Writing Expectations in a Colombian Major in Industrial Engineering

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Abstract

This paper offers insights that inform writing curriculum design in Industrial Engineering by including learning expectations of linguistic and non-linguistic contents. Data analyzed were: a) Faculty members' expectations regarding conducting and writing senior theses; and, b) Disciplinary learning expectations stated through syllabi with particular attention to writing. Findings suggest that students are expected to integrate linguistic and non-linguistic contents to convey professional performance in senior theses to make decisions, lead, and propose institutional changes in companies to improve processes and profits of organizations. The analysis of the syllabi overall reveals that linguistic and non-linguistic contents are part of different writing epistemologies (humanities writing, writing to learn, professional writing, and research writing). Ultimately, the analysis conducted by semesters and across classes reveals that there is not currently a developmental approach over time at least in the curriculum to support the development of diverse writing epistemologies.

Keywords: learning expectations in engineering, linguistic and non-linguistic contents in engineering learning, writing epistemologies in engineering curriculum

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Resumen

En este capítulo se presentan ideas que podrían nutrir el diseño curricular sobre la escritura en Ingeniería Industrial al identificar expectativas de aprendizaje asociadas a contenidos lingüísticos y no lingüísticos. Dicha identificación se realizó a partir de a) entrevistas con profesores acerca de la realización y escritura de trabajos de grado y b) un análisis de contenido de los programas de curso, poniendo especial atención a la presencia de expectativas sobre la escritura. Los hallazgos sugieren que se espera que los estudiantes integren contenidos lingüísticos y no lingüísticos para evidenciar un desempeño profesional en los trabajos de grado en los que deben tomar decisiones, liderar y proponer cambios institucionales en las empresas para mejorar los procesos e incrementar las ganancias de las organizaciones. El análisis de los programas de curso revela que los contenidos lingüísticos y no lingüísticos hacen parte de diferentes epistemologías de la escritura (escritura en las humanidades, escritura para aprender, escritura profesional y escritura para la investigación). El análisis realizado por semestres y por clases revela que actualmente no existe un enfoque de desarrollo, al menos en el plan de estudios, para apoyar la cualificación de dichas diversas epistemologías de la escritura.

Palabras clave: expectativas de aprendizaje en ingeniería, contenidos lingüísticos y no lingüísticos en el aprendizaje de la ingeniería, epistemologías de la escritura en el plan de estudios de ingeniería

Introduction

Colombian programmatic initiatives for reading and writing in Higher Education date since 2000. An inter-institutional research project conducted by 17 universities (2009-2011) confirms that the most overt institutional policy is to offer one or two freshman composition courses in Spanish. Furthermore, the analysis of 20 case studies of leading practices for teaching reading and writing across diverse disciplines showed that most of the experiences were led by disciplinary professors whose academic trajectories had impacted their pedagogical practices positively (Rincón & Pérez, 2013). These writing initiatives, however, were not necessarily part of writing programs or other institutional endeavors. Consequently, Colombian undergraduate students, at least those in the 17 participating universities, did not experience institutionalized, systematic teaching initiatives across their majors.

To understand the effect of the limitations of writing education in the engineering major, this paper describes writing abilities (including linguistic and non-linguistic components) necessary to complete an undergraduate major of Industrial Engineering[1]. Systematic teaching and research of engineering writing are recent throughout Latin-America, dating from 2009, and have treated engineering as a uniform field (Narváez-Cardona, 2016a). Furthermore, only a few studies consider writing/language as a multimodal phenomenon (Añino *et al.*, 2008, 2010, 2012, 2013; Parodi, 2010).

The present study contributes to initiatives in collaborative curricular mapping, in which writing specialists collect information from disciplinary instructors through syllabi, writing assignments, course projects, focus groups, interviews, and/or class observations/interventions to identify cooperatively to what extent learning to become a practitioner in a specific field is intertwined with writing and other communicative practices[2]. This interdisciplinary endeavor between writing specialists and other disciplinary instructors has been an important process in defining learning outcomes, envisioning faculty expectations, and making curriculum reforms (Carter, Anson & Miller, 2003; Durfee, Adams, Appelsies & Flash, 2011; Wagner, Hilger & Flash, 2014)[3].

