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"I'm not a big English person but I liked this class": Lessons from a collaboration between the School of Engineering and the English Department

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Abstract

This Complete Evidence-Based Practice paper describes a two-semester STEM-focused English composition sequence developed as part of an Engineering Learning Community (ELC) at a public urban research university. To create a course that achieves the goals of the standard two-course composition sequence taught to all students and prepares engineering students for writing challenges in their field, the English Department designed a two-course composition sequence for the students enrolled in the ELC. The engineering version of Composition I and II teaches traditional core writing skills, including rhetorical analysis, informational literacy, critical reading, and the importance of drafting and revision. In addition to these skills, students learn key writing and research skills for their major, including scientific citation formats, how to read and interpret scientific papers, and how to present technical information clearly and in a range of formats. Key assignments include the completion of a design report in the first semester and a technical report in the second semester. Finally, course readings have been chosen in order to prompt discussion of the role of the scientist in society. Conclusions are drawn from seven years of basic data collected about the class, including D/F/Withdraw (D/F/W) rates, Faculty Course Questionnaire (FCQ) scores, and FCQ comments in order to assess student reception of the course. It was found that the ELC composition sections compared to regular composition sections taught by the same instructor had lower D/F/W rates and higher FCQ scores. In addition, numerous student comments identified the scientific content as adding particular value to the course. Future work will include more formal outcome assessment, including surveys administered to graduating seniors, alumni of the program, and writing assessments.

Introduction

There is a long history of collaboration between mathematics and engineering departments, as demonstrated through engineering-specific sections of mathematics courses [1], but collaboration between English and engineering departments is less common (although see [2]–[4]). Similarly, collaborative efforts to incorporate writing and information literacy into the teaching of the natural sciences (e.g., biology and chemistry) appear to be more common than in engineering curricula [5]–[8]. Because writing is an essential skill for professional engineers, introducing and practicing engineering writing skills early in a student’s academic career is an opportunity to increase career-readiness for engineering graduates [9].

The University of Colorado Denver (CU Denver) is a public urban university. In 2017, the College of Engineering, Design, and Computing (Engineering) initiated an Engineering Learning Community (ELC), in which first year students register for several required courses together and participate in various community-building activities and support [10], [11]. The ELC is optional for first-year engineering students and includes one semester of a hands-on first-year interdisciplinary design course, two semesters of mathematics, and two semesters of English composition. The ELC sections of English composition I and II fulfill the English composition

requirement for the university's core curriculum, but the course is tailored to the unique needs of STEM, and specifically engineering, students. The composition sequence was designed and taught by a member of the English Department in the College of Liberal Arts and Sciences (CLAS).

CU Denver requires its undergraduates to take two composition courses, Composition 1 (ENGL 1020) and Composition II (ENGL 2030). The ELC began including English Composition in Fall 2017 and several enrolled students have been supported through a National Science Foundation (NSF) S-STEM grant beginning in Fall 2019. Students participating in the first semester of the ELC must co-register for ENGL 1020 unless they have already met the requirement (a 4 or 5 on the Advanced Placement Language and Composition exam, for example); students in the second semester are strongly encouraged but not required to register for the ELC-linked ENGL 2030. Therefore, the 1020 section is typically completely filled with ELC students while the 2030 section is mixed, with a combination of ELC and non-ELC engineering students and science majors.

While writing has been incorporated into many types of STEM classes [2]–[8], [12], most of this incorporation has involved bringing writing into STEM rather than STEM into writing (although see [13]). The effort reported on here, a two-semester composition course taught by the English department but focused on scientific writing and literacy, is thus unique.

Goals

The goal was to create a two-course composition sequence that would take engineering and computer science students with a range of preparation and ability in English writing skills and create students with a common vocabulary related to writing, more flexibility in writing styles, and some exposure to the types of writing they will be expected to do for their major and careers. The English department wanted to create courses that had value for engineering students from a pedagogical perspective and one that felt valuable to the students themselves.

Approach

The skills imparted by the ELC composition sequence needed to match the six outcomes of the Composition Program as defined on the CU Denver English Department website [14] (Table 1). They also needed to develop writing skills relevant to engineering and computer science students, including an introduction to disciplinary conventions, scientific ethics, and information literacy specific to science. The course was designed to achieve these goals in two main ways: students were assigned typical composition assignments but with a scientific component, and the course emphasized the practical and analytical elements of the writing process to help demystify it.

