Higher Education Quality Council of Ontario

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Tuning: Identifying and Measuring Sector-Based Learning Outcomes in Postsecondary Education

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[1] The primary authors of the report are indebted to the Tuning team panels, who wrote the learning outcomes. For a complete list of team members, see Appendix A.

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Executive Summary

As a key component of a comprehensive research program on learning outcomes, HEQCO initiated a Tuning project to identify and measure learning outcomes in specific "sectors" of postsecondary education (i.e., life and health science, physical science and social science) in Ontario colleges and universities. The term "Tuning" refers to a process of bringing together individuals from across institutions to articulate common student learning outcomes. Quite simply, it is a bottom-up process by those who are "on the ground" to articulate learning outcomes that are relevant, appropriate and useable.

Learning outcomes are measurable statements of student knowledge (what successful students should know) and skills (what successful students should be able to do) expected upon graduation. Clearly articulated learning outcomes are useful to ensure that students understand expectations and that instruction is constructively aligned with assessment (Biggs & Tang, 2011). When used in an effective assessment environment, they can provide high-quality information to describe what students have learned (Banta & Blaich, 2010).

This document presents competency areas and specific learning outcomes for the four most common types of qualifications granted by Ontario's postsecondary system: the two-year diploma, the three-year diploma, the four-year honours bachelor's degree and the master's degree (research-based). Six core competencies are presented for each qualification level, the first five of which are common to all three sectors: 1) Knowledge, 2) Critical and Creative Thinking, 3) Communication, 4) Social Responsibility, 5) Personal and Interpersonal Capacities, and 6) Practice and Methods (specific to each sector).

Affiliated with a number of similar projects both internationally and within Ontario, the Tuning learning outcomes intend to support the integration and use of learning outcomes by institutions, programs and faculty members, and by students and employers. Thus this report outlines the goals, purpose and value of identifying learning outcomes and presents the activities undertaken for this project. It highlights ways in which learning outcomes can be incorporated into programs, discusses issues of assessment, and provides examples of how students can demonstrate achievement. Also presented are appendices that provide examples of how the Tuning learning outcomes affiliate with Ontario standards frameworks, such as the Ontario Qualifications Framework and the Undergraduate and Graduate Degree Level Expectations.

Section 1: Introduction

Background

The Higher Education Quality Council of Ontario has focused on issues of quality since its inception in 2006. It has pursued research in areas relevant to the enhancement of quality in teaching and learning and student services, and has completed related work in quality assurance, accountability and performance indicators. Through this work it became apparent that Ontario was lacking a clear definition of quality, as well as an understanding of how it is achieved, demonstrated and measured.

In 2011, HEQCO hosted a two-day conference of international experts on quality, which subsequently became an edited volume outlining international best practices (Norrie & Lennon, 2013). Following this conference, HEQCO initiated a comprehensive research plan in the area of learning outcomes. Learning outcomes are measurable statements of what students should know, understand and be able to do upon successful completion of a program, such as a postsecondary credential (European Commission, 2006, p. 16).

This research plan included participating in international learning outcomes research on large-scale assessments, including the Organisation for Economic Co-operation and Development's (OECD) Assessment of Higher Education Learning Outcomes (AHELO) project (see Lennon & Jonker, 2014) and piloting the Collegiate Learning Assessment (Lennon, 2014). To this list can be added a number of other projects, including the formation of a consortium of institutions involved in learning outcomes activities, as well as research projects on trends in competency-based education and assessment techniques.

As a key component of this research program, HEQCO also initiated a Tuning project to identify and measure learning outcomes in specific "sectors" of postsecondary education (i.e., life and health science, physical science and social science) in Ontario colleges and universities.

The term "Tuning" refers to a process of bringing together individuals from across institutions to articulate common student learning outcomes. It is a bottom-up process by those who are "on the ground" to articulate learning outcomes that are relevant, appropriate and useable. The concept originated in Europe during the time of the Bologna Process and the integration of the European Higher Education Area, when systems across Europe needed to harmonize their programming (Wagenaar, 2013). Faculty members from different countries were brought together to formulate common student learning expectations in order to support program reform. The process was extremely successful and provided a way for academia to have a voice in the system-level overhaul. Based on the success of the model, Tuning has been employed around the world by regions, systems and disciplines wanting to create common and transparent expectations for student learning.

