ASSESSING THE ABILITY OF STUDENTS TO SELF-EVALUATE THEIR LEVEL OF COMPREHENSION IN A 1ST YEAR CHEMICAL ENGINEERING COURSE

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Abstract –Self-regulated learners have the ability to accurately assess their own level of learning, and to adjust their learning methods in order to master their learning. These types of learners generally show a strong persistence, and are most likely to succeed in their academic career [1].

To help determine whether students already possess the skill to identify their academic capabilities, a self-assessment and reflection method was employed after every lecture in a first year chemical engineering course. The students were also tested at the beginning of the next lecture to determine the accuracy of their self-assessment. To have an academic goal, students were asked at the beginning of the course to estimate their desired lowest mark.

On average, students overestimated their ability 47% of the time, and student did not show an improvement on their level comprehension over the course of the semester. Also only 22% of the students obtained a mark that was equal to or greater than their desired lowest mark.

Keywords: Self-assessment, Self-regulated learning, First-year students

1. INTRODUCTION

Many universities today face major operational challenges with a restricted supporting funds from provincial governments and increasing operational budgets, thus student retention has become an important topic at many institutions. Although enrollment to engineering has increased in the past 20 years, the percentage of engineering graduates has actually decreased [2]. Many studies attempting to predict student success have focused on pre-university markers such as grade point average (GPA), high school rank, and other demographics; however, the correlations are generally weak and do not represent all influential factors [3]. In another it was found that the lack some societal factors

such as good interactions with their instructors and peers had more of an effect on student retention than academic skills and abilities to adapt to the high demands of engineering curriculum [4].

Students who are self-regulated learners (i.e., masters of their learning) are also more likely to persist [1]. Generally these students proactively seek out information when needed and take the necessary steps to become proficient in a given topic. Self-regulation is composed of a three-phases for a particular event: forethought (before), performance (during), and self-reflection (after) [5]. An event in an academic setting is usually a test or midterm. The self-reflection phase can be used to adapt and prepare for the next event and can be viewed as an internal feedback mechanism to adjust for the next assessment [6]. Self-regulated learning also aligns well with Graduate Attribute 12, life-long learning, for the accreditation process of the Canadian Engineering Accreditation Board (CEAB), and is a skill that all new Canadian engineers must have upon graduation.

Self-assessment can be done both qualitatively and quantitatively, and accurate quantitative assessments can help students be more realistic about the grades they are able to accomplish [6]. Self-assessments are generally completed after tests and midterms, but has not been studied on a continuous basis, such as after each lecture.

This work focuses on the self-assessment and evaluation of student knowledge after each lecture of a first year chemical engineering course. With the multitude of self-assessment and evaluation exercises, it is expected that students will start to accurately assess the level of comprehension by the end of the semester. Since a first year course was studied, it is also expected that the majority of students would likely overestimate their level of comprehension on a given topic, as lower year students generally lack the metacognitive abilities to evaluate their abilities.

2. METHODOLOGY

This study focuses on the results from a cohort in a first year chemical engineering course. Academic expectations of a student can have an impact on the level of commitment the student has for a course. For example, if a student is expecting to receive a high grade, then the level of commitment to studying and understanding the course material is anticipated to be high as well. Similarly, setting a goal for a course could help a student stay motivated as they evaluate his or her own progress.

Therefore, prior to any formal lecture, students were asked to report their expected lowest grade (e.g., B+, A-, A, etc.) for the course. Throughout the semester at the beginning of each lecture, students were quizzed for approximately one minute, based on the material from the previous lecture. These one-minute quizzes consisted of four concept-based questions that were either true or false, multiple choice, or short answer.

Similarly, at the end of each lecture, students were given an exit ticket to reflect on their level of understanding of the lecture. The exit ticket consisted of three separate questions:

1. How well did you understand today's material? (Multiple choice)
 - a. Totally got it.
 - b. Pretty well.
 - c. Not very well.
 - d. Not at all.
2. What was the most difficult aspect of the lecture? (Open-ended)
3. What was the least difficult aspect of the lecture? (Open-ended)

Both the one-minute quizzes and the exit tickets were completed using Socrative (<http://www.socrative.com>), an online quizzing platform.