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[1] This article is derived from the doctoral thesis titled "Mapping expectations on writing and communication in engineering within a regional context: accounts from a Latin-American case" conducted under the guidance of Professors Charles Bazerman, Linda Adler-Kassner, and Karen Lunsford of the University of California, Santa Barbara (UCSB), United States. The research process met the IRB procedures required by UCSB and the Colombian university in which the data was collected.

[2] As a writing instructor affiliated to the Colombian university context of this study, I was aware of the challenges related to accomplishing the institutional senior thesis requirement. Engineering majors were the first programs offered by this institution; therefore, I decided to start the study with the faculty of industrial engineering, since I had conducted prior workshops on research writing and publication that allowed me to create alliances and cooperative conversations with some faculty, especially with the director of the undergraduate program.

[3] The project was presented to the faculty of the major to explain the scope of the study and the potential results to be utilized as useful insights for auto-evaluation and accreditation processes of the major. I asked for voluntary participation and cooperation for data collection. A meeting to discuss preliminary results was held at the middle of the process and, recently, a final report was presented to faculty to discuss how the analyses can be considered to envision further curriculum reforms.

Regional and institutional contexts of data collection[4]

The Industrial Engineering major serves the industrial economy in a Colombian mid-size city, with an employment rate of 55 % in 2011. The economic activities in the region are mainly focused on sales business (21 %), banks (21 %), and estate agency services (16 %). This industrial context influences the expectations of the senior thesis. The institution offering the major is a private university established in 1970. With a student population of about 8,450 students (UAO, n. d.), this university has 651 faculty members belonging to five faculties (Engineering, Sciences, Economics and Business, Humanities, and Communication); 21 undergraduate programs; 11 specializations; seven master programs; six technological programs; and, recently, two Ph. D. programs: one in Engineering and an interdisciplinary program in Sustainable Regions. Currently, the university has 28 research teams and has been awarded five patents, two of which are international. There is no writing program in this institution, although a freshman composition course in Spanish is offered to all undergraduate programs and a writing center was launched in 2014 primarily to support senior thesis writing by tutoring.

The program in Industrial Engineering was founded in 1971, but the major dates in Colombia since 1958. The curriculum is arranged in ten semesters (16 weeks each) for daytime and night students. Undergraduates of this program can enroll in daytime classes, and after the fifth semester, they switch to the night program. Originally, in 1971, the night program sought to offer education for non-traditional students (workers available after 6:00 pm) (PEP, 2015).

Current students complete the degree with 174 credits/units consisting of 88 credits for core education (including a first-year composition in Spanish), 68 credits for professional emphasis, and 18 credits for elective courses. Since 2011, Industrial Engineering students in the eighth semester must enroll in a senior thesis research seminar led by engineering instructors to support writing their initial proposals; during the 10th semester, they enroll in an independent study to work with a mentor. The initial proposals are often rewritten as they are conducted during the 9th and 10th semesters. According to the institutional policy regarding senior theses, students are allowed to pursue the following types of projects: a) research projects; b) internships in

[4] The information presented in this section was consulted during March 2014 through the websites of the local Town Hall, the University, and the Colombian Ministry of Education.

research teams, companies or non-profit organizations; c) business creation; and, d) scientific, technical or artistic innovations. Furthermore, students are allowed to skip the senior thesis if they have achieved a GPA of 3.5/5.0, which allows them to substitute a graduate course in the same institution for the requirement. It is not mandatory to complete the graduate program which the course belongs to.

Two types of data were analyzed:

a. Faculty members' expectations, as revealed through interviews, regarding conducting and writing senior theses, since this is the most ambitious writing project students need to address in the context of the undergraduate program analyzed.
b. Disciplinary learning expectations stated through syllabi with special attention to writing including non-linguistic contents (graphics, tables, or pics) (by semesters and by curriculum years, namely, freshman, sophomore, junior, and senior).

