

Sustainable Writing Support in a Second Year Pharmacy Course

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Abstract: In this article, we describe a multi-year writing intervention in a high-enrollment professional pharmacy course, implemented by a multidisciplinary team of pharmacy and writing instructors. Built around one capstone writing assignment, the “drug information question” paper, the intervention was designed to specifically improve students’ writing and health science reasoning skills and their overall scores in the course, since historically students scored low on this assignment. We provide a background of our pharmacy program and an overview of writing in pharmacy, describe the history of the intervention and collaboration between pharmacy and writing faculty, and explain the design and principles of the intervention, the results, and the implications of the study for STEM writing pedagogy. Over the course of four years, starting with a peer-review model, we have gradually added lectures, workshops, and optional and mandatory Writing Center sessions in an effort to improve students’ learning and health science reasoning skills. Over the same period of time, student scores on their written capstone in the course improved significantly, and survey results indicated that the students viewed the peer review process and the writing program interventions favorably.

Introduction

Stop us if you’ve heard this one: “Our students can’t write!” or, “What are you teaching them, exactly, in first year composition? They can’t write a decent paragraph by the time they’re in my fourth year [science] course.” As refrains of this theme have remained a stubborn staple of academic lament (see Zaretsky, 2019), writing faculty, especially at smaller, more traditional institutions, often have the quasi-Sisyphean task of persuading faculty across the campus that there are better approaches than reliance on first-year writing courses for getting students to be confident and competent writers in the disciplines. In pharmacy in particular, which follows a rigorous professional curriculum, writing across the curriculum (WAC) movements have lagged somewhat behind (Lerner, 2001), and writing instruction innovations have proved more difficult to implement. However, the transformative potential of such interventions is great enough to warrant the effort and unavoidable risks, and, we argue, to engender larger institutional changes. In this article, we discuss a longitudinal writing intervention in an upper-level pharmacy course that evolved over the years as we gradually adapted the course to our students’ needs. The intervention, in addition to helping improve student writing scores, also helped advance the campus conversation about WAC.

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Institutional Background

University of the Sciences is home to the Philadelphia College of Pharmacy (PCP), America's oldest college of pharmacy (established 1821). For many students at our institution, the Doctor of Pharmacy program consists of two years of general education coursework and four years of a professional pharmacy curriculum. The comparatively small size of the school and lack of undergraduate or graduate majors in writing-adjacent fields also translates into a limited pool of writing resources. Our own Writing Program, which functions as an independent academic unit, has a staff of three full time people and a handful of adjuncts, while the Writing Center (WC) is staffed primarily by undergraduates (see Everett, 2016; Pettipiece & Everett, 2013, for the history of this program's hard-earned independence).

The history of formal instruction in writing at the institution goes back to at least 1946, when course catalogs reported two semesters of writing entitled "Grammar and Composition." By 1974 the second course was changed to "Introduction to Literature," which remained in place until 2009. A WC was mentioned for the first time in the 1984 course catalog. Concerned with the quality of student writing, the institution implemented a "writing proficiency examination" in 1985, which required students to compose what amounted to a five-paragraph argument during a two-hour timed test. By the early 2000s, the failure rate on this exam, taken during the spring semester of the second year, was approaching 30%, causing serious impediments to graduation. This led to the WC being devoted almost exclusively to helping students pass this exam.

In 2007 the university sought to address this problem by hiring its first Director of the Writing Program and, by 2009, the Writing Program had become an independent academic unit. By 2009, the writing proficiency examination was eliminated, and within the next few years, a new first-year writing sequence was put in place. In addition, new courses in professional writing were created to serve various majors across campus, including courses in scientific and professional writing.

While progress was made in writing instruction, science faculty complaints about the students' ability to write in their courses persisted. In general, courses in the disciplines usually lacked the time for more sustained interventions. The process for attempting to create a WAC program, ongoing since roughly 2010, has been fraught by administrative obstacles related to the compact nature of the curriculum of a science and healthcare-focused institution. The Writing Program was asked to provide data as proof that such a program would be beneficial to our students and justify a potential budget. Fortunately, that was also the time when Pharmacy called. They wanted to work with the writing faculty in building a writing intervention that could help their students, and the writing faculty realized that this intervention could provide the data that would be required to justify the creation of a WAC program.

Overview of Writing in Pharmacy

As Palmquist et al. (2020) noted in their recent comprehensive review of the WAC movement, efforts to establish writing across the discipline programs have multiple nodes of emergence rather than a central origin story, though most acknowledge Barbara Walvoord's pioneering role in the movement through her creation of a WAC workshop at Central College in Iowa in 1969-1970. Since that time, scholarship in WAC/WID has grown and coalesced into a disciplinary subfield of Writing Studies, describing practices, theoretical models, and interventions in diverse fields spanning the entirety of modern academe, and WAC has become "a force for change" both within and outside Writing Studies (Palmquist et al, 2020, p. 33). We wanted our work with Pharmacy to be grounded in WAC theory and research, but we also needed more specific guidelines that captured the nature of the discipline of pharmacy. However, we discovered that very little scholarship on writing in pharmacy appeared prior to the early 1980s, when WAC programs finally began to creep into science curricula. Some of the earliest pedagogical articles addressing writing in the sciences from the 1970s and 1980s, in fact, largely ignored the WAC trends. Two articles from faculty serving pharmacy programs during this early period illustrate a determination to keep the focus on the

humanities in place. In “Teaching Freshman Composition at a Science College: The Problem of ‘pharmaceutical-English,’” Laurie Kirszner (1978), an English professor at the Philadelphia College of Pharmacy, rejected the notion of teaching in the disciplines at all by claiming that students were more engaged by the teaching of literature. Similarly, David Fedo of the Massachusetts College of Pharmacy argued in 1979 that “English courses should stand alone, as the legitimate offerings of a recognizable academic discipline; to violate their integrity with forced applications would be of no benefit to anyone” (p. 7); he also admitted that literature courses could serve “to analyze selected problems in science, technology, and medical ethics” (p. 8). This reticence toward interdisciplinary writing may have been less an artifact of the general movement within English than a result of the isolation of the teaching of writing within an institution where educating pharmacists was a primary focus.