International projects have approached learning outcomes in various ways. Some take a very broad definition and seek to identify learning outcomes that generalize across all of the areas that are included within a degree category, such as the BA or BSc. The Lumina Degree Qualification Profile (DQP) provides one example of such an approach (Lumina Foundation, 2010). Others adopt a much narrower scope and seek to identify and measure learning outcomes within a specific discipline (often restricted to a single administrative department), such as history or chemistry, as in the US Tuning project.[2] A third approach used in Europe, alongside discipline work, focuses on "academic sectors", groupings of disciplines that bridge the gap

[2] See Tuningusa.org for more information.

between the broad "degree qualification" learning outcome approaches and the narrower "discipline-based" learning outcome projects.[3]

HEQCO determined that its contribution to the existing work within Ontario would focus on sectors of disciplines. As an initial step, we focused on the broad categories of life and health science, physical science and social science.[4] The Tuning project examined the two-year diploma, three-year diploma, four-year honours bachelor's degree and the research-based master's degree. These sector groups worked independently to develop learning outcomes appropriate for their sectors.

In working at the sector level we determined that there was greater similarity than difference in many of the competency areas. As a result, the sectors decided to work together to create learning outcomes that were appropriate across the sectors where possible, and work independently on competency areas where there were greater differences. This resulted in five common competencies (Knowledge, Critical and Creative Thinking, Communication, Social Responsibility, Personal and Interpersonal Capacities) and one competency (Practice and Methods) that had distinct learning outcomes for each sector. Hence our final product both introduces credential-level expectations that are common across disciplines and highlights unique areas of focus for each sector in practice and methods.

Purpose of Identifying Learning Outcomes

Clearly articulated learning outcomes are useful to ensure that students understand expectations and that instruction is constructively aligned with assessment (Biggs & Tang, 2011). When used in an effective assessment environment, they can provide high-quality information to describe what students have learned (Banta & Blaich, 2010). Learning outcomes have been shown to have a significant positive effect on learning (Hattie, 2008; 2009) and are fundamental to assessing student learning and improving educational quality (Banta, Jones & Black, 2009). Many higher education institutions have adopted learning outcomes in an attempt to clearly articulate educational objectives and demonstrate accountability, but relatively few are at the point of regularly assessing student learning across the institution and using this information to improve learning (Baker, Jankowski, Provezis & Kinzie, 2012). In the province of Ontario learning outcomes have been embedded in the college sector for decades and have been introduced recently for universities in the form of degree-level expectations, but requirements to embed a systematic assessment process to improve student learning are largely restricted to professionally accredited programs (e.g., business, engineering, medicine, nursing, etc.).

It should be noted that using learning outcomes is not intended to be an exercise that limits spontaneity, restricts freedom to teach, or prescribes specific content. Learning outcomes have been criticized for being overly prescriptive and detracting from learning (for example, Furedi, 2012). Instead, their fundamental goal is to articulate what students should be able to do after finishing the course or program and to assess how well students are meeting those expectations. Learning outcomes do not limit an instructor's ability to expect open-ended problem solving, critical thinking or discovery. In fact, those kinds of expectations are embedded in learning outcomes.

[3] See http://www.unideusto.org/tuningeu/tuning-sqf-social-sciences.html for an example of the European Social Science Tuning project.
[4] Please see the Ontario Government Program Classification Guide for details.

Projects that identify and measure learning outcomes serve several important purposes:

1. They demonstrate the value, utility and relevance of higher education to students, government and the public by providing compelling evidence of what students learn as a result of their postsecondary programs.
2. They support validity and accuracy by engaging faculty – rather than government, quality assurance or other bureaucratic organizations – to control and drive the identification and measurement of the learning outcomes.
3. They assist student mobility and transitions through postsecondary systems (i.e., credit transfer) by establishing the evidentiary basis for student knowledge at various levels of postsecondary education and by demonstrating the similarities and differences to be expected across different programs of study.
4. They facilitate the alignment of teaching and learning activities and assessment, and inform ongoing program development.
5. They serve as a template to guide curriculum planning, including the development of measureable learning outcomes statements at the program level.

