

Reading matters in First Year Electrical Circuits Course

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Abstract – In Fall 2015, over 30 percent of the 216 first year students who were enrolled in Electrical Circuits (EMT1150) did not pass the course, which is required for the Associate Degree in Applied Science (AAS) in Electromechanical Engineering Technology (EMT) at New York City College of Technology. The reason for the low pass rate is complex. Some students have insufficient skills in Math, while some cannot grasp the concepts of problem solving techniques, but the most fundamental problem is that students are under-prepared in learning through reading texts, even after they purchased the expensive textbook. On the other hand, instructors also struggle with teaching specialized concepts, formula, and technical terminologies because of various levels of their readability and the lack of strategies to engage students in active reading and learning.

In this paper, we will examine the challenges students face in reading to learn in EMT 1150. First, we will review the correlation between students' reading proficiency and their performance in the course. We will analyze the results of reading assessments administered in two sections (N=41) of EMT1150 in Spring 2016, which reveal students' level of ability to comprehend, analyze, and evaluate information in their textbooks. This will allow us to identify the impact of students' reading skills on their ability to learn in EMT1150. Secondly, we will look at how students' reading habits affect their performance in the course, which will shed light on how they study outside of the classroom.

We will also describe the Reading Effectively Across the Disciplines (READ) program, a college-wide initiative established in 2013 to train faculty to implement instructional strategies and develop assignments to facilitate reading to learn across the disciplines. In this program, participating EMT faculty work with reading faculty to enable students to become strategic and effective readers and improve their disciplinary literacy.

Index Terms – college reading, Electrical Circuits course, engineering textbook, text comprehension

INTRODUCTION

New York City College of technology (City Tech) is a part of City University of New York, currently offering

baccalaureate and associate degrees, as well as specialized certificates. The college has an open admission policy and serves a diverse student population. It has seen a 50% growth in enrollment in the last 10 years, and in Fall 2015, the enrollment has reached 17,424. According to a recent student experience survey, 43% of the students were born outside of the U.S. and 62.3% reported language other than English spoken at home [1]. Because of the high percentage of English as Foreign Language learners and the open admission policy, many incoming students are not college ready in academic literacy and are required to take developmental courses in reading.

For students who are underprepared for college-level reading, learning through reading texts is especially challenging, especially in STEM disciplines, in which technical information, specialized concepts and vocabulary are extremely complex. Even for students who have reached the general college reading level, while reading STEM content, they still encounter difficulties. This happens especially when proper strategies and directions from instructors are not available, for reading STEM content often requires close reading, with attention to details [2]. In this paper, we examine the challenges students face in reading in Electrical Circuits (EMT 1150), a required first year course in the Computer Engineering Technology (CET) Department.

Electrical Circuits (EMT 1150) introduces students to the physical basis and mathematical models of electrical components and circuits. Topics include Ohm's Law, Watt's Law, resistance, series, parallel, and series-parallel circuits, network theorems, equivalent circuits, capacitive and inductive circuits, as well as sinusoidal ac inputs. Laboratory work is performed on a breadboard using the digital multi-meter, oscilloscope and function generator. EMT 1150 is the first formal engineering course requiring intensive reading and analytical skills. Very often students experience a steep learning curve in EMT 1150, as it has always been identified as one of the most challenging courses in the department. In Fall 2015, over 30 percent of the 216 first year students in EMT1150 did not pass the course. The reason for the low pass rate in this course is complex. Some students have insufficient skills in Math, while some cannot grasp the concepts of problem solving techniques, but the most fundamental problem is that students are underprepared in learning through reading texts, even after they purchased the expensive textbook.

The textbook used in this course is *Introductory Circuit Analysis, 13th Edition* by Robert, L. Boylestad, published by Pearson. Comparing to other textbooks in the market, which are relatively theoretical, and math oriented, this book covers actual circuit analysis without relying heavily on skills in calculus, making it accessible to our students. Besides, this book has enough illustrations and figures to introduce the key components and examples in real-life applications. It also provides substantial references and resources for further research if students want to study more in depth. Despite all its merits, from our experience, students always feel overwhelmed by the size of this book, which has more than one thousand pages, and the complexity of the technical terms and concepts in the text. Students in the course also need to be prepared for the cognitive processes involved in both the lecture and lab components, including various levels of concepts and tasks that require multiliteracies in the forms of traditional text, symbolic and graphic expressions both in print and electronic sources [3].

In this paper, we present the results of our survey on students' academic reading and our reading assessment; both were administered in two sections (N=41) of EMT 1150 in Spring 2016. From these results, the reading habits of this group of students are analyzed and correlated to their reading levels and course performance.