Faculty members' expectations regarding conducting and writing senior theses

To better understand the interplay among learning opportunities in the major, becoming an industrial engineer, faculty writing assumptions, and institutional arrangements, I conducted five semi-structured interviews, audio-recorded in Spanish by Skype, with faculty members who participated voluntarily. A retrospective strategy was used for reliable recall (Tagg, 1985). Interviewees were asked about their experiences as practitioners in the field, instructors in the major, advisers, and reviewers of senior theses.

Here I will report on the interviews with the Director of the major, and the Coordinator of the senior thesis process concerning institutional conditions in which the senior theses are conducted and written by the students[5] since these two participants provided expectations most aligned at the level of the Program[6]. In these two interviews, four themes emerged, the first two

[5] Since the original interviews were conducted in Spanish, the fragments utilized as illustrations of the analysis were translated into written English; therefore, the verbatim accounts do not mirror spoken English (Poland, 2002). The following symbol will be used […] to indicate eliminated lines not pertinent in illustrating the analysis.

[6] The two participants are tenured professors and hold about two uninterrupted decades working

relating to the university experience and the last two to the job experience. Each of these themes and their elaborations are supported with translated quotations from the interviews.

Senior theses should be documents clearly written by following the research format expected, and integrating linguistic and non-linguistic contents to convey a bounded problem and a professional solution accordingly

The most salient expectation is that students differentiate among the sections of proposals (title, general and specific objectives, literature review, justification, problem statement, and methodology):

> the most complicated issue is everything: the work they present from title, objectives, they do not know what is a literature review, what is a justification, they do not know how to present a problem statement… These issues have been improving, because the Program since two or three years ago has also offered a course named research seminar, so, with this, the students are supported to improve such competencies, but the improvements have impacted on problem statement; however, they still have problems in defining general and specific objectives, which is technically the project…from there, everything is interrelated. (Interviewee 1)

Additionally, writing cohesively within and between the sections is also expected:

> …in final reports, the structure should be improved, students need to follow a thread in their projects, I mean, what is a chapter, what should be included in this chapter, how to connect, how to claim that the objectives were accomplished. There are students that do not even use nomenclature for the data and, thus, one says: ok, this info where does it come from? Isolated paragraphs without connections and one says: well, I can understand what the idea is here, but this info cannot connect with that; then, it is very difficult to convey the results through writing. (Interviewee 2)

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as university teachers and completed their master's degrees; one in Industrial Engineering and the other in Administration and Business.

Furthermore, it is also expected that students can integrate linguistic and non-linguistic contents by presenting and analyzing information in their projects. Graphics and tables are seen as resources to summarize information deployed by prose:

> Well, now I got a case of a student who I advised about strategic planning. She conducted initially an internal and external analysis, which was an endless report of pages, pages, pages, pages. I told her: If this report is read by an industrial engineer, he will undermine your work. All this should be depicted by tables. So, take the relevant aspects, write with adequate punctuation, but show me all this as a depiction by figures and tables that allow better visualization of what you have done so far. (Interviewee 2)

However, written interpretations are also part of the expectations to aggregate meaning to what has been deployed by non-linguistics contents:

> Well, let's say that writing is difficult for us, so we have to correct students' documents several times, and even so there are students that only turn in tables, tables, tables, but there are no interpretations, descriptions, definitions, they do not define what they have there, why these tables are there. So we have to give their documents back and tell them: the work is not only comprised of tables, you have to write, you have to convey what you intended to mean with all this you have here, ok? In this document! (Interviewee 1)

Finally, the participants agreed that learning how to write paragraphs cohesively, and, mainly, how to write the proposals should be learned in the research seminar enrolled by the students in the 8th semester:

> Actually, this semester we were analyzing with [the name of another instructor], well, what is happening with the research seminar in the Program: Students are enrolling the seminar? This is a course we have in the semester eight, between eighth and ninth…they actually should enroll in it as a requirement before starting senior theses, and the idea is the students can start formulating a preliminary proposal and be able to write adequately and meaningfully by connecting paragraphs… (Interviewee 2)