Value of the HEQCO Initiative

HEQCO's project builds on other work on learning outcomes being done in Ontario and elsewhere in several ways.

First, it affiliates and links Ontario's efforts with similar projects happening internationally, and specifically with other learning outcome exercises being carried out in Europe and the US.[5] While creating the opportunity to share conclusions and best practices with these groups, the HEQCO project provides additional funding to stimulate this important area of research in Ontario and to engage international experts to increase the probability of a useful set of results for Ontario institutions.

Second, for universities, the HEQCO project adopts an approach that bridges the gap between the broad Ontario Qualifications Framework (OQF)[6], the Ontario Council of Academic Vice-Presidents' Degree Level Expectations[7], and narrower program-based learning outcomes.[8] Specifically, we aimed to provide clear competency areas and learning outcomes that were broad enough to apply to a range of sectors, but specific enough to provide clear statements of measurable expectations usable at the program level.

For example, the Ontario Qualifications Framework provides clear statements of what a student should be able to do at various credential levels, but does not provide explicit measurable learning outcomes. This Tuning document clarifies how programs can clearly demonstrate compatibility with the OQF, as the competency areas are well matched (see Appendix C for mapping of the OQF to the Tuning learning outcomes).

Similarly, a considerable amount of work has been done in the Council of Ontario Universities' (COU) Quality Assurance Framework to develop the Undergraduate Degree Level Expectations (UDLEs) and Graduate Degree Level Expectations (GDLEs). The Ontario Universities Council on Quality Assurance oversees the implementation of the Quality Assurance Framework UDLEs and GDLEs, and since 2010 has required that all new undergraduate and graduate programs in Ontario identify learning outcomes and their assessment (as part of the program approval process), as must existing programs at the time of their cyclical program review.

[5] See http://www.unideusto.org/tuningeu/home.html for a complete list of international Tuning activities.
[6] See http://www.edu.gov.on.ca/eng/general/postsec/oqf.htm
[7] See http://www.cou.on.ca/publications/reports/pdfs/ensuring-the-value-of-university-degrees-in-ontario
[8] See http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/

The UDLEs and GDLEs set out broad competency areas of student knowledge with which programs are expected to comply. But these frameworks offer little direction concerning how compliance can be demonstrated. Our Tuning learning outcomes contain sufficient detail to be mapped to the UDLEs and GDLEs (see Appendix C and D for mapping of UDLEs and GDLEs to Tuning learning outcomes). By achieving the explicit learning outcomes that we set out here, a program can clearly demonstrate how it satisfies the requirements of the COU Quality Assurance Framework.

While the Ontario College Program Standards provide clear and detailed expectations of student capabilities, they do not map easily onto university or other college programs within or outside of a sector. By mapping to the Tuning learning outcomes instead, a program could have a more generalizable way to compare student abilities across programs and credentials. In this manner, the Tuning document should provide considerable support for the ongoing discussions on credit transfer and student mobility.

Third, the HEQCO project links together learning outcomes exercises that are now occurring, somewhat independently, in Ontario's college and university sectors. By providing a common language and framework, this Tuning work can accelerate the transmission of best practices among institutions within and between these two sectors and can thereby assist in achieving the goal of a more robust, effective and efficient transfer credit system in Ontario.

Fourth, this project has attended to the challenge of how to measure defined learning outcomes from the outset. Many learning outcome projects are successful in defining the desired learning outcomes, but fall short on the problem of how to assess whether these desired outcomes are being achieved. The final section of this report provides principles and examples to guide the integration and assessment of learning outcomes.

Fifth, and most significantly, the Tuning learning outcomes provide information to students, parents, the public and employers on the skills and competencies of graduates. This work creates a transparent standard that will aid students in their decisions about which credentials and programs to pursue and provide them with information about what they will have achieved by graduation. Demonstrating achievement of learning outcomes as students progress through their program also provides them with a reflective learning opportunity.[9] Thus, the Tuning learning outcomes support students' learning both during their education and following graduation by helping them to articulate clearly what they are able to do and to demonstrate achievement through examples of work. Similarly, this work will be useful to employers who want to understand the skills sets of potential candidates. For this reason, both students and employers were an important part of our Tuning panels.