Table 1 – University of Colorado Denver Composition Program Outcomes, with Typical Assignments for Traditional Composition and ELC Composition Classes.

Outcomes **Source: [14]**	**Traditional Composition Assignments**	**Composition Assignments Adapted for ELC**
Rhetorical knowledge & purposeful writing	• Rhetorical analysis comparing a popular source with a scholarly source	Rhetorical analysis comparing an engineering document with a more literary or personal form
Revision and writing process	• Drafting; peer critique • Portfolio	Every paper requires multiple drafts; structured "peer review" style feedback from classmates.
Argument & analysis	• Responsible advocacy project	Students create documents in the format of key scientific genres: 1020 students write a Design Report and 2030 students write a Technical Report. Focus: scientific arguments and how to deploy scientific evidence.
Critical Reading	• Comparative rhetorical analysis, often comparing a popular source with a scholarly source • Literature review	Students read a variety of texts, including scientific papers, design reports, essays on ethics in engineering, and books like *Full Body Burden* (about Rocky Flats) and *The Immortal Life of Henrietta Lacks* (about medical ethics).
Research	• Exploratory Essay with a research component; • Annotated Bibliography. • MLA or APA documentation format used.	Students learn how to distinguish between scholarly peer-reviewed papers and material written for a general audience, and how to assess the credibility of non-scholarly sources. APA format used & IEEE discussed.
Technology & multimodality	• Create a multimedia text (poster, video, T-shirt, etc.) that uses research to advocate for a specific outcome	Students learn the principles of responsible image use and how to integrate and reference graphs and tables in scientific work.

The composition program at CU Denver is designed to achieve six outcomes over two semesters: rhetorical knowledge and purposeful writing, revision, argument & analysis, critical reading, research, and analysis (Table 1) [14]. ENGL 1020, or Composition I, focuses on developing students' ability to recognize and analyze and range of rhetorical situations and develop their

vocabulary in being able to talk about writing; typically students read and work through a set of texts together. ENGL 2030, or Composition II, develops research skills and students are encouraged to read independently. The composition curriculum for the Engineering Learning Community was developed to achieve these goals in the context of preparing them for the types of reading and writing they will be expected to do in their majors and careers.

Rhetorical Knowledge and Purposeful Writing

The CU Denver Composition program describes this outcome as **"**Student work demonstrates an understanding of the rhetorical nature of writing and language use and successfully addresses academic and non-academic audiences by adopting clear and consistent purposes, as well as appropriate organization, tone, and format, according to genre" [14]. This outcome is mission-critical and is featured in both Comp 1 and Comp 2. The first paper in Comp 1 is a rhetorical analysis, in which students compare the rhetorical strategies of a personal essay and a typical engineering document (for the past few years the class used the poet Camille Dungy's essay, "From Dirt," and a full-length professional style Design Report created by seniors in the civil engineering program at the University of Toledo).

The purpose of this assignment is twofold: students can discuss what kinds of language choices are appropriate for different writing situations and why; in addition, this is most students' first glimpse of a type of writing that will become important to their careers. It also helps bridge their high school English experience, which typically has been focused on reading and analyzing literature, to the types of documents they will read and write in college and beyond.

Revision

The CU Denver Composition program describes this outcome as **"**Students produce multiple drafts. Student writing demonstrates careful revision in response to commentary from peers (when relevant) and the instructor" [14]. The realization that writing is not something that happens the night before a paper is due but is a product of deliberate strategy comes eventually to most students, but the course fosters that realization in multiple ways. First, all papers are broken into a series of smaller assignments, and students receive and must respond to feedback at each stage. Then the complete rough draft undergoes peer review, followed by student reflection on that process before the final paper is submitted. Finally, students end each semester by writing a reflective paper in which they examine their own work.

