors. Elbow was also writing reports in another chemistry class that he was taking concurrently with Orrick's. Elbow perceived a stark contrast between the lab reports he wrote for these other classes and those assigned by Orrick: "A huge difference. I can't stress that enough. Those other lab reports I wrote in fifteen minutes. Totally different." Our comparisons of these lab reports confirmed Elbow's account: though they shared an IMRAD structure with sections separated by headings, the lab reports from these two other classes were significantly shorter and less complex. For example, the lab report for an experiment designed to determine the visible absorption spectrum of various dyes was three pages, with no section longer than four sentences. After a one-sentence purpose statement, the report offered a short paragraph that summarized relevant theories and offered a prediction, followed by three sentences describing procedures for the experiment. Results were presented in a table followed by a section in which Elbow demonstrated how he calculated the results. The report concluded with a short, three-sentence discussion, ending with the following conclusion: "Our experiment was expected to produce a difference between the calculated wavelength and the observed wavelength. This is what we observed. Based on this fact, we would call our experiment a success." The report did not include citations, though the course textbook was included as the single reference. Other reports were similar, with minimal complexity and none of the features of practitioner genres Orrick valued: indeed, many were shorter than the corresponding procedures provided by Elbow's instructors.

Having become adept at these short lab reports, Elbow found Orrick's lab reports difficult. The introduction and discussion sections were particularly challenging, since they required him to turn to chemical literature to both contextualize his experiments and determine the meaning of results. Indeed, Elbow's first two reports received failing grades. For example, his first lab report, fourteen pages, received 8/30. Through revision, he improved to 19.5/30, but even still struggled to make the rhetorical moves Orrick expected of inquiry. In his terminal comment, Orrick wrote, "No websites!", suggesting that Elbow did not yet understand how Orrick valued engagement with scientific journals. In a marginal comment, Orrick questioned Elbow's results and discussion, asking, "Are [these phenomena] the same? I don't think so. Expand your scope value," suggestive of Elbow's difficulties with interpretation of results.

Despite these early setbacks, Elbow adapted quickly, earning 34.5/40 on his third lab report. Orrick's comments began to focus less on citations and results but on developing a more scientific tone. The value Elbow placed on the course and the ways Orrick's classroom practices capitalized on this generative disposition certainly helped Elbow persist. For example, he valued Orrick's attempts to engage forward-reaching transfer, especially when Orrick discussed his own experiences in the lab with students and shared his own writing with them. For Elbow, this engagement with future contexts offered considerable value, and was "definitely useful, because I'm going to be a scientist one day. I want to start learning to write like one so I don't get embarrassed." Indeed, such language mirrored Orrick's goal of "writing papers that people aren't going to laugh at" and appealed to Elbow's generative self-efficacy.

But generative expectations for value alone aren't enough to explain how Elbow moved beyond these initial setbacks and learned to adapt his prior knowledge. Other dispositions must also be considered. Elbow's habits suggest a generative self-regulation. Elbow met with Orrick often, after class and during office hours, and also sought help from teaching assistants, asking, "What style does [Orrick] like? How should I structure [my report]?" Elbow also "turned to journal articles" to

learn the rhetoric and genre knowledge needed to write Orrick's lab reports—recognizing what the instructor valued. These behaviors were supported by Elbow's highly generative attribution. Both Orrick and Elbow described other students who blamed Orrick when they experienced setbacks in his course. For example, Orrick recalled one student who came to his office hours exclaiming, "How can I get a zero? I turned something in!" But rather than see Orrick as the problem, Elbow carefully considered his feedback. Recalling that first failing grade, he revealed, "Now, if I get an 8 out of 40, I deserve it. . . Some students say, 'Oh man, this sucks,' but I really like it when a person tells me, 'You are doing this wrong.'" Elbow described the benefits of feedback from both Orrick and his peers, and even though he had to rethink his writing processes as a result of Orrick's inquiry approach, he never suggested others were to blame for the difficulty he experienced.

