The CEEA graduate attributes (listed in Fig. 2) are diverse, requiring a wide range of skills, and have challenged faculty and instructors to develop new ways of teaching and assessing engineering students. Many of the graduate attributes depend on each other and rely on qualitative assessment which adds to the challenge [5]. While the graduate attributes are frequently discussed at the CEEA conference, there has not yet been a comprehensive review looking at how they are being assessed across Canada. Assessment plays a critical role in student motivation and learning [2], and the discussion is very important.

“The advancement of engineering education in many ways depends on assessment. High quality assessments can provide educators with information they can use to move the field forward. Inadequate or poorly constructed assessments can cause educators to pursue ineffective paths, resulting in the loss of time, money, and energy.” [3, p. 12]

**Assessment**

Good assessment should both improve student learning, and improve curriculum and programs [4]. Assessment is the deliberate use of multiple methods to analyze student learning, and not all aspects need to be graded [5]. “Assessments vary in scope (simple to complex), time frame (short-term to long-term), setting (decontextualized to authentic), and structure (directive to unstructured) [5, p. 352].” Assessment should be thought of as a collection of evidence gathered over time.

Diagnostic assessment is extremely important, as it provides information on where students currently are.

Formative assessment is widely understood to be an essential part of learning. “Formative assessment […] is to be interpreted as encompassing all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged [5, p. 7-8].” In formative assessment, students receive feedback on their progress, and their progress informs what is done in the classroom.

Summative assessment is used to provide grades and evaluate what students have learned.

**Methodology and Results**

The data for this research comes from the 2010-2017 CEEA conference proceedings [7]. These papers were categorized manually in two stages. First, by the orientation of the paper; program level assessment, learning opportunities and classroom assessment. Second, the papers were categorized into diagnostic, formative and summative assessment.

This categorization was done manually and did involve personal judgement. While this analysis does provide a snapshot at assessment methods most frequently discussed at the CEEA conference, it is not a comprehensive review.

Fig. 2. CEEA archives classified by graduate attributes

**Discussion**

197 papers were categorized. Figure 2 shows the discrepancy in frequency of each GA in the proceedings. It is not surprising that knowledge base is lowest, as it is frequently discussed outside of the context of graduate attributes. However, for a profession that prides itself heavily on ethics and equity, it seems to be addressed very little.

Figure 3 shows the orientation of each paper. Program level papers are looking at the graduate attributes from the program perspective; i.e., mapping graduate attributes to indicators and learning outcomes, or training faculty. While this process relates to assessment, it is not addressed in this paper. Learning opportunities papers are describing both curricular and co-curricular opportunities for students to develop graduate attributes. Classroom assessment papers describe specific classroom assessment techniques.

As shown in figure 5, engineering programs clearly, and not surprisingly, lean towards summative assessment. While there is some discussion of formative assessment, there is a severe lack diagnostic assessment being discussed at the conference.

**Assessment Instruments**

The way in which assessment instruments are used determines the type of assessment. The instruments below are grouped by which type of assessment they were used for in the proceedings.

Diagnostic assessment instruments: Self-tests, self-assessments, team quizzes, pre-assessments, surveys, and team quizzes.

Formative assessment instruments: Peer feedback, TA Training to increase feedback to students, Expert/follower labs, CATME, IF-AT cards, reflections, personal guidance from industry, learn-acq-reflect cycles, 360 degree reviews, PTP metrics, formative assessment of term papers, journaling, formative feedback for communication, increased dialogue training, guided group meetings, seminar time with instructor feedback, colour coded portfolios, portfolios with reflections, observations, interviews, and focus groups.

Summative assessment instruments: Assignments, quizzes, exams, reports, coded multiple choice exams, self-assessments, design deliverables, proposals, presentations, lifelong learning plans, reflections, surveys, colour coded portfolios, 360 degree reviews, journaling, portfolios, co-op surveys, and concept inventories.

**Conclusion and References**

Classroom assessment of graduate attributes is a critical component of the graduate attribute discussion. Part of this discussion is expanding the understanding of what assessment really means. Engineering has a very strong culture of summative assessment, but these methods may not be appropriate for all graduate attributes. It is critical that assessment for student learning is continuously improved to ensure engineering students develop the skills they need for an increasingly changing world.

Monique Sullivan msullivan@ucalgary.ca
Bob Brennan rbrennan@ucalgary.ca