Senior theses might expand final papers of prior courses and repurpose writing knowledge from a research seminar

In this program, conducting a senior thesis is an opportunity to repurpose and integrate learning:

> Mmmm, [a good analysis does not depend on] analytical models, rather, the learning contents of the courses they have previously enrolled, let's say, in the course: methods and time, they learned all the tools of methods and time; if they have learned Statistics, they should know that if they got normal distribution, then they will run variances; if they are working on quality control, then they should conduct the projects with the tools accordingly. So, every course offers those tools and students should decide what to apply in their projects. (Interviewee 2)

Consequently, it is expected that final projects from prior courses can be expanded in terms of the scope:

> for instance, in my course: Engineering of Methods, I assign a project in which they analyze a product production, from diagnosis, depiction […], time, all these processes. So, when the student is starting his/her senior thesis, I tell them: you could expand this project, but you should analyze more than a product production; instead, process production of five lines of products, for instance, of the same company; well, it depends on the size of the company…because, if we talk about [name of a large and leading company in the region], it would be impossible to conduct such type of project; so, let's say, this is the scope, by bounding the focus of the project. (Interviewee 1)

Additionally, it is expected that students repurpose knowledge from the research seminar enrolled between 7th and 8th semesters to write paragraphs cohesively and present proposals by differentiating its sections (literature review, justification, and problem statement).

Senior theses should include how to make decisions to improve companies' processes and practices

The participants agreed that students are expected to draw on methods of the field to diagnose company problems and propose solutions accordingly:

> Well, we are focused on assessing how students address a problem and its solutions because the most important issue is how you solve the problem; so, for instance, students say 'low productivity,' well, ok. What is your proposal to increase the productivity of this company? Ah, well, 'I conducted a study about methods and time, I defined the indicators to measure this, I proposed how to modify this machine in the company or change these staff, and this is my result. Then, this is what we have seen and there some enterprises that allow them doing this, but other projects that remain only as proposals. (Interviewee 2)

The senior theses may open job opportunities for students

In the case of senior theses conducted as company internships, one of the interviewees mentioned:

> …this student [the name of the student], his defense was last week, and he told us that given his good performance in the company, he got an opportunity… he conducted a study…he did a study on salaries, and the company really liked his professional performance, so we got the opportunity that he was hired… (Interviewee 1)

In the interviews, the two faculty program leaders take for granted the students are ready to convey their ideas and write proposals and reports by integrating linguistic and non-linguistic contents once they have completed the mandatory research seminar. However, these interview data did not disclose when and where knowledge about how to convey meaning by writing intertwined with non-linguistic contents is learned across the curriculum of the major. Therefore, the next step was to explore learning expectations of writing comprised of linguistic and non-linguistic contents across the curriculum to find where students might have developed these skills. This development was examined through curricular mapping across semesters and learning moments (freshman, sophomore, junior, and senior).

Learning expectations stated through syllabi

This portion of the analysis is based on 18 syllabi of classes that students mentioned when they responded a printed survey about courses and writing assignments in which they had had positive writing experiences, out of a

total of 53 courses in the undergraduate major.[7] Syllabi were read to create grounded categories to name learning expectations related to methodologies to become a practitioner, and systems of values for comparing, criticizing, making claims, and drawing conclusions to learn the discipline/field (Carter, 2007; Meyer, 2008; Meyer & Land, 2013).

Special attention was given to learning expectations related to writing including linguistic and non-linguistic contents. Names of grounded categories[8] were created to count their occurrences throughout the sample to:

1. Identify the total of learning expectations throughout the syllabi.
2. Identify learning expectations related to writing according to the description conducted in step 1.
3. Identify learning expectations related to visual communication throughout the syllabi.

Results

The total of learning expectations stated throughout the syllabi

Eighty-three occurrences of mentions for learning expectations were identified throughout the syllabi (Table 1). The most frequent learning expectations were: a) "Making claims to analyze case studies based on theoretical frameworks of the class" (10); b) "Making decisions to design solutions based on procedures learned in the class" (7); and, c) "Making decisions to design and redesign to improve productivity and profitability" (7).