Thanks in part to his generative self-efficacy, Elbow came to identify himself as both a technician able to get things done in the lab and a scientist who could engage in professional conversations with others. Reflecting on his writing process in Orrick's course, Elbow said, "As I start working through research articles, taking notes, and searching for more to figure out what results mean, I feel like an actual scientist." In our first interview of the semester immediately following Orrick's course, Elbow described a broad change: "The way I write from now on in chemistry is definitely influenced by Orrick. That is the one course that without a doubt changed everything." The combination of Orrick's inquiry labs and Elbow's dispositions created a transformative experience for him, a "game-changer" as he described it. But why didn't Helf's course, which Elbow took before Orrick's, provoke a transformative experience? On the one hand, his experience is connected to course content. "I never saw myself as a zoologist just because I never wanted to do that," Elbow shared. In contrast, the content of Orrick's course was more closely connected to his desire to be a forensic chemist. Elbow had chosen to narrow his specialization to forensic chemistry because he perceived such an emphasis would allow him to help people: "For me, chemistry research just didn't seem like enough. I took a class in forensics, in high school, and I thought that would be really cool. You would be able to help out people." But in Helf's course, Elbow didn't see a shift in his identity:

> When I wrote lab reports for Helf, I wrote them as a student writing a lab report. I'm just presenting the ideas the way the teacher wants them presented. Don't get me wrong, I did my best on it and did I what I needed to do to present the ideas. I just didn't see myself being anything different.

On the other hand, Elbow's experience was also connected to his perception of Helf's labs, which emerged in a discourse-based interview when we discussed the lab reports he wrote prior to Orrick's course: "Yeah, I remember that one. I thought that experiment was the biggest waste of time. Density is one of the first things you learn when you go into a general science class." Here Elbow rejected the ways verification labs reinforce concepts taught in textbooks or lectures. And despite the transition to a more inquiry approach, Helf's lab reports didn't seem as scientific to Elbow, who called them "composition reports with a biology twist," evoking writing as general skill rather than discipline specific writing. Orrick's guided inquiry approach and his direct appeals to the development of scientific identity, cued by Elbow's generative dispositions, appealed more than Helf's attempt to build up to inquiry over time.

Student Dispositions and Helf's Transition to Inquiry Labs

Alison was a zoology major and nutrition minor, entering our study as a junior. In contrast to Elbow, she was a continuing-generation student: her mother, a registered nurse of twenty-seven

years, graduated with an associates degree in science. When we first met Alison, her sense of purpose for her major and minor seemed to be mixed:

> I really like animals. That's why I chose the zoology major. I'm not sure what I will do with it, maybe work in a zoo or something. And the nutrition minor, I feel like that could sort of be helpful if I do work in a zoo taking care of animals.

We quote at length here to show Alison's characteristic expressions of lack of confidence and indecision—hedging and qualifications which understated her preparation and achievement. By the time she started at Western, Alison already had an extensive background in science, selecting courses in high school and her community college to provide her a foundation for work in zoology. For example, while most students in her high school took chemistry, Alison chose to take botany and zoology. She also sought relevant experiences outside the classroom, taking a job caring for the animals in the biology department at her community college, for example. Even so, Alison's writing experience was dominated by school genres: in the nutrition course from her community college, she wrote reflections on her diet, an interview essay about her mother's nutrition, and an essay examining the nutrition risks of her father. A few of her high school science courses required her to write lab reports, and Alison's portfolio included a lab report from a cell biology class she took the semester before joining our study. Interviews revealed how incredibly prescribed these experiences were. For example, the lab report for cell biology was based on a worksheet she filled out as she followed a procedure provided for the experiment. Like Elbow, Alison's prior writing experiences seldom challenged her, and her shaky self-efficacy and self-regulation were seldom highlighted by the demands of these courses.