METHODOLOGY

1. Survey

In Spring 2016, we administered an online study of students' academic reading under the college-wide Reading Across the Disciplines (READ) program in the first year Electrical Circuits course (EMT 1150). Students were recruited in two sections of EMT 1150 to respond to an online survey on an anonymous and voluntary basis outside of the classroom. There were 40 items in the survey. Of the 41 students in the two sections, 30 responded to the survey. Data were collected and analyzed using Excel. Eight items related to the students' linguistic and literacy backgrounds, challenges they face in and their perception of college reading in their course were selected for discussion in this paper.

2. Reading assessment

In the same two sections of EMT 1150, we administered a student reading assessment, using an excerpt from the course textbook. Based on the READ assessment rubric, which evaluates four different competencies in student reading—comprehension, analysis, context, and evaluation—EMT and reading faculty designed assessment questions. The descriptions of each competency are as follows:

- **Comprehension-** Ability to understand the main idea and major details in the text and make logical inferences.

- **Analysis-** Ability to identify patterns of organization, understand and analyze the relationships among ideas, and interpret information presented in diverse formats and media.
- **Context-** Ability to use concepts and ideas in the text to solve problems proficiently or make connection/apply them to a new context accurately and in a meaningful and relevant way.
- **Evaluation-** Ability to evaluate the purpose, argument, or specific claims in a text with adequate support, including valid reasoning, relevant and sufficient evidence.

The assessment contained eight questions, with two questions each in comprehension, context, analysis, and evaluation. The length of the passage was around 1500 words, including equations and formulas. The assessments were graded based on a scale of 1 to 4. An answer key for each question was developed. The range of the scores represents the highest proficiency (4) to the lowest (1), following the scale of 4=Full proficiency, 3= Some proficiency, 2=Low proficiency, 1=Very low proficiency. Responses (n=41) were analyzed using Excel.

RESULTS

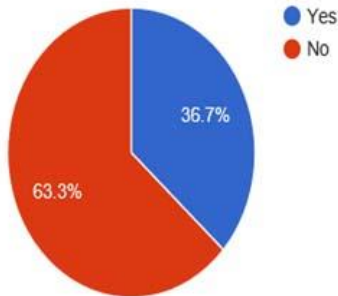
1. Survey results

An online survey was conducted on an anonymous and voluntary basis to gather information on student reading in two sections of EMT 1150. Of the 41 students in the two sections, 30 responded to the survey. Figure 1 shows their linguistic and literacy backgrounds, and their general attitude towards academic reading. Figure 1(a) shows that about 63.3% of the students have different primary language other than English at home, which is in line with the data reported about school population. The responses also reveal that 40% of students were required to take a developmental reading course, as shown in Figure 1(b). Meanwhile, most of the students recognize the importance of reading as shown in Figure 1(c); over 82% of students either agree or strongly agree that reading is important to their college success.

Reading STEM textbook is a big challenge to our students. Figure 2 shows the survey results of students' attitudes toward STEM textbook, the challenges they face in reading, and their reading habits. Students generally agree that the textbook used in the class is interesting. As shown in Figure 2(a), 40% of the students agree or highly agree with the statement. What is also worth noting is that 56.7% of the students are neutral about the statement. Meanwhile, about 23% of students agree or strongly agree that they have difficulties in understanding their STEM textbooks, and more than 56% of students are neutral about this, as shown in Figure 2(b). Among the difficulties in reading the texts, students identified reasons that are listed in Figure 2(c); "difficult vocabulary," "not having enough background knowledge on the topics," and "hard to retain/memorize information" are among the top three challenges. Other

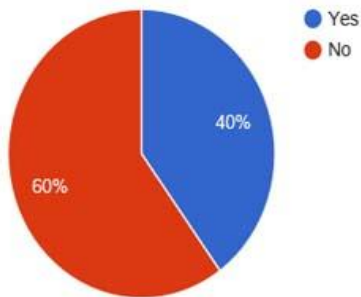
important reading habits of our students are shown in Figure 2(d). About half of the students (46.7%) read their textbook more than a few times per week, and about the same percentage (43.3%) of the students never or seldom read their textbooks, or only read them before tests.

English is your primary language



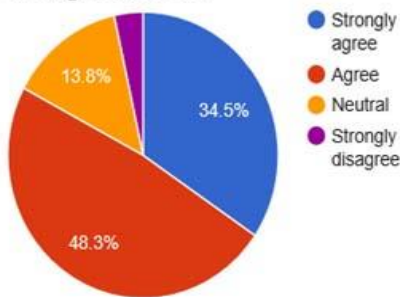
(a)

You are (were) required to take a developmental reading course.



(b)

Reading is important to your college success.



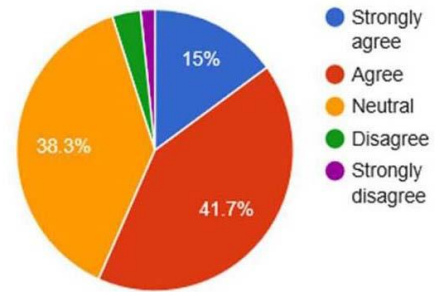
(c)

Figure 1. Survey results about students' linguistic and literacy backgrounds, and their attitude towards reading in general.

