INVESTIGATION OF LANGUAGE USED IN ENGINEERING ASSESSMENT

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INTRODUCTION

Inclusivity in the classroom is diminished when the instructional material is inaccessible to the students. One particular example that is pertinent to engineering education is the use of unfamiliar language during assessment. As instructors, we want to help students learn in an environment that is accessible, but also want to promote a robust technical vocabulary.¹ However, when we begin to test the student's understanding of non-technical vocabulary as part of a final exam, for example, we are affecting the validity of the assessment because not all students have the same background (academic, technical, cultural, etc.). This problem is particularly relevant to engineering education in Canada because of the very diverse student body in many of our engineering institutions.

Prior interpretations of accessibility were often limited to physically-disabling environments, or a learning population that had a diversity of physical needs and accommodations. More recently, however, the literature suggests that other types of disabling environments are present in higher education, and that many of them negatively affect inclusivity in the classroom.² As a result of increasing diversity, we need to analyze the inclusivity of our instructional and assessment material to maximize accessibility for all students.

Language is one barrier to inclusivity, especially when it is unfamiliar and misunderstood by the learner. One assumption that can lead to inaccessible language in the classroom is that all students have the same vocabulary as one another and the instructor. This assumption isn't true, particularly in diverse learning environments, because many of the cultural undertones of a language are different from individual to individual. Thus, whereas one student may be familiar with the word "toque", another may refer to it as a "wool hat", and so forth. In engineering education, technical terminology to a particular discipline is generally explicitly taught, but other "plain language" vocabulary is often assumed. Specifically, we are attempting to classify the language used on an engineering education artifact, engineering exams, to investigate the effect that language has as a barrier to an inclusive and accessible learning environment.

The contextualization of engineering problems in course material and assessments can also constitute a barrier to inclusivity when it is inaccessible to the learner. Authentic contexts often add depth to the realism of engineering problems, and are often used to describe the technical fundamentals of engineering. However, the barrier to accessibility arises when there are differences between the student's background (experience) and the context chosen. For example, if we use the context of an airplane cockpit to demonstrate technical material in an ergonomics course while assuming that all students are familiar with this context, we are creating an environment that alienates a portion of the learning population. However, adding information that helps better describe the context may assist to better understand the situation. This may be true for analyzing inaccessible language as well. Specifically, we will be investigating the role that context plays (if any) in helping make inaccessible language identifiable for the learner, and if context can help mitigate this learning barrier altogether. For example, we are studying cases like when the word "toque" is used in a sentence that describes its meaning, and if that would make it less inaccessible versus using another word altogether.

METHODOLOGY

In this study, an electronic bank of final exams from engineering courses at the University of Toronto is analyzed for inaccessible language. Final exams are chosen as the artifact for study because they are standardized and closely-supervised, and so they are comparable to one another to some degree. Further, invigilators of these exams are not permitted to provide clarification to the students having difficulty with the language; there is no alternative way of increasing accessibility of the language ad-hoc during the exam. Additionally, if the language is inaccessible on exams, then it may constitute an invalid performance assessment of the learner.

The analysis begins with a quantitative approach to identify characteristic words and remove discipline-specific words. This approach uses a method called Term Frequency Inverse-Document

Frequency (TF-IDF) which is well-known for information retrieval technologies, to determine characteristic and diagnostic words on electronic documents.^{3,4} In this study, we find the characteristic words of an exam by comparing the occurrence frequency of each word in the exam with two different corpora of vocabulary. First, discipline-specific words are identified and removed from the study by comparing the frequency of words to a corpus relevant to various engineering disciplines. Specifically, we:

1. Input all of the words from a particular exam into a database,
2. Calculate the occurrence frequency of each of those words
3. Compare this number to the occurrence frequency of that word in the Corpus of Canadian English.

Using this method, we are left with words that are diagnostic to the exam we are processing. These words may be "inaccessible" to an average reader because they occur infrequently in Canadian English, but are diagnostic to the exam.

The next step is to remove discipline-specific words from the study, because these words may comprise part of the technical fundamentals of the course. This is performed in a manner similar to the one described, but the corpus being used is now engineering discipline-specific. As a result of these two steps, we are now left with a database of words that are likely non-course specific and potentially inaccessible.

The output from the quantitative phase is used as the input for the qualitative phase; this phase evaluates the effectiveness of using TF-IDF for finding course-specific and potentially inaccessible words. Specifically, the qualitative phase uses interviews with human subjects to indicate whether words are accessible or inaccessible and whether the quantitative strategy was useful for finding inaccessible words accurately. In this phase, we test the accessibility of these words independent of an exam, as-used in an exam, out-of-context and in-context to help us develop a broader picture of the language used in engineering examinations. For example, we test whether the accessibility of a word changes with context, and how this potential change is perceived by the human subject.

This study attempts to provide insight about how language can be classified on engineering exams and this information can help inform approaches to reduce inaccessible vocabulary on engineering exams. Currently this is a work-in-progress that in the quantitative phase; we are in the process of understanding the pertinent literature on this matter and performing preliminary work to extract words from the engineering examinations.

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