Argument and Analysis

The CU Denver Composition program describes this outcome thus: "Students write persuasively and analytically. Student writing contains convincing arguments and is supported with evidence" [14]. The traditional culmination of a composition class is the researched argument—a 10-page paper arguing for a particular point, usually on a topic of current political import. While this does develop key communication skills, such as persuasiveness and the ability to support claims with evidence, it often does not feel relevant or even interesting to engineering students. The approach the ELC series has taken, in contrast, introduces students to the forms that will become important to their scientific career while also developing their ability to make persuasive scientific

arguments and support those arguments with empirical evidence. In Composition I students write a design report on a "life hack": they define a small life problem, such as an icy windshield in the morning, and then devise and evaluate a solution to address this problem. They describe the solution and report on their evaluation, ending with a recommendation. In addition to giving them hands-on practice with a key engineering genre, they learn the difference between claiming that something works and presenting quantifiable evidence of effectiveness. In Composition II, students create a technical report in the Introduction-Methods-Results-and-Discussion format. In additional learning the proper way to develop each of these sections, students work on how to clearly define a study's knowledge gap and how to make claims about their data that are supportable.

Critical Reading

The CU Denver Composition program says, "Students read to inquire, learn, think, and communicate. Student writing demonstrates understandings of assigned readings, and when requested, incorporates outside readings" [14]. In the ELC Composition series, students read a variety of texts. In Composition I they read sample design reports, a literary essay, an article about ethics in engineering, and *Full Body Burden*, a book about Rocky Flats. Students discuss the different purposes and strategies of these genres, as well as how to effectively read technical documents. In Composition II students devote a significant amount of time to developing strategies for reading scientific papers, as well as reading and discussing a classic in medical ethics, *The Immortal Life of Henrietta Lacks*.

Research

The CU Denver Composition program defines this outcome as "Student writing evidences understandings of citation and website validity, and avoids plagiarism. At the intermediate level, student writing integrates credible academic research" [14]. Composition II at CU Denver is the "research" semester of ENGL 2030. In the ELC section, students focus on finding, interpreting, and integrating scholarly research into a technical report. They learn about scholarly documentation in scientific fields as well as conventions of scientific writing, and learn how to assess the credibility of non-scholarly sources.

Technology and Multimodality

The CU Denver Composition program describes this outcome thus: "Students function in electronic writing spaces, and use technology to compose, revise, and present their writing. At the intermediate level, students analyze and/or produce visual, audio, and online texts" [14]. At its most fundamental level, this outcome is about producing, interpreting, and integrating images and other modes of communication. In Composition I students learn how to caption and refer to images to effectively support their claims, and in Composition II students create tables and figures to present their data and learn how to integrate these into their technical reports.

In addition to the assignments described above, which occurred throughout the time described, some semesters had activities which enhanced connectivity and career relevance. In the fall of 2017, the instructors of ENGL 1020 and MECH 1208, one of the required companion courses,

collaborated so that students in 1020 spent time in class peer-reviewing each other's 1208 term paper. This they were able to directly apply skills learned in composition to an assignment in their engineering class. Also, in the fall of 2019, three CU Denver engineering alumni were invited to speak to the ELC 1020 and 2030 sections about how they used writing in their careers.

Demystifying the Writing Process

One of the key elements of the teaching process is trying to demystify the writing process. Each step in crafting a document is broken down into component steps, and successful ways to achieve these steps is articulated. For example, the first paper in ENGL 2030 is translating a peer-reviewed scientific study of the student's choosing into popular language. Students need to imitate the genre of popular news report of a new scientific finding—the type of article that might appear in the *New York Times*'s science section or an online publication like *LiveScience*. They examine several examples and characterize the components—such as a "click bait" title, an opening hook, and a specific way of introducing the study to the reader. Then students review effective and less effective examples of each of these, and then produce their own. Later in the semester, students progress to more open-ended, complex assignments.

ELC Support

Students in the ELC courses had multiple forms of support not available to students in non-ELC sections of composition [15]. Every year starting in 2019, several of the students participated in a one-week Summer Bridge program in the summer before their first semester, which smoothed their transition to college and helped establish a sense of community [16]. In addition, some of the concurrent enrollment courses in the ELC program were supported by a near-peer teaching assistant (TA) (2017-present), a Peer Advocate Leader (PAL) (2017-present), and an Individual Peer Mentor (2019-present) who met with each student once a week [17].

Outcomes

Three measurements were used to determine the initial success of the ELC project: rate of students earning a D or an F or withdrawing (DFW rate), Faculty Course Questionnaire (FCQ) scores for the course, and anonymous student comments on the FCQs.