The Activities

Since November 2011, the three sector groups of life and health science, physical science and social science met on a monthly basis to identify learning outcomes relevant to their sectors. Each of the meetings was facilitated by the HEQCO lead and led by two co-chairs, one from each of the college and university systems. The social science panel was made up of nine members from universities and colleges, with one graduate student representative. The physical science panel had eleven members coming from universities and colleges, along with an employer and two students. The eight life and health science panel members were representative of colleges and universities, with one student and one employer. An advisory group consisting of experts in the area of learning outcomes, both within Ontario and abroad, was developed to provide guidance on the overall project. See Appendix A for a complete list of Ontario Tuning and advisory group members.

[9] A synthesis of meta-analyses by Hattie (2009) demonstrates that clarity of learning goals and what success looks like have some of the largest effects on student learning.

There were three stages to the work. In the first stage, the panels worked independently to develop sector-specific learning outcomes. In stage two, the panels worked collaboratively on common learning outcomes. And in stage three, the panels worked on various aspects of assessing and measuring learning outcomes.

Stage 1

The groups approached the development of their learning outcomes in various ways. In developing the learning outcomes, the groups worked both inductively and deductively, pulling from established learning outcomes from Ontario, Canada, the US and Europe, and from existing discipline-specific learning outcomes, such as those in engineering and nursing. Particular consideration was given to the OQF, UDLEs, GDLEs and college program standards. While the documents were not used as a starting framework, there was continued reference to them to identify commonalities, use of language and expectations.

The three panels worked independently for six months, drawing from relevant material and discussing the unique student characteristics and expectations at various credential levels.

During this time, a number of important issues were tackled. A primary issue was determining what credential levels to include. There were clear differences in the expectations of two-year and three-year diplomas, and it was decided that there would be benefit in examining both. Four-year honours bachelor's degrees were determined to be the most common undergraduate credential and were therefore included for this reason. Another conversation emerged concerning the differences in qualifications for research-based master's degrees compared to professional and practice-based programs. The groups agreed to focus on research-based master's degrees as they are the most common across all disciplines. It was hoped that the learning outcomes identified for these primary credentials could provide a valuable starting point for others wishing to expand the list of credentials (to include three-year degrees, hybrid college/university programs, clinical and professional programs, etc.).

One of the most significant decisions the panels made was to view learning outcomes as threshold rather than aspirational concepts – they would provide a benchmark of student learning. It is understood that some programs may focus more heavily, and have higher expectations, in certain areas. However, the Tuning learning outcomes are intended to demonstrate what a graduating student is able to do generally speaking and across the board. They do not and cannot indicate how successful the student was in doing so, nor do they represent a wish list of attributes we would like students to have, i.e., PSE cannot guarantee that graduates are "good people."

In identifying competency areas and learning outcomes, many characteristics were discussed. Because the learning outcomes needed to be both threshold and measurable concepts, some aspects were considered desirable but not appropriate. For example, the Tuning panel members had a range of opinions about whether leadership skills could be assessed and whether their development was a realistic threshold expectation for higher education programs. But how is it possible to measure the leadership abilities of a student? Not all programs incorporate leadership literature into the curriculum, so it was impossible to say that students would have an understanding of leadership styles. Furthermore, given group dynamics, it would be impossible to assess a student's capacity in a leadership position. It is possible, however, to say that students can work successfully in a team (see subcompetency 5.2). Similarly, entrepreneurship was considered a valuable learning outcome, but was not sufficiently common across entire sectors to be included as a threshold subcompetency. Furthermore, aspects of entrepreneurship are encompassed in a number of other learning outcomes, such as those set out in critical and creative thinking.

All groups also faced the challenge of finding a common language. This was not only a tension between college and university members, but across all members and panels. For this reason, a glossary of terms was compiled to ensure understanding and consistency of language use (see Appendix E).