Conversely, the appearance of instruction focused on writing within pedagogical journals serving the fields of biology, chemistry, and pharmacy began to illustrate interest in improving writing outcomes for students in these disciplines. Early examples were premised on the old “Johnny can’t write” complaint, where Johnny was a student in a science course (Agutter, 1979). An early attempt to use writing to assess not only students’ understanding of chemistry but their attitudes toward the course was employed by Strauss and Fulweiler (1987), who encouraged students in a chemistry course to voluntarily drop notes in a comment box at the end of each class describing the main concepts they learned in the class and how they felt about the course; analysis of those comments showed that the students often wrote self-clarifying comments, which ultimately helped them learn the course material.

In the early 1990s, some writing researchers focused on writing to learn in the sciences, pointing out the value of assigning complex writing tasks to help students understand the course material as well as their own identities as learners and scientists (Beall & Trimbur, 1993). Others emphasized how having students write about science concepts (a “journal approach”) and peer review in chemistry courses increased student learning (Viola, McGuinness, & Donovan, 1993) and led to better student performance, increased communication, higher student satisfaction, as well as faculty improvement (Cooper, 1993). Studies of writing in pharmacy are, however, rarer, beyond calls to address it more systematically. For example, Hobson (1998) argued that pharmacy faculty should resist the impulse to discount writing in large classes (i.e., over eighty students) and instead, give writing instructions the attention it deserves, starting with well-constructed and well-assessed written assignments, and reinforcing classroom writing practices such as peer review.

The role of writing instruction in helping future pharmacists navigate their responsibilities has been, however, addressed occasionally in pharmacy education journals. To some extent, such studies describe attempts to integrate WAC elements into pharmacy courses. For example, Smith, McGhan, and Miller (1989) focused on pharmacy students’ reading comprehension of professional literature through a pretest and posttest, reporting modest improvement in students’ ability to assess such literature at the end of the module. Similarly, Holiday-Goodman et al. (1994) set out to determine if students performed better in classes where critical reading and writing assignments were introduced by drawing resources from *Writing Across the Curriculum for Colleges of Pharmacy: A Sourcebook* (Holiday-Goodman & Lively, 1992). Posttests revealed students in the class that included interaction with a tutor, journaling, and written assignments reported perceived improvement in only two of eleven writing-focused questions: “thinking my ideas through before writing” and “deciding who is my audience” (Holiday-Goodman et al., 1994, p. 260). Though the researchers did not see the research results they had hoped for, they did believe that the use of tutors in the pharmacy class was helpful (Holiday-Goodman et al., 1994, p. 261).

The success of such writing interventions depended in part on the attitudes about writing of the pharmacy professorate; for example, in a 1996 study by Purkerson et al., the faculty defined the pharmacists’ writing on the job as of “extemporaneous nature,” which in effect meant that classroom practices did not build in the time required to truly develop students’ writing skills. However, not all pharmacy educators shared this view of the role of writing in a pharmacist’s practice. Late 1990s and early 2000s studies by pharmacy

educators show the benefits of writing instruction in content retention and in developing professional skills. A study by Ranelli and Nelson (1998) assessed “the writing perceptions and practices of pharmacy students” (p. 426), concluding that a writing intensive course boosted students’ writing confidence and writing scores. They recommended that the pharmacy curriculum include effective professional writing assignments “for the dual purpose of learning material and practicing the writing skills that students will need in the workplace,” which should be assessed following best practices developed by writing researchers (such as those recommended by John Bean in the now-classic *Engaging Ideas*). Noticing that “self-confidence in writing appears to be correlated with writing ability” (p. 432), the authors also recommend a more longitudinal approach to research about how such confidence can be built in pharmacy students over time by incorporating writing in both undergraduate and professional pharmacy courses.

A correlate of writing self-confidence is students’ comfort level in their skills as peer reviewers. Various studies conducted in pharmacy courses have shown that students agree that peer review is an essential skill in their profession (Wu, Davison, & Sheehan, 2012), and that they “consider[ed] peer- and self-evaluations useful in assessing students’ work in group projects, oral presentations, and professional skills” (Wagner, Suh, & Cruz, 2011, p. 1). Students similarly found peer mentoring to be valuable for their learning and writing process (Rodis et al., 2014), and, additionally, writing workshops and peer grading were linked to overall improvement in course performance (Davis, 2014).

It is possible that this gradual shift toward reconsidering the role of writing in pharmacy has been due to the changing standards of the profession. The Accreditation Council for Pharmacy Education (ACPE) had already expressed in 1989 its intent that all Bachelor of Pharmacy programs transition to a Doctorate in Pharmacy (PharmD) (at the time, only 14% of pharmacy schools offered PharmDs, 56% bachelor’s degrees, and 30% offered both) (Supapaan et al., 2019). In 1997, ACPE required that all pharmacy schools have a plan in place for the transition to a PharmD degree by 2000 (Supapaan et al., 2019). This change brought about an expansion of the curriculum to include additional coursework in pharmacotherapy, counselling patients, and consulting with healthcare teams on pharmacological interventions. Modern pharmacy curricula (including the PharmD program at the University of the Sciences) emphasize the role of the pharmacist as a clinical contributor to the overall patient healthcare team. Pharmacists specialize in clinical drug use and interactions, and need to be able to absorb and synthesize complex and up-to-date information in order to fulfill their clinical team roles. Essentially, pharmacists need to communicate with two types of audiences: (a) other healthcare providers, which requires a straightforward, evidence-based, unambiguous, and succinct style; and (b) patients or caregivers, which requires a more motivational and humanistic language for conveying to a lay audience for conveying the same information that might be given to clinicians. Understanding these roles is crucial to current attempts to integrate writing in the pharmacy curriculum.