Alison entered Helf's zoology WID course expecting it to be valuable, believing that her experiences in the course would be valuable to her work with animals and that her prior knowledge of lab reports would enable success. Unlike her experiences in composition, which Alison alternately described as "dreadful" or tolerable because of the large amount of writing and engagement with uncomfortable subject matter, Alison was able to see lab work as "fun" and "interesting." However, as suggested earlier, Alison's disruptive self-efficacy would overpower her high expectations of value. Throughout our interviews, Alison repeatedly voiced little confidence in her capabilities as a writer. For example, about her first full lab report for Helf, she explained, "I wasn't expecting to do well. I did alright." The middle of the road "alright" here was one of many hedged or weakly positive responses Alison provided when asked about her performance: unfortunately, despite being an honor student, she didn't have much confidence. This negative perception of her writing capabilities seemed to emerge from bad experiences with her community college composition instructor—who she had for two semesters in a row, due to schedule constraints, despite her discomfort with his demeanor and pedagogy. The politically charged nature of the class coupled with writing to give the instructor "what he wanted" seemed the genesis of her dislike of writing and negative view of her own writing abilities. For an early paper, she was able to negotiate a topic that connected to animals: factory farming, but avoided writing until the last minute, and submitted less than two pages when six were required. In her writing process evaluation, she admitted, "I didn't get much of the paper written, but I thought it would be better if I came to class with what I had than to not come to class at all." In a discourse-based interview, Alison could not articulate why she included quotes from Upton Sinclair's *The Jungle* other than as "fluff" to fill page length. Unfortunately for Alison, these bad experiences led to trying to avoid writing, and this pattern of procrastination and uncertainty persisted, even for writing assignments in her major.

For Alison, disruptive self-efficacy came to a head in the concluding inquiry lab in Helf's course. Students worked in pairs to craft their hypotheses, predictions, and data collection methods in lab nine, carried them out in lab ten, then wrote individual reports. Knowing that Helf saw this

collaborative moment as crucial for developing scientific identity, we asked Alison how she collaborated with her lab partner. Alison responded that though she came to lab nine with her own idea, it "wasn't very good" since she "came up with it really quickly." On the other hand, she sensed problems with her partner's research design, based on Helf's comments on the previous report she had written, which directed her to consider the larger scientific context. Even so, Alison agreed to drop her idea and use her partner's procedure. Why? Likely because he was "a graduate student in neurobiology"—the lab course included juniors, seniors, and graduate students, like many upper-level courses at Western—and "so he can come up with something, that's fine."

Unfortunately, Alison's intuition was correct, and the poor experiment design made writing difficult. Alison seemed to understand what the different sections of her report needed to do. "[Helf] wants us to be able to tell him about why it's important and what it could be used for," Alison told us, explaining the goals for the introduction and discussion section, "but with this lab, I don't know because [the experiment] really wasn't that important at all." Why not? It was this issue of larger context. Their experiment was "pretty basic. It's how your heart rate and breathing rate will decrease after exercise. That's obviously pretty well known. More specifically, it was pretty much heart rate decreases at a constant rate. I don't really know what you could use that information for." By agreeing to move forward with her lab partner's idea for the experiment, Alison ended up with an experiment difficult to connect to significant scientific context, one that is closer to verification than inquiry.

Alison scored high marks for her presentation of methods, data presentation, accuracy of results, and mechanical competence. But her difficulty connecting the experiment to a larger context can be seen in Helf's marginal comments. Alison's introduction began with their prediction: "After five minutes of exercise, our prediction was that breathing rate and heart rate would return to their normal rates at the same time after three minutes of resting followed by exercise." She then summarized the results of the experiment. In the margins, Helf wrote, "Nicely written summary of results, but you need to tell the hypothesis that leads to your prediction and explain the big-picture significance." In the first paragraph of the discussion section, Helf commented, "This will be more meaningful if you have a hypothesis for the three-minute prediction." She also scored low in this section, where she needed to state the significance of the physiological phenomena, raise questions about the hypothesis, and propose further experiments. Each of these evaluation criteria are related to the scientific identity Helf wanted his transition from verification to inquiry lab to produce, but without a sound experiment design, Alison's attempts were limited. That continued into her conclusion, where she summarized an article from the *Nephrology Nursing Journal*. Here, Helf remarked, "How does this relate to your experiment? It indicates a link between breathing (depth, not rate) and heart rate. Try to relate it more to your work."