When comparing the pass rates (grades of C or higher) of the STEM and non-STEM sections of Composition I and II taught by the same instructor between Fall 2017 and Fall 2022, a chi-square test revealed a statistically significant association ($\chi^2(1) = 40.79$, $p < .00001$; see Table 2), with STEM sections demonstrating higher pass rates (85%) than non-STEM sections (75%; see Figure 1).

Table 2. Crosstabulation, Pass Rates for English Composition I and II Fall 2017 – Fall 2022 by STEM vs. Non-STEM Section.

	STEM Section	Non-STEM Section	Total
Passing Grade (C or higher)	278	116	394
Non-Passing Grade (D, F, or W)	47	39	86
Total	325	155	480

Note. $\chi^2(1) = 40.79$, $p < .00001$.

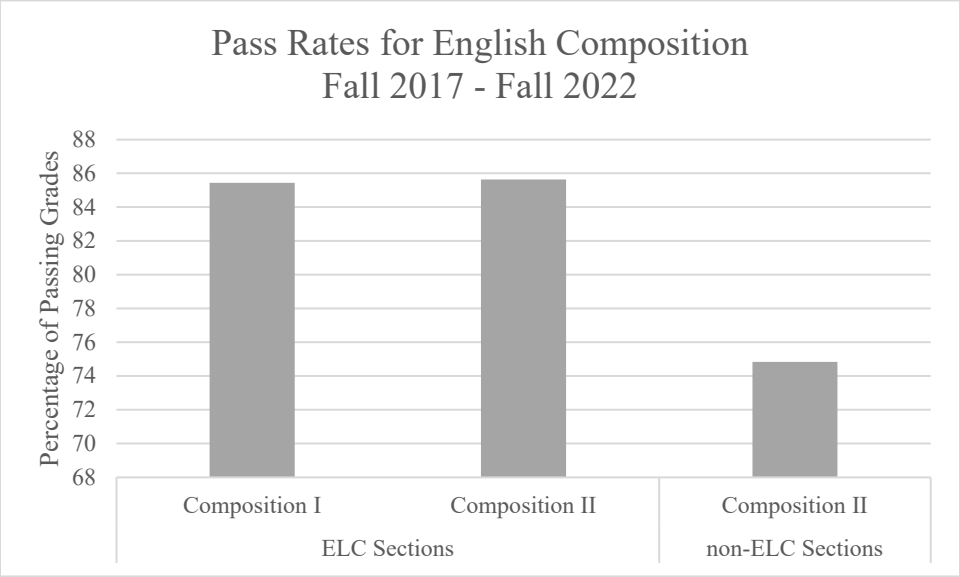

Figure 1. Pass Rates for English Composition, Fall 2017 – Fall 2022.
Note. This instructor did not teach non-ELC sections of Composition I.

Faculty Course Questionnaire (FCQ) Scores

The University of Colorado Denver administers an online faculty course questionnaire (FCQ) at the end of every semester, and response rates are typically high for composition courses taught by this instructor (80%). The FCQ consists of 22 Likert-type items that are asked of students in every course on campus, eight additional Likert-type items that are asked only of students in composition I and II. In addition, there are two free-response questions (Comment on the most effective aspects of this course and Comment on the least effective aspects of this course). The Likert-type response scale ranged from 1-6 in the 2017-2018 academic year (6 being the highest), and from 1-5, with 5 being the highest, starting in the fall of 2018. For ease of comparison, scores from the 2017-2018 academic year have been converted to a 1-5 range. The only questions used in tenure and promotion decision are Q20, Rate the effectiveness of this instructor, and Q21, Rate the effectiveness of this course, and the comments. Only scores for Q21, Rate the effectiveness of this course, are reported here.

The average Likert-type rating for the ENGL ELC 1020 course was 4.49 (5=highest rating) over six semesters; the average rating for the ENGL ELC 2030 course was 4.58 over seven semesters

(Figure 2). The average rating for non-ELC ENGL 2030 courses taught by the same instructor (this instructor did not teach non-ELC ENGL 1020 courses) was 4.19 (Figure 2). Further, an independent samples *t*-test revealed a statistically significant difference between FCQ scores for ELC sections and FCQ scores for non-ELC sections of English Composition taught by the same instructor ($t(23) = 3.23$, $p = .004$), with ELC sections demonstrating higher FCQ scores (M = 4.54, SD = .20) than non-ELC sections (M = 4.19, SD = .33) and a large effect size ($d = 1.23$).