The number of mentions suggests overall that learning relies on conducting case studies to apply theoretical frameworks of the classes. Furthermore, the students are expected to learn how to solve problems primarily by thinking under principles of productivity and profitability for companies.

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[7] The analysis of this survey data is included in Chapter 5 titled "Writing experiences of Colombian engineering students: writing variation within a major in Industrial Engineering" (p. 272-342) of my dissertation *Mapping expectations on writing and communication in engineering within a regional context: accounts from a Latin-American case* (Narváez-Cardona, 2016b).

[8] Results will present the names of grounded categories between quotation marks to indicate the learning expectations identified and the number of their occurrences between parentheses.

Table 1. The total of learning expectations identified across the syllabi

Learning expectations across the syllabi	Occurrences of mentions across the syllabi
• Making claims to analyze case studies based on theoretical frameworks of the class (CSTF)	10
• Making decisions to design solutions based on procedures learned in the class (MDDS)	7
• Making decisions to design and redesign to improve productivity and profitability (MDPP)	7
• Writing implies prior reading and intertextuality (WPRI)	4
• Reading carefully bibliographic resources (RCBR)	4
• Making measurements and creating data (CD)	4
• Solving problems methodically (SPM)	4
• Multivariable thinking to make decisions (MVT)	3
• Addressing writing as a process (WP)	3
• Working collaboratively (WC)	3
• Bounding and defining engineering problems (EP)	3
• Selecting materials and efficient procedures based on budgets (MPB)	3
• Developing and implementing control and management strategies (CMS)	2
• Preparing and delivering oral and written presentations (PDOWP)	2
• Mastering an engineering protocol for projects (MEP)	2
• Selecting bibliography (SB)	2
• Writing cohesively (WCY)	2
• Evaluating others' written productions (EOWP)	1
• Including graphics in presentations (GP)	1
• Making decisions to design and redesign on human resources expectations of companies (MDHR)	1

Learning expectations across the syllabi	Occurrences of mentions across the syllabi
• Information management (IM)	1
• Identifying differences between Engineering as a field and the student major (ESM)	1
• Standardizing procedures (SP)	1
• Writing Standards and guidelines manuals (WSM)	1
• Raising resources and funding (RRF)	1
• Anticipating social, environmental, economic, and legal limitations of a project to propose mitigations (LM)	1
• Depicting graphically and holistically companies (DGHC)	1
• Multivariable thinking to make decisions (MVT)	1
• Developing systemic thought (ST)	1
• Writing a senior thesis proposal (WSTP)	1
• Mastering a standard citation format [ICONTEC] (SFC)	1
• Mastering genre conventions of a senior thesis for the institution (STI)	1
• Understanding the interplay between conventions, mechanics and intended audiences (CMA)	1
• Writing a senior thesis as a process bounded by timelines, deadlines, and budgets (WPTDB)	1
• Expressing a personal voice respectfully among others vantage points (PVAO)	1
Total	**83**

Source: own work

Table 2 shows the number of occurrences and types of learning expectations identified in the sample by class. The maximum amount of learning expectations was 14 for a freshman professional course, and the smallest number of occurrences was 1 for Humanities courses ("Ethics" and "Democracy and Colombian Constitution" enrolled between semesters 1-4) and a sophomore course.

Table 2 suggests that in this engineering program there are two learning moments in which learning expectations are high in comparison with other semesters: in the freshman year and also again towards the end of the program in the senior year. The two syllabi at the extremes of the curriculum have been discussed and redesigned in order to incorporate agreed upon expectations particularly related to writing. The Department in charge of freshman composition classes (FYC) has worked with the engineering faculty to incorporate writing as part of the class projects in "Introduction to Engineering 1 and 2." As well, the "Research Seminar" in the major was created by the very same engineering faculty to guide senior thesis writing explicitly.