2. Students assessments

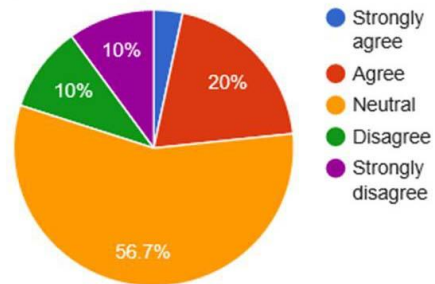
Based on the criteria in each category described in section 2, a reading assessment was developed, using a passage from the EMT1150 textbook. The assessment included two questions in each category; comprehension, context, evaluation, and analysis. First, students in two sections (n=41) read the passage closely and then answered the questions. Students were given 30 minutes to complete the

Your STEM textbook is interesting.



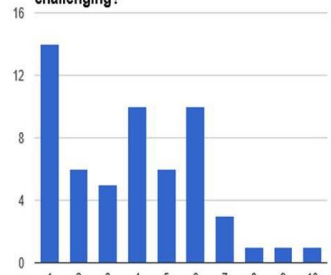
(a)

You have difficulties understanding your STEM textbook.



(b)

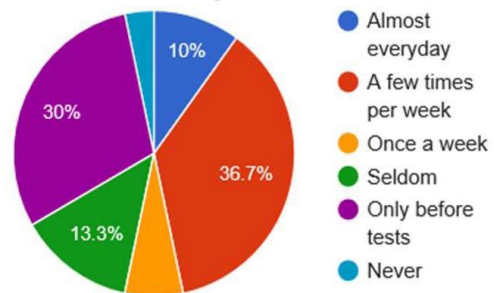
From your experience, which of the following factors make reading the texts challenging?



- 1 = Difficult vocabulary
- 2 = Unable to understand relationship among concepts
- 3 = Unable to understand the structure/organization of the textbook
- 4 = Not have enough background knowledge on the topics
- 5 = Unable to relate content to real life experience
- 6 = Find is hard to retain/memorize information
- 7 = Instructors do not provide sufficient guidelines for reading for reading the texts
- 8 = Unable to imagine the texts
- 9 = Not interesting
- 10 = Lack of time to complete readings.

(c)

How often do you read your textbook/ text material for your STEM classes?



(d)

Completion of assigned readings count towards your final grade

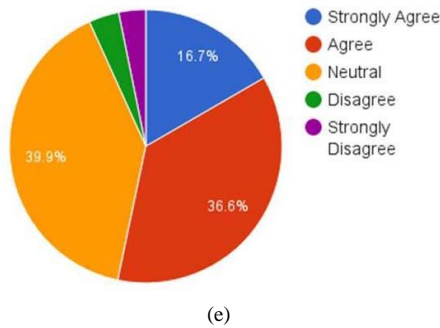


Figure 2. Students' attitude toward STEM textbook, the challenges, and their reading habits.

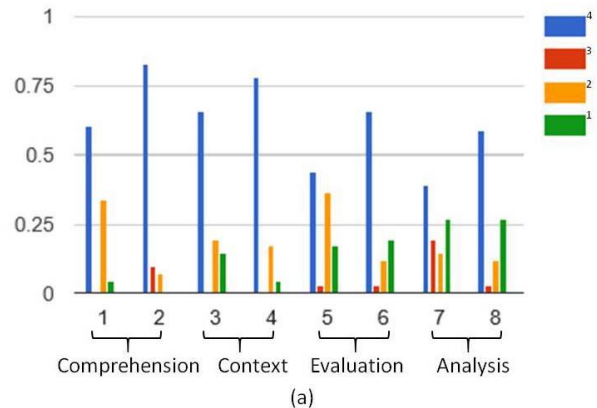
task. The assessments were graded based on a scale of 1 to 4 (4= Full proficiency, 3= Some proficiency, 2=Low proficiency, 1= Very low proficiency.) The full assessment results are shown in Fig. 3(a). The percentage of students who attained full proficiency in each category is shown in Fig. 3(b). About 70% of the students were proficient in comprehension and context, but only 55% and 48% of them were proficient in evaluation and analysis, which are the most important cognitive skills required for this course. A correlation analysis was conducted between the midterm exam scores and reading assessment average scores. The correlation between those two variables was .764, as shown in Fig 4. The result indicates positive association between midterm exam scores and pre-assessment average scores. In other words, students who performed well on the midterm also had higher average scores in the reading assessment.

