

LINKING THE CEAB GRADUATE ATTRIBUTE COMPETENCIES TO EMPLOYABILITY SKILLS 2000+: EQUIPPING STUDENTS WITH THE LANGUAGE AND TOOLS FOR CAREER/EMPLOYMENT SUCCESS

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Abstract - Graduate attributes are a relevant and pressing topic for engineering educators as we work to find innovative ways to teach and assess them in our courses and programs. The graduate attributes defined by the Canadian Engineering Accreditation Board (CEAB) are left to faculty of accredited Canadian Engineering programs to characterize into manageable, authentic and assessable indicators. Faculty are then responsible for demonstrating that their students possess these competencies, and that their programs are effective in training students in the skills, knowledge, behaviours, attitudes and values that are fundamental to the 12 graduate attributes. It has been a mammoth task that is still, in many cases, in its inception.

What if we could approach identifying and assessing the CEAB graduate attributes in another way? Should we be expecting faculty to be solely responsible for assessing students' graduate attribute competencies? Applying Knowles Theory of Andragogy and Super's Theory on Developmental Process of Vocational Behaviour, we are able to explain how students, as adult learners, are motivated to identify and assess their own skills and competencies, influenced by their life situations and the relevance of employment to their immediate and future career goals.

If we provide the framework for establishing the transference of the CEAB graduate attributes to their employment and career goals, students can be given the motivation to identify, and indeed, showcase their own competencies. Connecting the CEAB graduate attributes to the Conference Board of Canada Employability Skills 2000+ translates the attributes into a language recognizable and relevant to all engineering stakeholders, and may inspire students to seek understanding of the required engineering competencies as they focus on gaining employment, and ultimately achieving career success.

Keywords: CEAB graduate attributes; Conference Board of Canada Employability Skills 2000+; empowering students; Knowles' Theory of Andragogy; Super's Theory on Developmental Process of Vocational Behaviour

1. INTRODUCTION

The biggest motivator for students to attend university is to 'get a good job' and 'to prepare for a specific job or career'; 86% and 80% of students cited these reasons for attending university as *very important* on the Canadian University Survey Consortium 2013 [1]. Therefore, we can assume that the majority of students enroll in university because they want to graduate with the knowledge, skills and experience to be able to transition successfully into the world of work.

Not only are university students decisive about their educational goals, given the opportunity, students are impressively adept at characterizing their own educational strengths and limitations. Malcolm Knowles contributes to our understanding of how our students learn by using the Theory of Andragogy, or 'the art and science of helping adults learn' [2]. Knowles identifies adult learners as self-directed and autonomous, preferring involvement in the planning and evaluation of their education. They have valuable experiences to share that provide the foundation for their learning. Students also have a willingness to engage in learning activities that are problem-based (rather than content-driven) and have an immediate and pragmatic application to their lives. Most adult learners are intrinsically motivated and are served well by being informed about why they need to learn what they are required to learn [2].

Donald Super's work focuses on the developmental process of vocational behavior. Super's theory describes the various stages that individuals go through with the belief that as our self-concept becomes more realistic and stable, so do our vocational choices and behaviors. Traditional university years coincide with the 'exploration stage,' which Super describes as the phase between the years of 14-25. This is a period of transition where tentative career choices are considered based on academic and life experiences. Career maturity includes readiness to cope with developmental tasks at a given stage [3].

Recognizing that most of our undergraduate university students are in their 'exploration stage' and moving towards the adult learner stage (although there are

certainly exceptions), educators can capitalize on the qualities intrinsic to this stage of learner and on the career motivations many students have for attending university. We can work with students to direct them to take charge of their own learning.

2. BACKGROUND: CEAB GRADUATE ATTRIBUTES & CONFERENCE BOARD OF CANADA EMPLOYABILITY SKILLS 2000+

In accredited engineering programs in Canada, faculty members are required to demonstrate that their programs facilitate students to develop the competencies defined by the 12 CEAB graduate attributes. To date, it has been fundamentally the members of engineering faculties of accredited engineering programs in Canada who have been grappling with defining, teaching and assessing these attributes to ensure that their graduates are competent in these areas, and to provide evidence for accreditation [4][5][6][7][8][9][10][11]. Few have entertained placing some of the responsibility for demonstrating attribute competencies on the students; rather, indirect data are often gathered from students in the form of student surveys and forums, which faculty then use to demonstrate student competencies [11][12][13][14][15][16][17]. Students will have little motivation to demonstrate their own understanding, knowledge, skills and behaviours, values and attitudes attributed to the graduate attributes if they don't understand the value of the graduate attributes and the pragmatic application of the attributes to their professional lives.