Learning expectations related to writing

Out of 83 mentions for learning expectations identified across the syllabi (Table 1), 39 (47 %) were related to writing (Table 3). The analysis of amount and types of mentions by class reveal learning expectations related to writing again highly present at the beginning of the program (1-2 semester) and at the end (7-9 semester) (depicted in light gray boxes in table 4) when comparing the amount of expectations across semesters.

Table 3. Learning expectations related to writing

Methodologies and Systems across Syllabi	Occurrences of Mentions Related to Writing
• Making claims to analyze case studies based on theoretical frameworks of the class (CSTF)	10
• Writing implies prior reading and intertextuality (WPRI)	4
• Reading carefully bibliographic resources (RCBR)	4
• Addressing writing as a process (WP)	3
• Preparing and delivering oral and written presentations (PDOWP)	2
• Mastering an engineering protocol for projects (MEP)	2
• Selecting bibliography (SB)	2
• Writing cohesively (WCY)	2

Methodologies and Systems across Syllabi	Occurrences of Mentions Related to Writing
• Evaluating others' written productions (EOWP)	1
• Including graphics in presentations (GP)	1
• Writing Standards and guidelines manuals (WSM)	1
• Depicting graphically and holistically companies (DGHC)	1
• Writing a senior thesis proposal (WSTP)	1
• Mastering a standard citation format [ICONTEC] (SFC)	1
• Mastering genre conventions of a senior thesis for the institution (STI)	1
• Understanding the interplay between conventions, mechanics and intended audiences (CMA)	1
• Writing a senior thesis as a process bounded by timelines, deadlines, and budgets (WPTDB)	1
• Expressing a personal voice respectfully among others' vantage points (PVAO)	1
Total	**39**

Source: own work

The analysis, furthermore, reveals that during the first year, students are exposed to expectations that configure different writing epistemologies. For instance, names of the categories created for the FYC class reveal that students are expected to "express a personal voice respectfully among others' vantage points" (humanities writing), whereas, in Introduction to Engineering 1, they should learn how to "write standards and guidelines manuals" (professional writing).

The overall analysis suggests that the presence of expectations related to writing is neither constant nor progressive across the curriculum; although, the students are expected to intensively utilize writing as senior students, especially when they are enrolled in a research seminar between 7th and 8th semester. The following are the names created for types of expectations to fulfill in this specific senior class: "Writing cohesively"; "Writing a senior thesis

proposal"; "Mastering a standard citation format [ICONTEC[9]]"; "Addressing writing as a process"; "Mastering genre conventions of a senior thesis for the institution"; "Selecting bibliography"; "Understanding relationships among conventions, mechanics and intended audiences"; "Writing a senior thesis as a process bounded by timelines, deadlines, and budgets"; "Writing implies prior reading and intertextuality"; and, "Reading carefully bibliographic resources".

This analysis confirms that the high presence of learning expectations at the extremes of the curriculum is associated with adding writing expectations (depicted as gray boxes in table 4) along with disciplinary learning expectations (particularly, in the freshman course "Introduction to engineering 2" and the senior course "Research seminar," besides the writing expectations present in the FYC class). Furthermore, data reveals the presence of different writing epistemologies at different learning moments; for instance, the category "writing for developing a personal voice respectfully among others' vantage points" (humanities writing) is present as an expectation in the FYC class, as well as "writing to analyze readings" (writing to learn)[10], which is also an expectation in the research seminar that prepares students for writing a senior thesis between semesters 7-8 of the major (research writing); whereas the expectations named "writing for reporting cases studies" (writing to learn), and "writing to solve and report problem-solving" (which can count as writing to learn, research writing or professional writing depending of the genre production and rhetorical situation of the assignments) are more present and distributed across semesters in all years.

This data suggests that there is no overt pattern across semesters regarding specific growth or changes over time for different types of writing epistemologies, such as, for instance, expectations named as "bounding engineering problems in companies and proposing solutions by writing reports" (professional writing); and, "writing for developing a personal voice respectfully among others' vantage point to write a literature review" (research writing). In fact, in the extremes of the program, classes (introduction to

[9] ICONTEC is the Colombian Institute of Technical Standards and Certification (Instituto Colombiano de Normas Técnicas y Certificación) that accredits organizations, companies and individuals that participate in manufacturing or innovating industrial processes. A citation guideline to writing reports is one of the standards mandated by ICONTEC.

