

Aspects of Multilingual Writing of Biology Laboratory Reports

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Summary: A subset of student biology laboratory reports written by multilingual writers from a dissertation study reveals some differences between multilingual writing in comparison to non-multilingual writing. This article identifies some of the features of four ESOL students' technical writing abilities and whether these writing features are achieving the goals for science, technology, engineering and mathematics (STEM) writing.

Keywords: multilingual writing, laboratory report, technical writing, STEM

Students in science, technology, engineering, and mathematics (STEM) courses are likely to need to write a laboratory report as part of their required courses at the undergraduate level. Often, discipline courses do not offer specific language support for their written assignments, nor do university English courses typically provide instruction for these types of assignments. An English language learner or a multilingual writer may therefore not know how to even begin to write them.

Background

This article is a brief analysis of how four multilingual writers from one particular lab section of a larger lecture/lab introductory biology course at a state university wrote the required lab report for their lab section final assignment. These four students were identified by the fact that they took the university's English composition for multilingual writers. All analyses were conducted after the completion of the semester with university IRB approval, and there was no interaction between the students and the researcher. The four multilingual writers' papers were compared to two full score student papers from the same lab section. Table 1 reports the scores of the papers analyzed.

Literature Review

In terms of science or expository texts, Fang (2008) has identified four distinct features used when addressing science: Information density, abstraction, technicality, and authoritativeness. Information density refers to the amount of information placed in a sentence in the form of nouns

or noun groups. Abstraction refers to the idea that the written content tends to include more abstract concepts in comparison to concrete objects. Technicality refers to the technical vocabulary needed to express the concepts discussed. Lastly, authoritativeness refers to the fact that there is limited use of first person in order to establish a level of authority for the author. These concepts proposed by Fang can help us understand the difficulties multilingual students have in reading science or other expository texts. Further, these four elements can make it difficult for multilingual writers to learn to be effective science writers due to difficulty in mastering the grammar required to achieve these desired features.

When multilingual students do not get direct grammatical instruction, they can become even more disadvantaged in writing for STEM courses since they may not have mastered the standard grammatical structures typical for academic writing, and their lack of familiarity with the

Student	Score	Lab section paper score range
ML1	14.5	8.5-20
ML2	19.5	8.5-20
ML3	15	8.5-20
ML4	15.5	8.5-20
NML1	20	8.5-20
NML2	20	8.5-20

Table 1. Scores of analyzed student papers out of a total of 20 points

grammatical structures needed to achieve information density, abstraction, and authoritativeness means they may struggle to achieve the standards required for the science genre. Schleppegrell (2002) noted that the multilingual writers in her study seemed either to use grammatical structures with errors or to use error-free but less complex sentence structures. This type of strategy for error-free sentences could undermine a multilingual student's ability to master the expository writing standards identified by Fang.

This current study focused on the abstract, introduction, and discussion sections of the introduction, methods, results, discussion (IMRD) report format. The papers came from the course's final biology laboratory report, the culminating assignment for the course's lab section. Inglis et al (2007) focused on introduction and discussion sections as those sections would demonstrate whether students were practicing the rhetorical tools that were being taught for science writing. For similar reasons, Gil and Caro (2019) focused on introduction and conclusions for lexical bundles used by undergraduate students.

Swales (1990) states that the purpose of the introduction section for research articles is to create a research space, meaning that a researcher needs to situate the current study in previous science literature to identify what they are investigating. The discussion section takes the results of an experiment or study and interprets the results for additional use. Discussion sections can be difficult to write, whether in a laboratory report or as part of a dissertation (Parkinson, 2011; Shen et al, 2019), with students often desiring to have help to master writing this section. In addition to the introduction and discussion sections, the abstract was also included for analysis because it can also be a difficult section for students to write. The abstract requires an understanding of each IMRD report section

in addition to good summarization skills. Therefore, a focus on these three sections (abstract, introduction, and discussion) could help us understand multilingual student science writing, and could therefore help us to identify exercises to better prepare or support for future multilingual discipline writing.

The final lab reports from the semester in question were collected. The papers from one particular lab section were analyzed for each of the four features identified by Fang (2008): Information density, abstraction, technicality, and authoritativeness. These papers were also recursively analyzed for any distinct features of the student writers of the laboratory report. These features were then compared with other researchers for confirmation of the findings. The laboratory report assignment was to report on the semester-long in-class experiments to identify a new bacteriophage (virus for bacteria) as part of the SEAPHAGES curriculum (Elgin & Shaffer, 2014).

Research Question: How does the written work of multilingual writers achieve the purpose of the lab report assignment and science writing in general?