Despite some reluctance from pharmacy instructors to incorporate writing in large pharmacy courses due to lack of time, class size, curricular constraints, lack of training, and/or lack of support in how to effectively develop and assess writing assignments, writing has an important place and role in the pharmacy curriculum. While each institution has its own constraints and opportunities and develops its own unique approach to writing in pharmacy, various studies have shown the benefit of writing instruction and peer review to all pharmacy students in terms of comprehension and retention of subject matter, class performance, writing self-confidence, and writing ability. Time and resources (for feedback, writing workshops, and sound assessment) are crucial to the development of good writing skills, albeit in short supply. Because many studies have promoted the benefits of peer review with writing assignments in similar pharmacy courses, and because our school resources were limited in terms of writing instructor pools, we decided to ground our intervention in peer review and augment it gradually with other writing interventions to improve student writing ability and performance in a professional pharmacy course.

Description of the Writing Intervention

Background of the Course and Assignment

PP460, “Research Design and Drug Information” (RDDI), is a pharmacy course for students in the second year of their professional curriculum. Its aim is “to prepare doctor of pharmacy candidates to critically evaluate clinical and scientific information related to the therapeutic use of medications and prepare the student for the practice of pharmacy” (USciences Course Catalog). Emphasis is placed on learning the health science reasoning¹ skills students will need for lifelong learning, and especially on assessing appropriate uses for new or old drugs in light of new clinical research. RDDI, the first in a series of three medical literature evaluation courses, is “flipped,” meaning that short, focused lectures are posted online with knowledge and skills being reinforced in live class periods through quizzes, discussions, and various activities. Classes are sizeable, ranging between 144-195 students, depending on the semester’s enrollment, with a composition of roughly 45% males and 55% females over the course of our study (2015-2018), which is slightly different than the national average for pharmacy students in 2018-2019 (36.7% male, 63.3% female, as reported by Taylor, Nguyen, & Lopez, 2020). Racially, about 40-42% of the students identify as White and roughly 38-42% as Asian, compared to the national 2018-2019 average of 37% White and 28.6% Asian (Taylor, Nguyen & Lopez, 2020).

RDDI’s capstone (worth 15% of the grade) is a “Drug Information Question” paper, which, while not long (1 single-spaced page of text, or roughly 500 words, plus a separate page of references), is a culmination of a semester-long process where students demonstrate the ability to evaluate medical literature and synthesize an evidence-based recommendation for drug therapy that must address both efficacy and safety. The paper is conceived as an answer to a question about an off-label use of a drug. This type of writing would be geared toward a prescriber (e.g., physician), and needs to be concise to facilitate the efficient care of patients, hence the short length of the paper. The course instructors assign new questions each semester, for example:

- Should acetaminophen be given for prophylaxis of fever in infants receiving vaccines?
- Should domperidone be given to increase the production of breast milk in new mothers?
- Should vitamin D supplementation be given to reduce the rate of COPD exacerbations?

Students work on this assignment in five stages (each graded separately) throughout the semester: (a) background and references, (b) literature selection, (c) complete draft, (d) student reflection, and (e) final paper (see Appendix A for the assignment sheet). The assignment steps parallel skills taught in the course. For example, the background requires the student to utilize tertiary references and materials all pharmacists need to be familiar with.

This assignment is a good illustration of the three main constructs for effective writing assignments highlighted in Anderson et al’s (2016) large-scale study of WAC/WID practices: (a) interactive writing processes (which may include peer review and writing workshops); (b) meaning-making writing tasks, which “occur when students engage in some form of integrative, critical, or original thinking” (p. 5); and (c) clear writing expectations (as demonstrated by the assignment description and rubrics) (see Appendices A and B). The written format gives students an opportunity to demonstrate their clinical judgment skills addressing a professional audience. In effect, the paper makes a clinical argument based on scientific evidence, the type of argument that clinicians and pharmacists in particular will have to make within their practice and as part of clinical care teams. Such an argument requires research, labor that cannot be otherwise controlled via multiple choice quizzes, and health sciences reasoning skills—an offshoot of critical thinking skills which, when applied to the health sciences field, measure students’ ability to engage in high-stakes reasoning processes and make high-stakes decisions.

RDDI’s course outcomes pertaining to the Drug Information Question (DIQ) paper are:

1. Critically evaluate the primary literature with regard to the qualitative assessment of study design, methods, results and validity and applicability of conclusion.
2. Compare and contrast the different types of drug information resources (primary, secondary, tertiary), considering criteria such as timeliness, accuracy, truthfulness, free of bias.
3. Select the most appropriate drug information resource for a specific question or type of information.
4. Demonstrate the ability to search and retrieve information using print and electronic databases and reference sources.
5. Formulate a concise, written response to a given drug information question

These objectives were assessed via the rubric used to grade the DIQ paper (see Appendix B).

Prior to the intervention, students scored on average in the low 70s on this assignment; a new approach to teaching this assignment appeared necessary. The large class size presented, however, a significant barrier in providing individualized writing feedback to all students at all stages of writing, and especially in the drafting stage.

Methods

Year 1: Peer Review Model

Wondering if more formative feedback would help students' performance on the DIQ paper, the Pharmacy faculty implemented in 2015 a peer review process, based on current research in pharmacy education that found, among other things, that pharmacy alumni considered peer evaluations a valuable skill in their profession (Wagner, Suh, & Cruz, 2011, p. 1), that writing self-confidence is correlated with pharmacy students' confidence in their skills as peer reviewers (Wu, Davison, Sheehan., 2012), that pharmacy students valued peer mentoring (Rodis et al., 2014), and that peer grading improved performance in a drug information workshop (Davis, 2014).