CONCLUSION AND DISCUSSION

The preliminary findings of our study show that students in EMT 1150 need to read proficiently in the discipline in order to succeed in the course. Despite the fact that most students consider reading as important to their college independently. Reading the course textbook, which requires high-level cognitive skills and reading proficiency can be challenging, especially for EFL students and those who need developmental reading courses, both groups represent a high percentage of student population in the course.

According to our survey responses, as shown in Figure 2(b), more students have difficulties in understanding their textbooks than those who do not. What is noteworthy is that a very high percentage of the students are neutral or have no opinion (56.7%) about if they have difficulties understanding their textbooks. This can be attributed to their lack of metacognitive ability to monitor their understanding of the text or their lack of familiarity with the text because they do not read it often enough. This can be supported by their evaluation of whether their textbooks are interesting, because the percentage of students who are neutral about if they have difficulties in understanding the text is exactly the same as that who are neutral about if their textbooks are

interesting and informative (56.7%). When students do not read their textbooks, they simply cannot tell if they are difficult to understand and if they are interesting.



Assessment performance

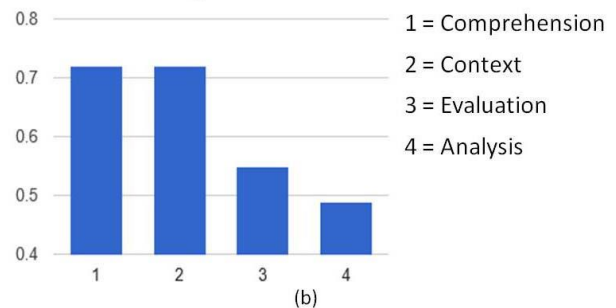


Figure 3. Assessment results

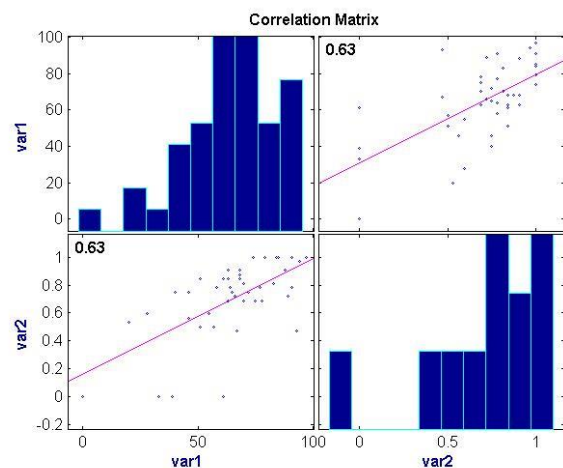


Figure 4. Correlation between Midterm and Reading Assessment

Students identify difficult vocabulary to be the main challenge for them to understand the text. Given the high conceptual density and the large amount of technical terms and equations students need to learn, the reading level of the required textbook for the Electrical Circuits course is significantly above what many students can handle. The difficulty is further multiplied by students' lack of prior knowledge in the subject, which in the survey is also

identified as a main contributing factor to their difficulty in understanding the text. When concepts and terms are not fully understood and when prior knowledge are not activated or developed before learning the content, students often resort to memorizing facts and information that do not contribute to any improvement in their disciplinary literacy. It is also hard for students to memorize information without full comprehension.

While some students read the textbook frequently, some never or seldom read it or only do so before tests (Figure 2(d)). When analyzing the responses of students who reported if the completion of assigned readings count towards their final grades (Figure 2(e)), we see that the percentage of students who agree or strongly agree with this statement is similar to those who read their textbooks frequently (a few times per week). This shows that students read their assigned readings only when they are necessary, and when they count towards for their final grades.

When comparing our reading assessment results with students' midterm scores, we notice that there is a strong correlation between student performance in the exam and their reading proficiency. The percentages of those who achieve various levels of proficiency in the assessment correspond with the respective performance levels in the midterm. About half of the students in the study underperformed in both the reading assessment and the exam.

To address the challenges students face in reading in content area courses, a college-wide Reading Effectively Across the Disciplines (READ) program was established in 2013 to prepare students in strategic reading. This study conducted by READ helps us understand the specific literacy needs of our students in EMT1150. The results inform the development and implementation of strategies and approaches that target at those needs.

In Fall 2016, READ will continue to serve as a collaborative teaching and learning platform to strengthen students' reading proficiency and disciplinary literacy, especially in evaluation and analysis, with special focus on vocabulary development and building students' prior knowledge of main topics in EMT1150 and EMT1255, a higher level Electronics course. Apart from strong vocabulary skills, adequate prior knowledge and familiarity with a topic facilitates basic comprehension. This can leave the reader free to make connections between the new material and previously learned information and other cognitive tasks [4]. Our next step is to conduct a full study on student reading in EMT 1150, in which we will examine the effectiveness of our existing and new interventions to enhance students' disciplinary literacy. One of the new components we will introduce in this course is peer-led readings to foster students' skills in analysis and evaluation.

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