In order to meet the needs of an ever-changing and diverse economy, industry and the federal government are also invested and focused on the attributes – or *employability skills* – of newly educated graduates as they enter the workplace. The Conference Board of Canada is a Canadian not-for-profit think-tank dedicated to researching and analyzing economic trends, as well as organizational performance and public policy issues. They define employability skills as ‘...the generic skills, attitudes and behaviours that employers look for when they hire new recruits and that they seek to develop in their current employees’ [18]. The Conference Board of Canada has created a framework called Employability Skills 2000+ to help plan, strategize and articulate competencies that employers require from the employees in their workplaces for the 21st century. This framework identifies the critical skills required of the Canadian workforce and is used today to be more strategic about developing and assessing Canadians’ ‘career capital’ – those skills that will make individuals successful in the workplace [19].

Considering that our students are motivated ‘to get a good job’ and to ‘prepare for a specific job,’ are in the

exploration stage focused on making provisional career choices, and are motivated by knowing *why* they are learning what they are learning to identify the practical application of that knowledge and those skills, they would likely be inspired to learn about and develop the critical Employability Skills defined by the Conference Board of Canada in order to build their own career capital. Furthermore, seeing that we as engineering educators are accountable for our students demonstrating the CEAB graduate attributes, and that these attributes are defined as the competencies required for successful engineering in the workplace, a strong case can be made for mapping the graduate attributes onto the Employability Skills 2000+. Amalgamating the attributes with the employability skills will facilitate meeting our accreditation requirements by leveraging students’ characteristics as adult learners within their exploration stage and their career motivations. Demonstrating the transference of the attributes to the employability skills will provide a multi-dimensional framework through which to direct students to acquire and assess their own competencies, thereby supporting students to take responsibility for developing their own career capital.

By demonstrating how the CEAB graduate attributes are linked to the Conference Board of Canada Employability Skills 2000+, students will regard the attributes with increased value, and be willing to hone such tools as learning portfolios, which will enable them to market their own knowledge, skills and abilities, and effectively empower them to manage their own career paths.

3. SKILLS AND COMPETENCIES FOR SUCCESS: MAKING CONNECTIONS FOR STUDENTS AND FACULTY

3.1 Conference Board of Canada – Employability Skills 2000+

Employability Skills 2000+ are broken into three main categories: Academic/Fundamental Skills, Personal Management Skills and Teamwork Skills. The Academic/Fundamental Skills are defined as the foundational skills: ‘those skills which provide the basic foundation to get, keep and progress on a job and to achieve the best results’ [18]. This category includes skills in the following areas: Communication; Ability to Manage Information; Use Numbers; and Think and Solve Problems. The Personal Management skills are the ‘personal skills, attributes and behaviours that drive one’s potential for growth’ [18]. They include: the ability to Demonstrate Positive Behaviours; Be Responsible; Be Adaptable; Learn Continuously; and Work Safely. And finally, the Teamwork Skills are considered the ‘skills and attributes needed to contribute productively’ [18].

They comprise the ability to Work with Others; and Participate in Projects and Tasks.

3.2 CEAB Graduate Attributes and Accreditation

The International Engineering Alliance defines engineering as follows:

Engineering is an activity that is essential to meeting the needs of people, economic development and the provision of services to society. Engineering involves the purposeful application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system. [20]

The 12 graduate attributes personify the engineer today as described by Engineers Canada. They are enumerated by CEAB as: (1) A knowledge base for engineering; (2) Problem analysis; (3) Investigation; (4) Use of engineering tools; (5) Design; (6) Individual and team work; (7) Communication skills; (8) Professionalism; (9) Impact on society and the environment; (10) Ethics and equity; (11) Economics and project management; and (12) Lifelong learning. They comprise the ‘assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level’ [20]. For engineering students, the graduate attributes embody the knowledge, skills, behaviours, attitudes and values that ensure they are prepared specifically for a career as an engineer. Development of the CEAB attributes ‘...[demand] that students demonstrate how they can synthesize into actions what they have learned in course...perform effectively as professionals, and presumably also as citizens...and self-reflective humans’ [21]. In other words, engineering students are enabled to acquire skills that not only prepare them for engineering, but also equip them with the proficiencies required for the greater professional world. Considering how many engineers today work for more than one firm in their career lives, or take on a variety of other professional roles, including managerial, entrepreneurial and financier positions [22], developing such attributes in our students is of universal benefit to them.