The peer-review model was thus the first in a series of interventions focused on students' writing skills. While overall a positive step, it nevertheless had little effect on students' overall scores on this paper. In the peer review model, students were assigned to peer teams of three or four students. Students within the same group had different topics, chosen from an instructor-provided pool of "Drug Information Questions." Teams used faculty-provided peer review rubrics to provide formative review to each other on interim drafts of the major components of the assignment using the discussion board feature in our Learning Management System (Blackboard). Participation in the peer review process contributed 10% to the overall course grade and included the following stages:

1. Draft of background narrative including literature search and citation.
2. Selection of primary literature, also known as the "Big Table." The table summarized the two key clinical trials required under columns such as "methods," "participants," "results," and so forth as a way to organize and assess clinical evidence.
3. Draft of final paper.

Students also participated in a team critique of de-identified student submissions from previous years' classes. All peer review activities took place online through Blackboard. Student survey results regarding this activity were generally positive, but performance on this paper remained the same as in past years, with a mean score of 73.3% (a C grade). Thus, although some of the best writing practices were used in designing

the DIQ assignment—such as requiring multiple and scaffolded drafts, peer review, and reflection—these activities did not seem to have an impact on the students’ performance on the final drafts.

Year 2: Writing Program Assistance in Implementing the Peer Review Model

These results prompted pharmacy faculty to seek out a collaboration with the Writing Program faculty (starting in Spring 2016) with the goal of delivering writing instruction and modeling peer review. Pharmacy faculty suspected that the peer review model was the right way to go, but students needed to be taught how to practice constructive peer review so they could get the most out of the process. The goal of the intervention was to improve students’ performance on their capstone paper by helping them (a) interpret, synthesize, and evaluate primary medical literature; (b) articulate in writing coherent, evidence-based clinical judgments; and (c) produce professional, well-written, and correctly referenced documents in support of their conclusions. To that end, the Writing and Pharmacy faculty added the following components to the course in 2016:

- Peer-review workshop. Based on best peer review practices (and Richard Staub’s [1999] piece “Responding—Really Responding to Student Writing”), this in-class workshop summarized principles of effective peer review and asked students to “norm” or grade anonymized A-, B-, and C-level papers written in the class in previous years. Students were also prompted to practice giving constructive peer review. Writing and Pharmacy faculty worked together to help students critique the papers; for example, the writing faculty would emphasize evaluating whether the components of the introduction (bringing Swales’s [1990] Creating a Research Space [CARS] model into play), vocabulary, transitions, et cetera. Pharmacy faculty focused on the proper way to report methods and results, the merits of including *p* values versus actual results, et cetera.
- Avoiding plagiarism workshop. This in-class workshop focused on getting students to practice paraphrasing and summarizing, something that the instructors have observed students struggling with when presented with scientific texts.² Using as a starting point articles on plagiarism originating in scientific journals (e.g., *Nature*), the workshop aimed to clarify perennial questions such as what should be cited versus what is common knowledge, how to paraphrase without preserving syntax and vocabulary, and what constitutes plagiarism. Scientific style, as well as the restricted length of the paper require students to not use longer direct quotes. Students had to produce accurate and clinically relevant paraphrases and/or summaries in class and peer review them, with a select few being discussed by the whole class.
- Optional scheduled tutoring period with the Writing Center (WC). While such tutoring sessions could not be mandated at the time, they were strongly encouraged at all stages of writing.
- Handout with tips and embedded video links explaining how to review and summarize published clinical literature.

Faculty and adjunct faculty graded the papers each year. All graders had a PharmD degree and varied from year to year based on the faculty assignments decided by the department chair. A training session was provided by the course faculty each year with the goal of standardizing the grading approach and use of the rubric. Graders were given sample papers from previous years (high scores, mid-scores, and low scores), asked to grade them, then provided feedback on how the papers were eventually graded. The pharmacy faculty also administered an IRB-approved questionnaire to the PP460 class each year of the intervention to assess their attitudes regarding this assignment.

Year 3: Intensive Writing-Targeted Workshops (with Optional Tutoring)

Based on the preliminary results and the exit survey, we decided to enhance our approach in 2017 with the following:

- The addition of a workshop targeted at summarizing primary literature. This workshop focused on turning reading notes, summarized in a “big table,” into prose. Starting the workshop was a brief interactive presentation using some of the principles laid out by Gopen and Swan (1992) in their article “The Science of Scientific Writing,” such as old before new, placing appropriate information in the topic and stress positions, keeping subjects and verbs relatively close together, creating coherent paragraphs, et cetera. Students worked on creating one such summary paragraph and peer reviewed one another’s work. Appropriate feedback was modeled at the end of the session with student volunteers.
- The addition of a face-to-face peer review workshop following the online peer review of the final paper draft. This was a large and coordinated event involving the WC and Writing Program faculty, during which the final drafts of the paper were workshopped in small group sessions (20 minutes each).
- Optional tutoring period scheduled two days following the face-to-face peer review workshop.

Year 4: Intensive Writing-Targeted Workshops (with Mandatory Tutoring)

Finally, in 2018, after reviewing the previous year’s results, we further enhanced the approach with,

- Face-to-face peer review time scheduled for every step of the peer review process (as opposed to mostly online);
- Mandatory tutoring period with WC tutors, Writing Program faculty, and drug information fellows (for writing and content support).

Writing Center’s Role in the RDDI Writing Intervention

The WC was tasked with taking our support services out of the center and into the PP460 classroom to provide small group tutoring sessions during class time. According to Walton and Matthews (1989), literature in the WC field highlights the effectiveness of small-group student-centered work with tutorial supervision as one of the conditions that enhance problem-based learning (PBL) environments. To some faculty outside of the Writing Studies field, peer-review and peer-led tutoring classroom interventions may seem unhelpful. However, a study conducted by Schmidt (1993) showed no significant overall differences between teacher-led and student-led peer review feedback groups. Their results indicated that peer tutors were able to facilitate students’ learning as well as teacher tutors, helping to dispel the myth that student-led peer review is unproductive. Further, Walton and Matthews’ (1989) study of peer tutor adequacy suggested that peer tutors are effective in providing meaningful feedback to peers regardless of content familiarity. The same study also reported that students revised papers more frequently under the guidance of peer tutors.