[10] Broadhead (1999, as cited in Carter, Ferzli & Wiebe, 2007), summarizes these two approaches "writing to learn— i.e., writing as a means of acquiring information, understanding concepts, and appreciating significance in any discipline... [versus] learning to write—i.e., acquiring the socially-mediated communication skills and genre knowledge appropriate to a specific discipline".

engineering in freshman year, and a research seminar in senior year) embrace expectations that might be difficult for students to achieve within the 16 weeks of the course (e.g., "mastering genre conventions of a senior thesis for the institution"; "understanding relationships among conventions, mechanics and intended audiences"; or "writing implies prior reading and intertextuality").

This analysis, therefore, reveals that there are four different writing epistemologies: (1) "writing for applying knowledge through case studies" or "writing reports" (both writing to learn); (2) "developing a voice among others" (humanities writing); (3) "writing to conduct a senior thesis" (research writing), and (4) "writing standards and guidelines manuals" or "mastering an engineering protocol for projects" (professional writing).

Learning expectations related to visual communication

Eighteen occurrences of mentions for these types of learning expectations were identified across the syllabi (Table 5). The two most frequent categories of these learning expectations were utilizing a) "visual communication to represent solutions of problems" (5); and, b) "tables and graphics to plan and make decisions" (5). There are syllabi across semesters that have no expectations on this issue. This is important to notice since the interviews with faculty members revealed that senior students are expected to integrate linguistic and non-linguistic contents in conducting their senior theses.

Table 5. Amount of mentions and types of learning expectations related to visual communication

Learning Expectations Related to Visual Communication	Occurrences
• Graphic representations to summarize readings (GRSR)	1
• Interpreting symbols in diagrams (SD)	1
• Interpreting symbols in floor plans (FP)	1
• Expressing ideas graphically (EG)	2
• Depicting data collected from labs to interpret results (DDLI)	3
• Tables and graphics to plan and make decisions (TGPM)	5
• Visual communication to represent solutions to problems (SP)	5
Total	**18**

Source: own work

Overall, the analysis shows that since the freshman classes, students are expected to "express ideas graphically by utilizing visuals to summarize, make decisions, and represent problems". Since the junior courses, students must learn how to "interpret standardized symbols that depict information of business and industrial processes and practices," and "create data in labs".

These data show that, as happens with linguistic contents, the students are exposed and asked to produce visuals that can count as contents for writing to learn (e.g., "graphic representation to summarize readings"), research writing (e.g., "depicting data collected from labs to interpret results"), or professional writing (e.g., "interpreting symbols in floor plans").

Discussion

The analysis of the interviews and syllabi shows that, in this major, the students are expected to learn about content knowledge through writing "reports" of case studies, labs, readings, and senior theses.

The most frequent expectation inferred by the syllabus analysis ("Making claims to analyze case studies based on theoretical frameworks of the class") suggests that writing case studies is an important means to help students gain ownership of concepts; in fact, the interview data also reveals that faculty members are expecting that students can reutilize case studies and extend their scope to fulfill the senior thesis requirement.

Regarding the syllabi, the analysis discloses that students are expected to integrate linguistic and non-linguistic contents (tables and graphics) to analyze problems and make decisions in companies or depict information of business and industrial processes. This finding is also related to the expectations informed by the interviews regarding "senior theses may open job opportunities for students," "Senior thesis should include how to make decisions to improve companies' processes and practices," and "Senior theses should be documents clearly written by following the research format expected, and integrating linguistic and non-linguistic contents to convey a bounded problem and a professional solution accordingly." The latter, in turn, is associated with local features of the economy that indicate that practitioners will be likely professionals in businesses.

