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Forging a successful graduate

Brett McCollum

How do you take the measure of people and their training?

It's a question asked by employers as they sort through *curriculum vitae* seeking candidates who have the right skills to excel in their organization. With university graduation season just around the corner, it's also a question being asked by university departments as they celebrate the transition of their best and brightest into the workforce. What knowledge, skills, and competencies will these graduates take with them? How will employers or post-graduate schools view their graduates?

The Canadian Degrees Qualification Framework, published in 2007 by the Council of Ministers of Education, established an outcome-focused process for the evaluation of post-secondary education degrees. For example, recipients of a Bachelor degree in Canada must have demonstrated "the ability to gather, review, evaluate, and interpret information, including new information relevant to the discipline, and to compare the merits of alternate hypotheses or creative options relevant to one or more of the major fields in a discipline".

The transferable skills, along with a defined level of mastery, that students should be able to demonstrate at the end of a course or program are called learning outcomes. By developing and publicly communicating learning outcomes, departments provide transparency regarding the goals of courses and programs to both students and their prospective employers.

The University of Alberta is hosting the 101st Canadian Chemistry Conference and Exhibition (CSC 2018), the annual conference for the Canadian Society for Chemistry (CSC), from May 27-31, which prompted me to reach out to three chemistry faculty from the Edmonton area to share their perspectives on learning outcomes.

When Elizabeth McGinitie, assistant professor at the Augustana Campus of the University of Alberta, told me about her motivation for developing learning outcomes, she described a scenario familiar to anyone who has taught periodic table trends: as she did her best to guide learners through the topic, a student asked "Why should I care about this? Why is this even important?"

"These questions really got me thinking about how I, as the lecturer of the course, portray the importance of the fundamental topics that I choose to discuss in lectures, what I want the students to know, and what I want the students to be able to do," says McGinitie. Her desire to clearly articulate the demonstrable skills of a successful student sparked conversations with her departmental peers to formulate the key competencies and knowledge they wanted their students to have after each chemistry course. By scaffolding assignments and projects in each course for students to demonstrate their skills, McGinitie now feels more confident that her students are benefiting from an appropriate balance of challenge and preparation throughout the program.

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Peter Mahaffy, FCIC, professor at King's University and 3M National Teaching Fellow, has a passion for learning outcomes extending into his research program, which includes a recent publication in *Nature Reviews Chemistry* [http://rdcu.be/J9ep]. Mahaffy and Imperial College London professor Stephen Matlin are co-chairs of an IUPAC task force, *Learning Objectives and Strategies for Infusing Systems Thinking into (Post)-Secondary General Chemistry Education*.

"IUPAC is interested in learning outcomes as the professional body that sets standards in the area of chemistry," Mahaffy notes. "We have responsibilities as professional chemists and chemistry educators to equip the next generation of chemists, scientists, and citizens to make use of the powerful tools of chemistry to address societal and planetary needs. Using student learning outcomes gives us a lens that refocuses our thinking from the chemistry that we teach (inputs to students) to student outcomes."

For Mahaffy, a key question for instructors is ensuring what learners take away from their educational experience, in terms of chemistry content, scientific thinking, interdisciplinary connections, communication, application of knowledge, and the limits of this knowledge. "When students themselves understand the outcomes they have attained at the end of a course or program, they can represent to employers, and graduate and professional schools, both their mastery of detailed chemistry content and the many other skills and attributes they have gained."

A third Edmontonian with a passion for learning outcomes is Glen Loppnow, FCIC, U of A professor, Vargo Teaching Chair, and 3M National Teaching Fellow. He started his considerations of this topic by first identifying the broad learning goals in his course and then re-writing them as specific learning outcomes.

"Once I published those in my first year general chemistry course, I never heard the words, 'Will this be on the test?' again. The main benefit to students is that they know where the course is headed and what they have to do along the way. This allows them to reflect and plan, allowing them to bring a meta-cognitive perspective to their learning and to develop self-regulation."

Seeing the benefits in his own courses, Loppnow instituted SCI-LIFT, the Science Education and Learning Innovation Facilitation Team at U of A. Composed of a director who specializes in science, technology, engineering, and math education research and two instructional designers, the team works with faculty members to embrace evidence-based teaching practices and reform curriculum around learning outcomes.

If you aren't convinced that defining learning outcomes are of value to you, Mahaffy offers some words of motivation: "A recent important development is that both provincial quality assurance agencies such as CAQC [Campus Alberta Quality Council] and our own CSC accreditation processes are asking institutions to think about both articulating and assessing learning outcomes for students in chemistry programs." Fortunately, departments don't need to start from scratch. Loppnow is an organizer of the *Learning Outcomes* symposium in the Chemistry Education Division at the CSC 2018 conference in Edmonton. For those

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looking to learn more about learning outcomes, this is a great place to connect with others and get started!

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