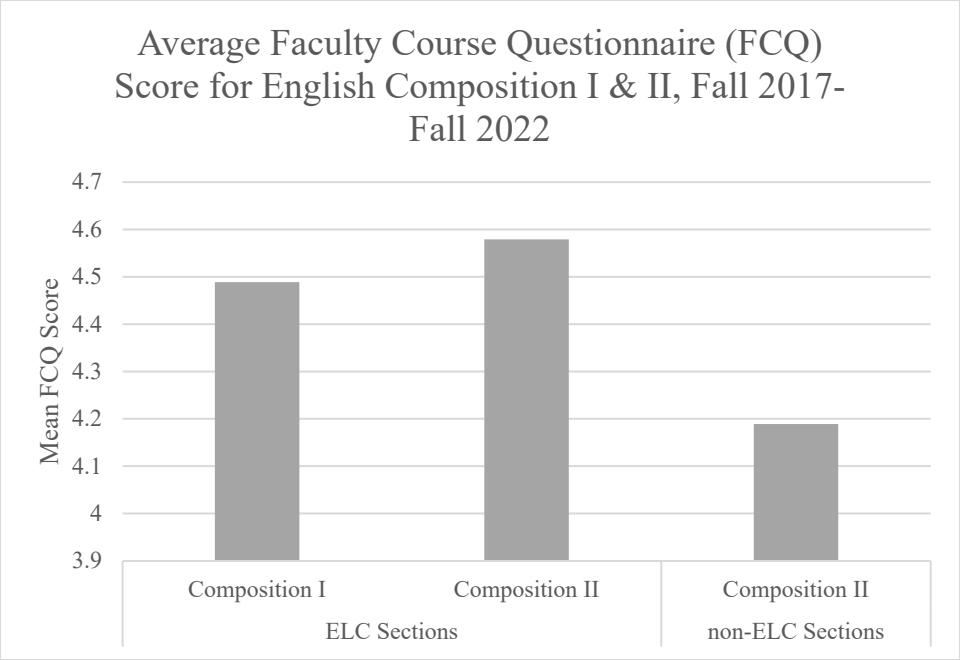

Figure 2. Average FCQ Scores for English Composition, Fall 2017 – Fall 2022.
Note. This instructor did not teach non-ELC sections of Composition I.

Student FCQ Comments

Overall, student feedback on the ELC composition sections has been positive, with numerous students commenting that they appreciated the value of getting trained in the types of writing they will do in their field (Table 3). In the spring of 2019, an ELC 2030 student wrote in their FCQ, “I really liked the scientific lens through which this class was modeled. Being a STEM major it is very useful to learn how to write scientific papers as well as give and receive criticism.” In the fall of 2019, a 1020 student wrote, “The assignments felt meaningful and felt very important to learn for my future career as an engineer.” In the spring of 2021 a 2030 student wrote, “This was a very beneficial course in terms of giving me more confidence in STEM writing... This is one of the courses that I will reference throughout my career.” Finally, a 2030 student in the spring of 2022 wrote, “Before taking this class I did not think it was necessary to take language arts since I thought it didn't have to do with my career path with science but I was misinformed and glad that your class teaches that.”

Several students also specifically called out the ethics discussions and readings they did for class (Table 3), with one 2030 student writing, “Most importantly, I liked some of the social commentary work that she gave us like "The Immortal Life of Henrietta Lacks" as it helped a STEM major like me to learn about the ethics and morals of my field and that of the world for most STEM majors will probably never get to interact with those philosophical questions.” Another wrote that “despite it being a STEM course, the human aspect remained intact. [The instructor] encouraged discussion of barriers such as race, class, and gender that make STEM fields harder to access for certain populations.”

Table 3: Student FCQ Comments Specifically Referring to the Scientific Components of the Course (1020 sections combined and ELC sections of 2030 combined).