The level of comprehension of a student was evaluated by the response of question 1 of the exit ticket for a lecture and with the evaluation of the one-minute quizzes at the beginning of the following lecture. This was calculated by dividing the score of the one-minute quiz by the coded score of question 1 of the exit ticket where the value of *Totally got it* equates to 4, *Pretty well* equates to 3, etc. If the score was above one, equal to one or below one the student underestimated, accurately estimated, or overestimated his or her level of comprehension respectively. There was a maximum of 13 possible evaluations per student. If the student did not complete the one-minute quiz, then the datum point was omitted. Questions 2 and 3 were not used in this study, but may be used in future studies.

Students were not informed that the exit tickets would be paired with their one-minute quiz from the next class to avoid biasing students with an extrinsic motivator. It is

important that self-regulated learning becomes an intrinsically motivated skill.

3. RESULTS AND DISCUSSION

Of the 117 students registered to the course, only 58 students reported their expected final mark. The 58 students were therefore used as the dataset for this work. For each student, the percent of time he or she overestimated, accurately estimated, underestimated, or did not complete the self-assessment over the course of the semester was calculated. These values were averaged for the 58 students and are reported in Figure 1. On average students overestimated their ability 47% of the time, and were only able to accurately estimate their level of comprehension 19% of the time.

Fig. 1. The average percent of self-assessments that students overestimated, accurately estimated, underestimated, or did not complete. The error bars represent the 95% confidence interval of the average.

The overestimation of comprehension was partly expected since this study was focused on first year students who likely have not developed precise self-assessment skills. It was expected that students would ultimately improve their ability to accurately self-assess; however, no trend was observed as students progressed through the semester when investigating self-assessments with respect to time.

The expected grade of a student was also compared to their actual final grade to determine whether goal-setting would help motivate students to adjust their study habits over the course of the semester. A plot of the expected grade vs. the actual grade is shown in Figure 2. Data points below the 45° line meant that students received a grade lower than their desired lowest grade. Also, the further the data point from the 45° line, the larger the difference between the actual and expected grades. Only 22% of the students obtained a grade that was equal or greater than their desired lowest grade, which signifies that first year students may not be realistic for their

academic expectations and may not have made any significant changes in their study habits.

Fig. 2. The difference in the expected grade and actual grade received by the student.

The self-assessments for each student was also averaged over the course of the semester and was compared to the respective difference between their expected and actual grade (Figure 3). A negative difference meant that the student received a grade below their lowest expected grade. For example, if a student expected an A in the course but received a B+ then then difference is -2. With an average self-assessment greater than one, only three students underestimated their level of comprehension, and only one of those students were able to achieve his or her desired grade. The rest of the students, or 95% of the students, overestimated their level of comprehension, and the majority of the students did not obtain their desired grade.

Fig. 3. The average self-assessment for each student vs. the difference between his or her expected and actual letter grade.

Even though few students underestimated their level of comprehension, showing perhaps a lack of self-

confidence, this did not translate into achieving or exceeding their desired grade. This may be that students do not see rgw self-assessment exercise after a lecture as a meaningful activity. Perhaps after more impactful other events such as a test or midterm students may find self-assessments more meaningful. It may be beneficial to couple the self-assessment exercises after each lecture with other self-assessments after tests and midterms to have a larger influence on student comprehension.

4. CONCLUSIONS AND FUTURE WORK

Overall students were not able to accurately self-assess their level of comprehension for a first-year chemical engineering courses. Since this was a first-year course, it was expected that the majority of students would likely not possess the adequate skills to self-assess and to adjust their study habits to succeed. Students were also not able to improve their ability to self-evaluate over the course of the semester as no significant trend was observed. Even students that underestimated their abilities did not necessarily obtain or exceed their desired grade in the course. This suggests that performing self-assessment exercises after each lecture may not have a large impact on the final grade of student; however, coupling these exercises with ones after more impactful assessments such as tests or midterms may be more useful.

For this study, students were not educated on the importance of self-assessment, nor were they provided with any intervention techniques to help improve their performance. In future work emphasizing the importance of self-regulated learning and assessment will be studied to see if the grades and ultimately retention of students improve. A similar study can also be completed in upper-year courses to determine if these skills are developed subconsciously over time. Such a study would also benefit the required development of Graduate Attribute 12, lifelong learning, of the accreditation process..

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