As the PP460 course is essentially a PBL course like the one described in the Walton and Matthews’s (1989) study, we applied a similar intervention. The combination of large class size and workload constraints did not allow for instructors to provide personalized feedback to every student in the course, so the WC tutors and staff were brought in to assist with the drafting and peer review process. The large number of students and the small size and reduced personnel of our WC did not make individual WC tutoring sessions feasible;³

thus, small groups (approximately three students per group) were informally created the day of the peer review to help students revise the assignment.

Due to a limited number of tutors, the Coordinator of the WC e-mailed the entire staff seeking paid volunteers to participate in the workshop. Each year approximately 6 WC tutors were available to assist in the peer review session. Those tutors were briefed on the assignment a few days prior to the class but were not given much more direction. Most, though not all, of the tutors who offered support were pharmacy students who had taken the RDDI course the previous year. The tutors and pharmacy fellows fanned the room and were assigned to specific zones due to class size. Along with the WC tutors, the Coordinator of the WC, the Pharmacy instructors and fellows, and the Writing Program faculty walked from table to table offering writing assistance. While students at each table peer reviewed each other's work, the peer tutors were also offering individual consultations at each table. All students were given the opportunity to have their paper reviewed by a peer tutor, fellow, or professional writing faculty, in addition to a classmate.

As outsiders to the RDDI course, the Writing Program faculty and WC team welcomed the opportunity these workshops afforded us to engage students in dialogue about their writing process and explore ways to enhance the paper through revision. We approached small groups of students similarly to the way we begin one-on-one tutoring sessions in the WC, asking students questions about their drafting process, reading their assignments out loud, and asking questions that could help the students meaningfully reflect on their work. Working in small groups helped students find strengths and weaknesses within each other's writing, based on the rubric, which in turn often helped students become better reviewers of their own work.

Results

Student scores on the DIQ paper improved steadily since the beginning of the collaboration with the Writing Program. Unpaired Student's t-test for continuous, independent data, not controlled for any other variables were used to compute class mean and median scores (Table 1). The scores stagnated in 2015, the year the online peer review process was implemented, when they remained essentially identical to those from the year prior to the intervention (2014: average of 73.4; 2015: average of 73.3, or a C grade). Starting in 2016, however, average scores leaped into the B-range, with an average of 89.3% in 2018 (B+) and much higher medians (Table 1).

Table 1: Student scores on the DIQ paper over five years⁴

	2014	2015	2016	2017	2018
Total number of students in course⁵	N = 195	N = 184	N = 193	N = 146	N = 144
Final Paper Mean	11.02/15 (73.4%)	10.99/15 (73.3%) p-value n/a	12.65/15 (84.3%) p-value (2016 vs 2015) <0.001	12.5/15 (81%) p-value (2017 vs 2015) <0.001	13.4/15 (89.3%) p-value (2018 vs 2015) <0.001
Final Paper Median	11/15	11/15	13/15	12.5/15	13.5/15

The learning outcomes were assessed via the rubric criteria described in Appendix A; overall, scores increased across the board on all criteria (see Table 2). Not all categories experienced a continuous, consistent increase; for example, the number of students who got full credit for reference format was at its peak in 2016 (63%) and decreased after that (down to 53% of students getting full credit for it in 2018).

Similar fluctuations can be seen for the spelling/grammar category. The steepest gains from pre-intervention (2014) to 2018 for students who got full credit occurred in the “Primary Literature: Completeness” criterion, which jumped 45 percentage points (from 23% in 2014 to 68% in 2018); other major gains were obtained in reference formatting (+33%), accuracy and relevance of primary literature (+22%), as well as in reference appropriateness (+18%), spelling and grammar (+18), and the adequacy of the introduction (14%).

Table 2: DIQ Paper scores, 2014-2018 for students getting full, partial, or no credit⁶

Criteria	Full credit (% students)				
	2014	2015	2016	2017	2018
Introduction	61%	65%	75%	76%	75%
Primary Literature: Accuracy & Relevance	73%	69%	81%	74%	91%
Primary Literature: Completeness	23%	11%	40%	47%	68%
Conclusion & Recommendation	67%	43%	67%	69%	78%
Succinctness	94%	97%	95%	98%	97%
Reference Format	20%	48%	63%	52%	53%
Reference Appropriateness	79%	80%	84%	77%	97%
Spelling/Grammar	49%	38%	74%	58%	67%

Criteria	Partial credit (% students)				
	2014	2015	2016	2017	2018
Introduction	35%	34%	25%	23%	25%
Primary Literature: Accuracy & Relevance	25%	29%	16%	24%	9%
Primary Literature: Completeness	35%	62%	45%	42%	26%
Conclusion & Recommendation	30%	52%	29%	29%	22%
Succinctness	4%	2%	5%	2%	3%
Reference Format	33%	38%	26%	25%	38%
Reference Appropriateness	21%	17%	15%	23%	3%
Spelling/Grammar	29%	50%	23%	31%	30%

Criteria	No credit (% students)				
	2014	2015	2016	2017	2018
Introduction	4%	1%	0%	1%	0%
Primary Literature: Accuracy & Relevance	2%	2%	3%	1%	0%
Primary Literature: Completeness	42%	27%	15%	11%	6%
Conclusion & Recommendation	4%	4%	4%	2%	0%
Succinctness	1%	1%	0%	0%	0%
Reference Format	47%	15%	11%	23%	9%
Reference Appropriateness	1%	2%	1%	1%	0%
Spelling/Grammar	22%	11%	3%	11%	2%

Students were also surveyed each year of the intervention; a summary of these results is presented in Table 3.