Helf's approach helped Alison master content, successfully conduct simple experiments, and report the results effectively—which are broadly considered strengths of verification labs. But in this inquiry lab, when Alison attempted to transfer writing knowledge between Helf's first and second lab report, disruptive self-efficacy discouraged her from participating in the development of experiment design. As a result, her experiment was better suited to verifying her content knowledge, not exploring their implications, making it difficult for her to make the more scientific moves required in Helf's final lab report. Though Alison entered the course with high expectations of value, Helf's approach to lab work never affected Alison's sense of identity: "To me, [lab reports] are just a required part of the class. I guess we're sort of learning to be scientists, but I don't feel like we actually are yet."

Considering More Dispositions, and More Complex Methods for Measuring Their Impact

These case studies raise theoretical and methodological questions that we believe can help shape future research on dispositions and writing transfer. As noted above, we made a conscious choice to analyze data using expectancy-value, attribution, self-regulation, and self-efficacy (Driscoll & Wells, 2012). However, we could have turned to other transfer research, including answer-getting and problem-solving dispositions (Wardle, 2012) or ease and ownership (Baird & Dilger, 2017). Or we could look to other research in writing studies, such as the NCTE/CWPA/NWP Framework for Postsecondary Writing (2011), or sources in educational psychology (e.g. Ambrose, Bridges, DiPietro, Lovett, & Norman, 2011). Which dispositions should we be thinking about? How can transfer research be designed to test the value of adding to this growing list of dispositions relevant for writing? How should we ensure student perceptions of writing instruction influence this conversation, as Bromley et al. (2016) suggest? While we are satisfied with the framework we're using here, more research is needed to systematically investigate other possibilities.

Like Driscoll et al. (2017), we advocate for precise definition of dispositions, but we believe precision will come as we carefully add to the list of dispositions commonly engaged in research, offering the field a more nuanced understanding of how individual factors impact writing transfer. For example, in representing Elbow's experiences, we had to consider whether self-regulation, problem-solving, or ease, three closely related dispositions, enabled him to move beyond initial setbacks. Are these three separate dispositions, or are they related to or subsets of each other? We had similar challenges with Alison. Was it her lack of confidence in her capabilities as a writer (self-efficacy) or investment in the project (ownership) that hindered engagement in Orrick's inquiry lab? Cataloguing such subtle differences through case study research will invite us to ask these questions, helping us to tease out more precise definitions and developing approaches to understanding both how dispositions related to each other and how they are different. This research can educate the larger-scale research designs which we agree are necessary to help transfer research most effectively and productively shape classroom practices.

More importantly, these case studies invite us to consider more complex frameworks that move beyond the generative/disruptive binaries commonly seen in dispositional thinking (Bronfenbrenner & Morris, 2006). In our research, expectancy-value is a powerful disposition shaping transfer, here and elsewhere, but as we've argued, other dispositions interact in complex ways. In Elbow's case, generative expectancy-value is aided by both attribution and self-regulation, enabling him to persist through setbacks. In contrast, disruptive self-efficacy interacted with Alison's generative expectations of value to hinder engagement. Elbow's experience suggests that an either/or generative/disruptive binary is insufficient. He had generative expectancy-value in both Orrick and Helf's contexts; however, he experienced different degrees of intensity or magnitude depending on classroom environments. A framework which considered how different environments led to strongly or weakly generative or disruptive dispositions would add complexity which could help better consider how those individuals and contextual influences are related—that is, how writers motivate prior knowledge across contexts, what intrinsic qualities hinder, support, or variably impact their ability to do so, and the classroom practices, curricular elements, and culture forces that make successful writing transfer possible.