The analysis also reveals that there are explicit expectations on writing at the extremes of the program belonging to different writing epistemologies: in the freshman year and in the senior year, but there is no overt connection between these two learning moments and expectations. There are, for

instance, different writing expectations to freshman year in two different classes: "writing by negotiating meanings with others" (humanities writing in FYC) vs. "mastering an engineering protocol for projects" (professional writing in Introduction to Engineering), and later in the senior year the expectations are mainly related to learning about senior thesis writing in the research seminar (research writing).

Regarding expectations on ownership, authorship, and mastering intertextuality, the analysis also discloses diverse practices expected in different times and spaces. During the first year, at least three courses share the following expectations regarding humanities writing, writing to learn, and intertextuality practices: "Reading bibliographic resources carefully"; "Writing implies prior reading and intertextuality"; and "Addressing writing as a process." Mastering intertextuality appears as an expectation in the FYC class, "Writing for developing a personal voice respectfully among others' vantage point," while in the senior year, it is expected "a personal voice and critical stance based on theoretical concepts" in a class on finance and budgets, and in the research seminar is expected "a personal voice embedded among others while avoiding plagiarism." Between semester 7 and 8 in the research seminar, the following freshman expectations emerge once again: "Addressing writing as a process," "Writing implies prior reading and intertextuality," and "Reading bibliographic resources carefully." This reappearance of writing expectations across curriculum might count as evidence that there are writing goals that exceed the curricular time of a class to become developmental writing goals to be better approached as endeavors across the curriculum.

This finding might be an important topic to further discuss and negotiate with faculty of the program to create differences between types of reports and, especially, writing outcomes of the classes (e.g., case study reports or lab reports) and developmental writing goals (e.g., mastering intertextuality in a professional report vs. in a literature review of a research report). The influence across diverse classes might better achieve this developmental writing goals.

Ultimately, the analysis reveals the presence of different writing epistemologies: one that is *valuing meaning negotiations and finding the own voice among others point of view* (humanities writing), the next one utilizing writing for *comprehension and learning* (writing to learn), another *praising standards/formats and used for solving problems in companies* (professional writing), and also another one advocating for *senior thesis writing* (research writing). This coexistence of writing epistemologies might explain some of the challenges

for accomplishing the senior thesis requirement that the faculty members mentioned in the interviews since all these epistemologies must be integrated and repurposed at some degree by senior students when accomplishing their senior theses.

Limitations and further steps

Data collected are not enough[11] to explore differing expectations across years related to *professional and research writing*. Nor does this study explore variations among classes and semesters regarding writing reports for case studies, lab reports, and senior theses. Further analyses on these regards will be needed.

This study ultimately reveals the presence of writing variation in this major, but it is insufficient to explore to what extent these students are aware of these variations to generalize while learning disciplinary concepts, developing their writing theories, or recognizing differences among humanities writing, writing to learn, professional writing, and research writing.

Conclusion

This paper offered insights that might inform writing curriculum design in a specific engineering subfield by including learning expectations of writing comprised of linguistic and non-linguistic contents of a Colombian major in industrial engineering. Overall, the analysis reveals the presence of diverse sets of writing epistemologies: humanities writing, writing to learn, professional writing, and research writing. The analysis relied on the syllabi as these might offer a methodological approach to be replicated by other writing advocates to create grounded categories for learning expectations related to methodologies to become a practitioner, and systems of values to comparing, criticizing, making claims, and drawing conclusions to learn disciplines/fields. Such methodological strategy contributes to understanding Writing Studies as an interdisciplinary domain between writing specialists and disciplinary instructors.

[11] Data here presented are only derived from two interviews with faculty members (out of approximately 27 in charge of the professional courses), and from 18 syllabi out of 53 in total that comprise the undergraduate program.

Ultimately, findings offer preliminary accounts regarding writing abilities necessary to complete an undergraduate major of Industrial Engineering. Since the analyst has created the data collection and analysis as a doctoral student, further institutional work must be done between engineering and writing instructors to negotiate the pertinence of the accounts to frame future pedagogical interventions and curriculum design.

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