Table 3: Pharmacy students responding “agree” or “strongly agree” in surveys in RDDI over four years

Year	2015	2016	2017	2018
Survey Response Rates	87% (160/184)	70% (135/193)	85% (124/146)	86% (124/144)
“Peer review had a positive effect on the quality of my paper”	42.5%	73%	72.6%	72.6%
“Peer review reduced my stress in completing my final paper”	39%	53%	56.5%	64.5%
“I was able to accurately assess others' final paper”	59.4%	77.8%	79%	81.5%
“My group members were able to accurately assess my final paper”	50%	71.9%	68.5%	70.2%
“I was comfortable providing others' feedback”	71.3%	82.2%	79%	88.7%
“The writing center had a positive effect on the quality of my paper” *71% did not respond to this item	-	63%	64.8%	23.4%*
“The writing center reduced my stress in completing my final paper” *71% did not respond to this item	-	56%	56.5%	20.2%

Finally, we have tracked the number of students seeking WC support over the four years of the intervention, which overall shows an increase in both number of appointments and number of individual WC clients by 2018 (Table 4).

Table 4: Traffic to Writing Center from pharmacy majors

Writing Center Appointments per year	2015	2016	2017	2018
Total appointments (pharmacy majors)	228	284	154	479
Individual clients (pharmacy majors)	86	102	71	111
Average grade for the DIQ paper	73.3%	84.3%	81%	89.3%

Discussion

Overall, the leap in scores over time and across rubric categories, as well as the significant decrease in the number of students who got partial or no credit, indicates that strengthening writing support interventions seemed to be associated with student writing more closely approximating professor expectations. As we mentioned, every year we reassessed our intervention based on paper scores and the student feedback, collected via questionnaires; in effect, the intervention was an exercise in trial and error, in which every year we closed the feedback loop by assessing student results and surveys, discussing them as a team, and deciding on adjustments to better respond to our students' needs. This continuous evaluation allowed for the introduction of new elements every year and/or tweaking existing elements (e.g., adding face-to-face peer review sessions, or making one WC session mandatory). The only year that did not demonstrate substantial improvement from 2015 (although overall maintaining gains over the pre-intervention year) was 2017. That year correlated with a dip in enrollment from the previous year; it is also possible that the variations in graders from year to year (selected from a pool of pharmacy faculty and adjuncts) might have influenced the results. The mandated 2018 WC sessions appeared to be correlated with a substantial difference in overall scores.

The intervention also increased traffic to the WC in the first year of its implementation in 2016 (Table 4). The decreased traffic in 2017 can be partly explained through the dip in course enrollment. By 2018, the pharmacy faculty running the intervention made WC visits mandatory, which explains the sharp increase in Pharmacy major traffic and individual appointments; that year we also observed higher paper scores.

Student surveys generally indicated the new writing interventions substantially reduced stress, improved the overall quality of students' papers, and improved performance as peer reviewers (Table 3). Students' confidence as peer reviewers and writers went consistently up by double digits. The only outliers are the 2018 results for the questions "The writing center had a positive effect on the quality of my paper" and "The writing center reduced my stress in completing my paper," which are notably lower than in years past. However, this may be due to a defect in administering the questionnaire: these questions were printed on the back of the page, and students had to turn the page to see them; the proctors may not have reinforced that students needed to turn the page. As a result, less than one third of the students answered these questions. An additional writing workshop on summarizing primary literature was introduced in 2017 with good feedback; for example, 58.9% of the respondents in 2017 agreed or strongly agreed that the workshops led by writing faculty had a positive impact on their final paper (Table 3).

Each year students were given the opportunity to provide open-ended feedback. A deeper dive into the 2018 qualitative data was performed. Of the 124 students who completed the survey, 36 students provided written comments (30%). We coded these comments based on area of concern: 27 comments addressed peer review

and 6 addressed the WC; 3 addressed neither. Of the 27 peer review comments, 5 were positive, 11 were negative and 12 were neither positive nor negative (commentary was a suggestion or general feedback); all three Writing Program faculty reached agreement on the coding. Most of the positive feedback regarding peer review mentioned the “helpfulness” of the review sessions. One student remarked, “It definitely resulted in less stress writing the DIQ paper.” Students who provided negative feedback regarding the peer review consistently mentioned lack of confidence in their peers’ ability to provide worthwhile feedback. Many students reported not liking the randomness of peer groups or that groups were composed of students with different topics. Commenters seemed to have a perception that their peers did not have the topic knowledge necessary to provide meaningful revisions. Finally, a common response among the commenters was the desire to have faculty or fellows provide the bulk of the feedback rather than peers.

There were only 6 comments that cited the WC (roughly 5% of all respondents). Of those comments 2 were positive, 3 were negative, and one was neither positive nor negative. Of the positive comments both students wrote that the WC was “helpful” and a good use of class time; one comment stated, “I think the writing center is an excellent way to support your own style of writing.” The students who left negative comments felt the WC merely checked grammar or sentence structure rather than focus on content. For example, one student wrote, “Students can proofread/look for confusing parts, but it wasn’t effective in terms of content at all.”

Since so few students chose to provide written feedback, it is difficult to come to a larger conclusion from the data that were analyzed. However, it appears that a common perception among respondents was that peer feedback is not as valuable as faculty or fellow critiques. This is not an uncommon opinion among many college-level writers with limited peer review experience, although it does seem to contradict findings by, for example, Wagner, Suh, and Cruz (2011). This approach may be mitigated in future classes by using upper-level pharmacy students in a peer mentoring system like the one modeled in Rodis et al. (2014). Further, while the WC intervention was put in place to offer an added layer of writing support, it would seem that some students found the WC tutor’s feedback surface-level in nature, only addressing grammar and syntax rather than focusing on deeper revision concerning content. Again, it is difficult to ascertain if this sample of opinions are a representation of the larger body of students who were enrolled in the course or if the majority of commenters were disgruntled students, who therefore may have been more likely to comment than the rest of the class.