A Larger Role for Dispositions in Pedagogical Thinking

We conclude by considering what our case studies might mean for writing faculty in the disciplines and WID specialists. First, faculty need to carefully consider how they talk about pedagogy and

genre to students. Orrick did very admirable work, in a resource-poor environment, to learn from practicing chemists and pass that knowledge on to his students—even moving outside of his research specialization. Even so, drawing on Rezba et al.'s (2009) framework, we note that Orrick considered his labs to be "open" inquiry with lab reports reflecting how practicing chemists write. However, it might be more precise to define his lab procedures as "structured" or "guided" inquiry, as they included elements of verification labs, namely instructor prescribed questions and procedures. Similarly, Orrick's lab reports grew in complexity and length, but elements of school genres remained, such as minimum numbers of sources. Elbow's experience suggests Orrick had designed a course which could help students achieve his goal of forward-reaching transfer. However, we're unsure he accurately represented the differences between the laboratory work his students performed, the ways they wrote about it, and the practices he held up as models—which could have problematic results if students acted upon the belief their experiences mirrored practitioner work.

In Helf's course, both Elbow and Alison perceived verification labs as school genres. Elbow suggested that such labs and their reports were "the biggest waste of time." Alison's difficulty trying to quickly "come up with something" when trying to design an experiment spoke to the ways Helf's inquiry lab lacked the reality of real experiments. Verification labs did indeed offer her familiarity with science concepts, methods, and lab equipment, but they didn't provide her with enough ability to consider the scientific context of a research area in order to design an open-ended experiment. In other words, at least for Alison and her graduate student partner, Helf's move from confirmation to open inquiry was too sudden. Notably, neither Orrick nor Helf acknowledged the nuanced nature of laboratory pedagogy, conceptualizing labs as either verification or inquiry (and using the marked terms "cookbook" and "authentic" labs). Neither had opportunities to talk through their pedagogical choices with other faculty in their department. These case studies suggest specific ways WAC or WID faculty development could encourage transfer in science laboratories: introducing relevant literature, helping faculty become aware of the ways they perceive and talk about pedagogy and genre, offering models for being explicit about pedagogical goals, and helping faculty communicate what should and should not be carried forward into future contexts to their students.

Second, in these cases, classroom practices can fall short of their goals in the face of strong dispositions, suggesting faculty would benefit from considering how dispositions motivate engagement. In interviews, both Orrick and Helf described designing labs in the hopes of helping students enjoy their learning. For example, Orrick taught certain labs because students find it exciting when certain chemicals change color, and Helf assigned a lab requiring students to perform experiments on turtle hearts because it's "quite dramatic" for students to observe that the heart generates its own contraction outside the body. But the wonder of science created value for only a few of our participants, and arguably, only Elbow experienced the growth in scientific identity that both Orrick and Helf expected. These students might have responded more enthusiastically if connections between this wonderment and the development of a scientific identity had been modeled or discussed. That is, we believe a clearer understanding of the ways dispositions shape motivation—especially for the shifts in identity often necessary for the takeup of disciplinary writing—could have helped these instructors shape their lessons for engagement more effectively.

Furthermore, both faculty made negative assumptions about students who exhibited disruptive attitudes about the value of their courses. Helf told us he found such students "pretty casual" about the value of learning overall. However, without exception, our participants were anything but casual when it came to the science they valued: participating in undergraduate research, carefully planning for their futures, and taking their coursework very seriously. We think that if Helf and Orrick had been better prepared to more carefully consider why students were "pretty casual" about their particular courses, they might have been better able to refine their approaches to lab

pedagogy. We also note that neither professor had a language to carefully break down the attitudes of their students. If they did consider dispositions at all, these faculty focused primarily on value, rather than attribution, self-regulation, or self-efficacy. Not only would faculty benefit from more complex ways to discuss what's meaningful for students with colleagues and students too, Alison's experience suggests that faculty would also benefit from considering how other dispositions interact with expectations of value. Writing program stakeholders could help faculty become conscious of dispositions by sharing those we have identified and explaining what we have learned about the relationship between dispositions and writing transfer. More importantly, writing transfer researchers could develop models that represent how dispositions can interact with each other in complex ways. Research in collaboration with these faculty in the disciplines could help refine these models and continue the process of learning more about the important roles dispositions play in writing transfer.

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Contact Information

Neil Baird
Associate Professor of English
Bowling Green State University
Email: neilb@bgsu.edu

Bradley Dilger
Associate Professor of English
Purdue University
Email: dilger@purdue.edu

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