One of the most challenging aspects for each of the panels was identifying learning outcomes that were relevant to all of the disciplines under the sector umbrella. There are different expectations between programs – such as math and engineering in physical science, or early childhood education and political science in social science. The learning outcomes naturally became broad in order to encompass the differences. Thus, despite the panels' unique approaches to writing the learning outcomes, the need to be general in their descriptions resulted in marked similarities in the first drafts of their work.

Stage 2

The advisory group reviewed the panels' work in July 2012. Its members were struck by the similarities in the competencies and learning outcomes developed by each of the sectors and suggested determining a common framework, as well as identifying any similar learning outcomes.[10] The notion of finding the same language to describe common learning outcomes where possible was agreeable to the sectors and they worked tirelessly to establish these common learning outcomes by drawing on the existing draft documents.

The work of these groups culminated in a document that clearly defined competency areas and learning outcomes appropriate to the three sectors. By creating five areas of common competencies suitable for the three sectors, it was recognized that the humanities were not explicitly represented as a sector.[11] The teams felt, however, that the common learning outcomes were suitably broad to encompass humanities programs. Furthermore, as for the other sectors, there is space for the humanities to create the appropriate practice and methods learning outcomes to distinguish their students' capacities and skills.

The final document was then shared with the advisory board and stakeholders for feedback in spring 2013. Reviewers were asked to consider the following questions when reviewing the document:

- Do you feel that the stated learning outcomes and characteristics of each qualification level are complete, representing all common aspects of skills, knowledge and abilities expected of graduates in each sector?
- Is the format of the document understandable to the audience of students and employers, as well as faculty members, program planners and institutional administrators?

A substantial number of Individuals, programs and institutions provided feedback. The comments provided considerable guidance on the development of this final document and the learning outcomes found in Section 2.

Stage 3

From the outset, one of the primary elements of the Tuning project was to develop ways of assessing the learning outcomes. This was a particularly challenging piece for the panel members, and there was a good deal of discussion as to what assessment meant, what measurement meant, and at what "level" assessments should take place: Should the focus be placed on sector-wide assessments, program assessments, or student-level assessments? It became clear that ways of measuring student learning outcomes would often depend on the program, and that student-level assessments would be determined by the faculty member. What is common, however, is that the achievement of learning outcomes can be demonstrated in a number of ways, and that there are emerging best practices.

[10] An alternate comment was that the learning outcomes were perhaps too broad and needed to be more specific to the sectors. As the sectors represent a wide range of programs, the panels considered it impossible to make them more detailed.
[11] Humanities were excluded at the outset of the project, with the intention of working with the three other sectors first.

Paramount to the discussion was determining the audience: Who needs to know what learning outcomes students have achieved? Government, institutional administration, faculty members or students? It was determined that each of these stakeholders was important to consider, and each of the panels undertook work on ways to demonstrate achieved learning outcomes to the various groups. The physical science panel considered ways in which learning outcomes could be demonstrated within a program by integrating and mapping them from within a program or course and linking them to student assignments. The social science panel considered how learning outcomes could be useful to individual faculty members when designing curriculum to support teaching and learning. The life and health science panel focused on how student achievement of outcomes could be demonstrated to employers, the public and students themselves.

Following the work of the panels, the co-chairs came together to integrate the work and provide an example of how the Tuning learning outcomes could be used to demonstrate achievement of learning outcomes at all these levels. This work is found in Section 3.

Lessons Learned and Implications

Over the past two years, Ontario, HEQCO, the Tuning members and the wider audience have embraced the notion of learning outcomes as a critical piece for enhancing the quality of postsecondary education. The result of the Tuning panels' devoted work has the potential to contribute to this conversation and has already helped shape thinking.

- The Tuning work provides a common language for students, programs, institutions, government and non-governmental agencies.
- It demonstrates that learning outcomes are not just an accountability tool, but also a tool for teaching and learning, and student success.
- It highlights the commonalities between existing frameworks and will support compliance with accountability/quality frameworks.

It also brings to the forefront a number of issues that require further investigation, research and partnerships.