ENGL 1020 (all ELC sections combined—seven sections total)
• “Communicated very well with the students to teach us the best way to construct a paper in regards to engineering” • “The most effective aspects of the course are the application to engineering. ” • “This course was the best English class I have ever taken. I think you did a wonderful job giving us real-world applications and I feel like you prepared me and my fellow classmates for our writing in our future.” • “I enjoyed the explanations of the assignments in relation to the real world. The assignments felt meaningful and felt very important to learn for my future career as an engineer. This course is well developed and was beneficial to me.” • “The paper 3 Design report was very helpful because it is something I will most likely use in my career.” • “This class was really helpful with learning the different types of technical writing and it gave me a understanding of the future for my major” • “This course was very good about teaching some valuable skills needed for the career world, especially as pertaining to the engineering and science community.” • “I wasn't a big English person but the way she broke down writing papers was very helpful and I actually enjoyed writing those papers.”
ENGL 2030 (all ELC sections combined—seven sections total)
• “I personally enjoyed learning about IMRAD papers and conducting an experiment on my own. It felt very professional and loosely guided.” • “I think that you explained the material that we will need to know for our chosen career course in a very effective way that allowed me to learn and understand my writing better.” • “This course has prepared me very well for the scientific writing I will be doing in my future. IMRAD papers are a large portion of scientific writing and after taking this course, I know a lot about them, and how to write them. ” • “The most effective aspect of the course was learning how to write and understand scientific papers” • “I really liked the scientific lens through which this class was modeled. Being a STEM major it is very useful to learn how to write scientific papers as well as give and receive criticism. I

really enjoyed the book we read this semester, it was informative, scientific, dramatic, and emotional"

- "Most importantly, I liked some of the social commentary work that she gave us like "The Immortal Life of Henrietta Lacks" as it helped a STEM major like me to learn about the ethics and morals of my field and that of the world for most STEM majors will probably never get to interact with those philosophical questions."
- "I walked into this course unexcited because I never saw myself as a writer but this course transformed me and developed a kind of love in me towards writing. Each of the assignments was different in its own way and geared towards scientific and professional writing which I know is something that I struggled with before taking the course. "
- "This was a very beneficial course in terms of giving me more confidence in STEM writing... This is one of the courses that I will reference throughout my career. Also, despite it being a STEM course, the human aspect remained intact. Prof. Wortman-Wunder encouraged discussion of barriers such as race, class, and gender that make STEM fields harder to access for certain populations. "
- "I feel like the IMRAD paper will be very useful in the future. "
- "Reading scientific papers was the best way to learn a new style of writing. I did not read these before and it was great to be introduced to them. "
- "I really appreciate the way that we are able to connect language arts with science. Before taking this class I did not think it was necessary to take language arts since I thought it didn't have to do with my career path with science but I was misinformed and glad that your class teaches that. "

Discussion

Overall, students responded positively to the ELC sections of composition and said that they had value. Compared to non-ELC sections, passing rates were higher (85% vs. 75%; Table 2), average FCQ scores reflected greater satisfaction (4.58 vs. 4.19; Figure 2), and student comments reflected an appreciation for the incorporation of writing formats and science-relevant readings (Table 3). This positive response could be due to a few factors.

Students in the ELC sections of ENGL 1020 and 2030 appreciated the fact that the writing tasks they did were relevant to their chosen careers, and said this in the FCQ comments (Table 3). This relevance was both self-evident (students read and wrote a design report in ENGL 1020 and scientific paper in 2030; they read books about scientific topics) and made explicit. The instructor frequently reminded students in the ELC sections of 1020 and 2030 of the relevance of these classes to their careers, for example. Articulating coursework relevance can enhance students' intrinsic motivation, which has been identified as a critical factor in student engagement [18], [19]. Similarly, non-science majors in required science courses have reported higher motivation when they believe the course has relevance to their career [20].

In addition, student success in the ELC sections may have been higher because these students were embedded in a supportive learning community. Students in the ELC take two or three classes together and participate in community-building activities like the Summer Bridge Program. Furthermore, ELC classes are supported by near-peer TAs and PALs. Extensive

research on the importance of a growth mindset to student success indicates that a sense of belonging is a critical factor (reviewed in [21]). In other words, success in the ELC composition classes may have been due to the community and support surrounding the ELC as well as the content of the course.

Conclusion

The evidence presented here shows that an English Composition series tailored to the needs and interests of engineering students can lead to better course completion and higher student satisfaction. Future efforts will seek to measure outcomes more systematically though surveys administered in students' senior year and comparative writing assessments.

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