Findings & Discussion

Three of the multilingual writers (ML1, ML3, and ML4) seemed to struggle more in trying to achieve the aspects of science writing identified by Fang (2008). They struggled with information density, using technical terminology or academic language along with the technical terminology needed to explain the procedures and concepts mentioned. That said, these three writers achieved the basics of the lab report assignment format by having an introduction to the experiment, identifying the methods to conduct the experiment, reporting results and interpreting the results. Writer ML2 had longer noun groups creating

greater information density, but often the longer noun groups that were used resulted from direct quotes from published literature. Table 2 provides some examples of noun groups used by the students in their sentences. The two non-multilingual writers achieved longer noun groups in their sentences achieving greater informational density.

At a more basic level, these four multilingual writers demonstrated some typical writing challenges for multilingual writers. All four of the multilingual writers included citations for their introduction sections. However, a closer look at the citations and references used may not provide the level of authority needed to support the claims of the student

Student	Noun group example
ML1	<i>bacteria</i>
ML2	<i>the phage DNA</i>
ML3	<i>the procedures</i>
ML4	<i>the medical field</i>
NML1	<i>the heads of new phages</i>
NML2	<i>a plaque test that did not have phage</i>

Table 2. Examples of noun groups used by the students in the lab reports for information density

writer, similar to Wette's (2017) findings where the multilingual writers struggled to make good use of their source texts in disciplinary courses. The nature of the subject of biology could, in and of itself, be a challenge for the multilingual writers as it relies more on written language rather than equations common in chemistry or physics (Okamura, 2006). Writer ML2 mixed up the use of family names versus given names for the in-text citations. None of the papers analyzed (multilingual and non-multilingual) used citations in their discussion sections providing explanation for their results, as is typical for interpreting the results of experiments. This indicates all the students in the sample are still learning the IMRD format of writing.

All six students (four multilingual and the two non-multilingual) struggled with mastering bacteria nomenclature. The standards for bacteria nomenclature state that at the first mention of a species, the genus is to be capitalized and both genus and species names are to be written in italics (*Genus species*; i.e. *Mycobacterium smegmatis*). Any following mentions of the species can use the capitalized genus initial with the full species name in italics (*G. species*; i.e. *M. smegmatis*; De Vos & Trüper, 1999). In the three study sections, only ML3 had two instances of italics for the bacteria name in the discussion section. All other bacteria name references were not italicized.

“mycobacterium smegmatis (M. smeg)” (ML2)

“M. smeg” (ML3)

The use of *M. smeg* may result from the way the bacteria were referred to in spoken English during the lab section. One of the non-multilingual writers (NML1) had fairly standard adherence to the nomenclature norms when discussing other bacteria names. However, even though this writer remembered to use italics for the bacteria names, she used *M. smeg* instead of *M. smegmatis* for the bacteria, similar to ML3. NML2 had one or two instances of not italicizing the bacteria name throughout her lab report.

The multilingual writers were more likely than the non-multilingual writers to use contractions or first and/or second pronouns in their papers.

“From animals especially dogs get infected commonly because dogs don't have knowledge that they have to be careful or not” (ML1).

“In the old days treating cancer wasn't possible and therefore, many people died by cancer...” (ML4).

The use of the contractions in these sentences may lessen the authoritativeness of the sentence. The discussion

section was where two of the writers slipped into using first person pronouns.

“Then, we repeated streaking again” (ML3)

“However, I had learned many biological skills ...” (ML4).

The use of first person pronouns seems to demonstrate some confusion regarding the purpose of the discussion section especially for writer ML4, who lapsed into narrating what was individually learned rather than interpreting the results from the experimental procedures.

What is interesting is that in the discussion sections studied none of the multilingual papers effectively make an argument about the point of the assigned experimental procedure (to find a new bacteriophage). Parkinson (2011) states that discussion sections should show cause and effect relationships in the grammatical structures used. These papers demonstrate a repetition of the results in the discussion but little to no explanation of the achieved results other than possible reasons for them being inconclusive. Writer ML2, the strongest multilingual writer, demonstrated a greater range of sentence structures to explain the achieved results, and the range of sentences was more similar to the sentence structures used by the two non-multilingual writers. The repetition of the information in the results section could be a part of the difference between laboratory reports and research articles (Parkinson, 2017). This repetition of the information could also mean that the students have an incomplete understanding of the exact purpose of the discussion section, as discussion sections are intended to provide an interpretation or explanation of the results achieved (Parkinson, 2011, 2017).

The findings of this analysis show that multilingual students may not have the full linguistic ability to achieve the needed purposes of the lab report. Nor do the students have good exemplars, as they mainly read textbooks but are then expected to produce a completely different genre (i.e. the laboratory report).

This article also suggests that multilingual writers may need more direct grammatical instruction in order to achieve all the requirements to write a paper that will meet the needs for scientific writing, whether in the content/discipline course or in a language course. These four multilingual writers probably needed more direct instruction regarding the technical writing needs of the assignment. This analysis also shows that multilingual writers are attempting to meet the criteria and not ignoring the criteria of the laboratory report assignment.

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