In a nutshell, our intervention suggested that when pharmacy students receive continued, sustained writing support and access to resources, they may be more likely to demonstrate proficiency in a capstone assignment. It seems possible that, as reflected here, additional writing support can enhance learning and understanding, strengthening professional pharmacy skills. We also believe the following factors played a role in the success of this intervention:

- Active teaching methods: the flipped classroom allowed students to participate in both online and face-to-face writing workshops;
- Emphasis on writing as an organic part of science and clinical decision-making rather than an afterthought;
- Emphasis on meta-cognitive skills: we believe that teaching students effective peer review practices had a positive impact on their writing and overall learning outcomes;
- The availability of WC sessions: these offered students a boost when revising their final drafts. It is not clear whether keeping them mandatory will be sustainable in the future, though it is an option we remain open to.
- Flexibility and adaptability in closing the feedback loop: each year of the intervention, the pharmacy and writing faculty teamed up to assess the results of the previous year and further

tweak the intervention. We believe this “trial and error” approach improved our chances of success.

This experience has taught us that, when classroom collaborations like the ones we tried are implemented, diversely trained faculty can agree that students benefit when writing instruction occurs across the curriculum. While science and clinical faculty may not feel it is feasible to incorporate or teach writing in their courses, this intervention demonstrated that, with the right approach tailored to institutional and program-specific needs, writing faculty and the WC can support faculty and students from different disciplines. Furthermore, this approach showed that pharmacy students were more proficient at producing writing geared to other healthcare providers, which is an important curricular outcome in pharmacy education. Positive outcomes such as described in this paper are supported by a variety of previous studies on peer review and writing support in science and pharmacy classes (Hobson, 1998; Purkerson et al., 1996; Ranelli & Nelson, 1998; Smith, McGhan, & Miller, 1989) and highlight the importance of creating meaningful learning experiences where students receive support integrating skills across disciplines.

Limitations

Among the limitations of our study are enrollment variations, meaning that each year’s cohort was different in size (enrollment declined significantly after 2016), background (e.g. students’ prior writing experiences may have varied), demographics, and so forth, and as such may have introduced confounding variables we could not control for. There were also limitations related to the WC, which relied on reduced staffing that changed from year to year, and to the scorers, which, despite training workshops, may have introduced grading variability. Not all faculty were available all the time for in-class or WC workshops, which may have also influenced some of the students’ experience. Finally, some inconsistencies in how the final surveys were administered, as explained in the previous section, have hindered our ability to get a complete picture of the students’ attitudes toward their WC experience in the course.

Conclusion

This study showed how a series of “trial and error” incremental interventions focused on improving pharmacy students’ writing led to better performance on a capstone paper in a drug information course. Over the course of four years, pharmacy faculty built on a peer-review model to gradually involve the Writing Program faculty and the Writing Center and to require students to spend more time with their writing through peer review workshops, in-class workshops, and optional (eventually mandatory) Writing Center sessions. Notably, paper scores showed the most improvement when the intervention built on previous steps and added more writing support.

In 2019, our Pharmacy program underwent a complete overhaul of its curriculum, which was replaced with a competency-driven, modular, professional curriculum; as a result, RDDI has been transformed as well. While the peer-review model has been preserved, the constraints of the new module structure as well as the COVID-19 pandemic have forced us to rethink the WC intervention for the time being. Writing faculty, however, continued to be involved in the course through 2020 via online lectures, handouts, and other materials. The revamped curriculum also offered opportunities to include reflective writing in other professional pharmacy courses, a practice that has been suggested as a way to enhance pharmacy students’ performance in the course (Lonie & Rahim, 2010); develop students’ ability to reflect, grow, and learn from their experiences (Nuffer et al., 2013); and develop students’ empathy in their clinical encounters (Chen & Forbes, 2014). Due to our previous work in the RDDI course, writing faculty have been invited to assist with this component of the new curriculum as well as contribute to the curriculum-wide rubric used for grading of reflective writing.

Additionally, the sustained gains in student writing, as demonstrated through the DIQ paper scores and the RDDI surveys, helped us win a teaching award and provided an opening for us to promote a WAC program at our institution. Writing Program faculty met with all the departments and stakeholders on campus (including Student Affairs) and fine-tuned a WAC plan as a result. The proposal was also presented to faculty councils across our three colleges; however, the vote has been delayed due to logistics and leadership changes at university, general education, and senate level.⁷ Nevertheless, we obtained an initial administrative commitment and a tentative budget to implement WAC workshops for faculty across the campus and to hire writing tutors, among other things. However, many issues remain, such as faculty labor and resources. The type of WAC work Writing Program faculty did with Pharmacy and others has been laborious and time-consuming, and requires further institutional investment to remain sustainable. While efforts to formally establish WAC at our institution continue, the demonstrated growth in our pharmacy students' writing and learning provided at the time of this intervention opens up avenues for future studies of flexible approaches to enhance lateral and longitudinal transfer of writing skills, both to other pharmacy courses and to professional practice.

Appendix A: Drug Information Question Assignment

This is an individual effort assignment. Plagiarism, copying or unauthorized collaboration is not permitted. You are expected to use PubMed to search the MEDLINE database to find at least 2 appropriate clinical trials (primary literature sources) plus at least one appropriate review article (tertiary literature source) and use these references to answer your assigned drug information question. You may use a PI, clinical practice guidelines, and/or a chapter in a textbook (if relevant). Answers must be typed, single-spaced, and no more than one page in length, not including your reference list. You may use reasonably narrow margins but do not use font sizes less than 10. Completeness, relevance and accuracy of the response, spelling and grammar, and appropriateness of references will be assessed. A scoring rubric is available on BLACKBOARD and shows how the assignment will be graded.