3.3 Motivations for a New Framework

There have been some efforts to group engineering student attributes (CEAB) and outcomes (ABET) in different ways, with one familiar division being the separation of the technical and professional skills [23]. The problem with this two-stem view of engineering attributes/outcomes is that it inadvertently places more importance on the technical skills, considered the ‘traditional engineering skills,’ inauthentically separating the professional skills from the technical. This division, at its most severe, could ‘ultimately impoverish engineering education by attending only to utilitarian ends and ignoring the capacity of a liberal education [i.e., comprised by the professional skills] to enrich students individually and culturally’ [21]. Neeley argues that this type of dichotomy isolates communication skills; we would argue that it could isolate all of the professional skills, ‘minimiz[ing] [their] connection to professional development and intellectual activity, and promot[ing] an impoverished view of what successful communication [and professional skills] entail’ [22]. On the other hand, considering the attributes holistically within alternative frameworks might be a way of repackaging them to increase their perceived value for students. At the University of Victoria, they have done this by mapping their Last Co-op Employer Survey (LCES) – designed to collect employer feedback on students’ competencies of the graduate attributes – onto their Co-op Competency Assessment Tool (CCAT) [24] – developed by UVic’s Co-operative Education Program and Career Services Office to assess the core competencies that reflect the connection between academic study and the world of work [25].

It would be useful for both engineering educators and engineering students to take this idea and consider mapping the CEAB graduate attributes to the Conference Board of Canada Employability Skills 2000+. Mapping the CEAB graduate attributes to the Conference Board of Canada Employability Skills 2000+ translates the attributes into a language recognizable and relevant to all engineering stakeholders, including faculty, students and industry, and may inspire students to seek understanding of these required competencies as they focus on gaining employment, and ultimately achieving career success. If we provide the framework establishing the transference of the CEAB graduate attributes to their marketable employability skills, students will be given the a multi-faceted tool to identify, and indeed, showcase their engineering and employability competencies, which will feed into their motivations and career foci. This will also alleviate the sole responsibility on faculty to demonstrate that their students possess the CEAB attributes, as students can be guided to exhibit these attributes

themselves. This transference can be achieved by demonstrating how the CEAB graduate attributes can be grouped into the three Employability Skills 2000+ categories: Academic/Fundamental Skills, Personal Management Skills and Teamwork Skills.

3.4 Framework

As stated, the Employability Skills 2000+ are grouped into Academic/Fundamental Skills comprised of Communication, Manage Information, Use Numbers, Think and Solve Problems [18]. The CEAB graduate attributes that fit into this category are: (1) A Knowledge Base for Engineering (i.e., Manage Information; Use Numbers); (2) Problem Analysis (i.e., Manage Information; Think and Solve Problems); (3) Investigation (i.e., Manage Information; Think and Solve Problems); (4) Design (i.e., Manage Information; Think and Solve Problems); (5) Use of Engineering Tools (Manage Information; Think and Solve Problems); (7) Communication Skills (i.e., Manage Information; Communication); and (9) Impact of Engineering on Society and the Environment (i.e., Manage Information; Think and Solve Problems).

The Employability Skills 2000+ Personal Management Skills are comprised of Demonstrate Positive Behaviours; Be Responsible; Be Adaptable; Learn Continuously; Work Safely [18]. These can be translated into the following CEAB graduate attributes: (8) Professionalism (i.e., Demonstrate Positive Behaviours; Be Responsible; Work Safely); (10) Ethics and Equity (i.e., Be Responsible; Work Safely); and (12) Lifelong Learning (i.e., Be Adaptable; Learn Continuously).

Finally, the Teamwork Skills category of Employability Skills 2000+ is defined by Work with Others and Participate in Projects and Tasks [18]. This category can be represented by the CEAB attributes (6) Individual and Teamwork (i.e., Work with Others; Participate in Projects and Tasks) and (11) Economics and Project Management (i.e., Work with Others; Participate in Projects and Tasks).

Demonstrating how the CEAB graduate attributes fit into the Employability Skills 2000+ provides a framework for both faculty and students that shows how the graduate attributes are transferable into employability skills. (See Figure 1.) This framework could ultimately increase the value and motivation for students to demonstrate their CEAB graduate attributes competencies.

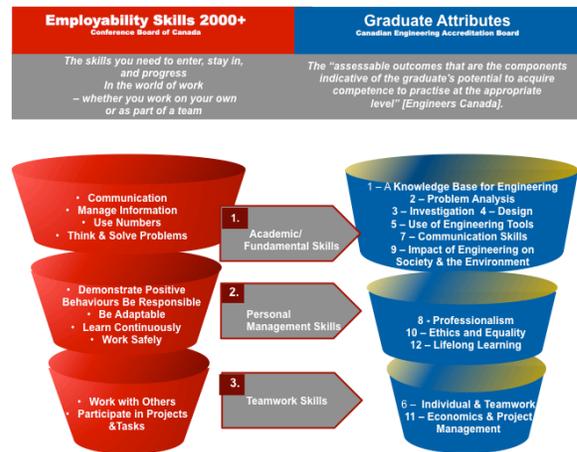


Fig. 1. Employability Skills 2000+ Graduate Attribute Framework

4. SUGGESTIONS FOR USE

4.1 Course Level

The Employability Skills 2000+ Graduate Attribute Framework could be used at the course level to reframe the graduate attributes for engineering students. The authors of this paper have partnered with a professor and two instructors who are teaching a second year Biosystems Engineering core course in Engineering CAD technology at the University of Manitoba. The course has been recently redesigned to provide students initial insight into the principles of engineering design from the perspective of CAD, and related digital fabrication technologies. The applied portion of the course covers a design project that revolves around the application of CAD tools (such as creation of parts/assemblies) to solve a mechanical design problem in the field of Biosystems engineering.