Please submit your assignment via Blackboard. Be sure to include your name on the paper as well as in the file name.

Format your written assignment with the following sections:

The Question

Briefly re-state or paraphrase the question.

Background

Briefly provide background information on the drug, disease, and/or clinical situation and its RELEVANCE to your question. The information for this section's contents will come primarily from tertiary literature. You must use a review article for this assignment. You may use a PI, clinical practice guidelines, and/or a chapter in a textbook (if relevant).

Primary Literature

This is the main body of your report. Answer the question by discussing information that you've found from the primary literature. Be sure to include the clinical trials' experimental design, a brief description of the study's interventions, the RESULTS of the relevant end-point(s) with statistical assessment, and a brief summary of any significant safety endpoint results. Discuss one clinical trial at a time, don't segue back and forth between studies.

Conclusion and Recommendation (your answer to the question)

Based on the evidence of your primary literature, include your conclusion and recommendation in your own words. Be specific and include your rationale for recommending the therapy as first-line, second-line, adjunctive, not recommending the therapy. Base your rationale on the evidence presented in your primary literature. Don't forget to interpret the evidence in terms of clinical importance in the context of your specific disease and drug. You may also need to briefly compare and contrast the results or conclusions of your two trials, especially if the trials differ in their conclusion (suggest why: how do the studies differ regarding quality, subjects, methods, end-points, results or conclusions).

References

List all references used in the preparation of this assignment. References should appear in the order they are used in your narrative and be numbered (see example below). Cite your narrative with the appropriate reference using the National Library of Medicine (NLM) format.

EXAMPLE:

Approximately 20% of all hospitalized Medicare patients are readmitted within 30 days, and 34% are readmitted within 90 days of discharge.¹ Discharge planning should begin when patients are admitted to the hospital and all diabetic patients should receive detailed instructions for management of their diabetes at discharge.²

1. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med.* 2009;360(14):1418–28.
2. American Diabetes Association. Diabetes care in the hospital, nursing home, and skilled nursing facility. *Diabetes Care.* 2015 Jan;38(Supplement 1):S80-S85.

Appendix B: General Rubric used to assess the Drug Information Question (DIQ) paper

Introduction	2 All necessary background information is clearly expressed in an organized manner	1 Some background information is not present OR information is expressed in an unorganized manner	0 Major background information is missing OR is unrelated to the drug information question
Primary Literature: Accuracy and Relevance of Information	2 Information is accurate, relevant, AND supported by 2 clinical trials	1 Information contains some inaccuracies OR is relevant and supported by only 1 clinical trial	0 Significantly inaccurate OR information is NOT relevant supported by clinical trials
Primary Literature: Completeness of Information	2 Main clinical results of 2 trials are included as well as statistical significance	1 Significant result data or statistical significance missing in one trial	0 Significant result data or statistical significance missing in both trials
Conclusion and Recommendation	2	1	0

	Conclusion present AND completely accurate	Conclusion present, but contains some inaccuracies	No conclusion present OR conclusion is completely inaccurate
Page length/Succinctness	2 1 page of text (not including references) AND answer does not contain irrelevant information	1 Answer contains minimal irrelevant information or some wordiness OR is >1 page but <1.5 pages (not including references)	0 Over 1 page of text (not including references) plus moderate to major irrelevant information or is wordy
Reference Format	1 All references are in the correct format AND accurately cited in the document	0.5 1 reference format is incorrect OR inaccurately cited in the document	0 ≥ 2 reference formats are incorrect OR inaccurately cited in the document
Reference Appropriateness	2 All references are clearly related to the topic AND all critical references are included	1 Some references are not related to the topic OR some critical references are not included	0 Most references are not related to the topic OR all critical references are missing
Spelling/ Grammar	2 No spelling or grammatical errors	1 1-2 spelling or grammatical errors	0 >3 spelling or grammatical errors

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Notes

- ¹ We use this specific term—health science reasoning—because it is a measurable, specific skill assessed in our Pharmacy program via the Health Sciences Reasoning Test (HSRT), which “measures high-stakes reasoning and decision-making processes” for health science students (<https://www.insightassessment.com/article/health-sciences-reasoning-test-hsrt-2>).
- ² For example, one student who was trying to avoid plagiarism replaced the clinical endpoint of “inconsolable crying” (referring to infant distress) with “incessant weeping,” which changed the scientific meaning of the summary. At the other end of the spectrum, students have reproduced verbatim passages that were scientifically dense, without paraphrasing or proper attribution, resulting in referral to the University Conduct Board.
- ³ Because of the specialized nature of the paper, writing tutors had to be at least juniors or seniors, and our WC had a very limited pool of such students working at the time.
- ⁴ Descriptive data—means, standard deviations (SD) and 95% CI (confidence intervals) for DIQ scores—2015–2018, are as follows:

	As grade %			As points out of 15		
	Mean	95% CI	SD	Mean	95% CI	SD
2018	89.4%	90.7%-88.3%	6.79%	13.42	13.60-13.24	1.02
2017	81.0%	83.4-78.5%	14.9%	12.15	12.52-11.78	2.24
2016	84.3%	85.9%-82.3%	11%	12.65	12.88-12.42	1.65
2015	73.9%	75.9%-71.8%	13.8%	11.08	11.38-10.78	2.07

- ⁵ These N's describe the total number of students in the DIQ course for each year, applying to all 3 sections of Table 2, which report on the percentages of students who earned full credit, partial credit, and no credit for the course.
- ⁶ Chi Squared test was used for independent categorical data, without stratification.
- ⁷ These changes are likely to be even more significant going further, as our University has recently (June 2020) merged with St. Joseph's University, a major liberal arts university. Plans for integrating the two institutions were incipient at the time of this writing and are complete at the time this publication is in print (hence our changed institutional affiliations).

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