Currently, the course syllabus includes a table that illustrates how the CEAB graduate attributes are connected to the course learning outcomes, and at which competency level, defined by Bloom's Taxonomy [26], students are expected to perform for each attribute. To date, the instructors have spent very little time going through this portion of the syllabus with the students. When introduced to the concept, the instructors were intrigued with how the graduate attributes transfer into employability skills that are easily understandable in the general applicability to the workplace.

We are teaming up with the instructors to help develop a syllabus that reflects both the graduate attributes and employability skills, experimenting with communicating the relevancy and importance of the graduate attribute competencies from an employability perspective. We will use the developed Employability Skills 2000+ CEAB Graduate Attribute Framework to

design the syllabus and to communicate the transferability of the graduate attributes to employability skills for students (see Figure 1).

Students in the course will be introduced to the framework, and asked to reflect on and rate their own competencies before and after taking the course. This will give students another ‘language’ with which to discuss their competencies, preparing them for eventual professional life. If students and the instructors find this application of the CEAB graduate attributes and employability skills useful, the Employability Skills 2000+ CEAB Graduate Attribute Framework could potentially be applied in other courses.

4.2 Program Level

Another use of the Employability Skills 2000+ Graduate Attribute Framework could be its application to the development of student portfolios. A number of engineering programs in Canada are already making use of portfolios to showcase students’ graduate attribute competencies [27][28][29][30]. The use of the Employability Skills 2000+ Graduate Attribute Framework could further support students’ efforts to demonstrate and showcase their employability skills. Students could use this portfolio at career fairs [31] and at job interviews.

Students’ portfolios could be developed throughout their engineering program. For example, the Biosystems Department at the University of Manitoba has developed a group of four design courses, each one of which is offered every year of the program. The courses have been created to be synergistic with Engineering Communications; in other words, the required engineering communication course content is infused with the design content [32][33]. Students’ could be guided to develop their portfolios through this Design spine, with the final year culminating in a portfolio that students could use to market their skills when applying for jobs. In creating such a artifact, students would be able to promote themselves using a language familiar to industry, effectively transcending a two-dimensional understanding of their engineering degree skills into a multi-faceted-understanding of their universal professional skills, essentially increasing their ability to perceive and communicate their career capital and value for the workplace. Additionally, faculty could use these student portfolios to demonstrate students’ graduate attribute competencies, fundamentally supporting their program accreditation efforts.

5. CONCLUSIONS

According to Knowles’ Theory of Andragogy and Super’s Theory of the Developmental Process of

Vocational Behavior, our university students are generally positioned between the exploration and adult stages of learning. The significance of this is that students are ready to consider career choices based on academic and life experiences, and to learn knowledge and skills that have direct relevance to their professional lives. They are in the position to be self-directed in their learning, using their experience to participate in problem-solving activities that they are responsible for planning and evaluating. And they are propelled by their intrinsic, career-oriented motivations.

Capitalizing on students’ motivations, positioned within the theoretical lenses of the Process of Vocational Behaviour and Andragogy, it makes sense for Engineering faculty to partner with their students to have students demonstrate their graduate attribute competencies. After all, the CEAB graduate attributes, part of the requirements for CEAB program accreditation, are indicative of students’ potential to acquire the competence to practice engineering at the appropriate level. What better way to demonstrate competence than by demonstrating it by oneself?

In order to motivate engineering students to participate in demonstrating their graduate attribute competencies, we propose increasing the relevance of the CEAB graduate attributes for students by reframing the attributes using the Conference Board of Canada Employability Skills 2000+. This reconfiguration will increase the perceived value of the graduate attributes for students by demonstrating how the attributes transfer into the skills and knowledge that employers are looking for when they hire new graduates. The intention of this transference is to make the graduate attributes more accessible for students and industry, and to trigger students’ self-directed learning proclivity and intrinsic motivations by providing the *why* in why students are learning what they are learning. The subsequent enhancement of the relevance of the graduate attributes will ultimately support faculty’s work in teaching and assessing the attributes. Students’ understanding of the value of their education will increase, and they will have the means by which to market themselves to potential employers using a multi-dimensional framework to showcase their skills and abilities.

In summary, the proposed Employability Skills 2000+ Graduate Attribute Framework gives engineering stakeholders a tool with which to facilitate students’ development of the knowledge and skills required to build their career capital, which will ultimately support students in leading successful, professional lives.

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