It is clear that writing learning outcomes is only the first step in integrating them into a system. Beyond using them as accountability tools, proper engagement with them requires devoted planning and implementation. Recognizing this, HEQCO has created a consortium of six institutions working on various aspects of learning outcomes which will develop and share promising practices.

Also apparent is that the most significant hurdle is the assessment piece, not only in Ontario but around the world. Measuring and assessing learning outcomes is critical to ensuring that students have successfully mastered the skill, competency or knowledge. But where and how this is done is still an underdeveloped area. For this reason, HEQCO has engaged with large-scale international assessments of learning outcomes (such as the OECD's AHELO project) and is also investing in institutional and discipline-level assessment activities that could inform the broader conversation.

Section 2: Learning Outcomes

How to Use this Document

This document presents competencies, subcompetencies and learning outcomes for the life and health science, physical science and social science sectors in Ontario. It covers the four most common types of qualifications granted by Ontario's postsecondary system: the two-year diploma, the three-year diploma, the four-year honours bachelor's degree and the master's degrees (research-based). Also included is a glossary of terms in Appendix E.

Below is a table indicating the characteristics associated with activities typically undertaken by students at each of these qualification levels (see Table 1). These characteristics describe the context of how the learning outcomes should be assessed. They are characteristics, or the context in which activities are embedded in each credential. They are not specific learning outcomes as they are not measurable elements, but they should be considered critical elements of every learning outcome. For example, the degree of student autonomy or interdependence, or the required knowledge base differ across credentials but are constant themes embedded within learning outcomes. These characteristics are fundamental to understanding both the differences between the credential levels and the broad set of student skills that they cultivate. It is important to keep these elements in mind when considering the type of activities undertaken and expectations about how the learning outcomes are achieved.

Table 1. Characteristics of Qualification Levels*

CHARACTERISTICS	TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
	Activities are well-defined and...	**Activities are broadly defined and...**	**Activities are complex and...**	**Activities are exploratory and...**
PROCESSES AND SCOPE	...have clear constraints and processes, limited scope and involve unambiguous information	...involve adaptation/extension of standard processes; may have loose constraints and/or involve conflicting information	...require abstract thinking where processes are not immediately apparent; have a wide scope; often involve ambiguous or uncertain information	...require abstract thinking where processes are not immediately apparent; have an open scope; often involve unknown information and constraints
REQUIRED KNOWLEDGE BASE	...involve using limited theoretical knowledge but extensive practical knowledge	...involve extensive practical knowledge as it relates to fundamental theoretical knowledge	...involve a focus on theoretical knowledge as it relates to practical knowledge	...involve extensive and current theoretical knowledge related to the research area
INTERDEPENDENCE	...involve discrete and self-contained problems	...involve elements of extensive problems	...involve multiple elements or sub-problems which are interconnected	...involve the extension of interconnected ideas and concepts
INNOVATION	...involve the use of existing concepts or processes in modified ways	...involve the use of concepts or processes in non-standard ways	...involve the creative use of principles and research-based knowledge in novel ways	...involve the creation of new knowledge or novel application of existing knowledge to new areas
AUTONOMY	...have prescribed goals and methods; activities supervised	...have goals and methods loosely prescribed and activities supervised	...require independent determination of processes and methods with periodic supervision	...involve conducting independent research with limited supervision

* Table 1 is adapted from Section 4.1 of http://www.washingtonaccord.org/IEA-Grad-Attr-Prof-Competencies.pdf

Six core competencies are presented for each qualification level, the first five of which are common to all three sectors: 1) Knowledge, 2) Critical and Creative Thinking, 3) Communication, 4) Social Responsibility, 5) Personal and Interpersonal Capacities, and 6) Practice and Methods (specific to each sector). In broad terms, the competencies, subcompetencies and student learning outcomes include the knowledge (what successful students should know) and skills (what successful students should be able to do) expected upon graduation.

These competencies reflect related clusters of learning outcomes. This categorization is not meant to imply a desire for "category pure" learning experiences, but rather an attempt to communicate in a clear, if not slightly oversimplified, manner. The competencies are considered relative to each credential to arrive at learning outcomes that explicitly articulate the expected abilities of graduating students. These learning outcomes are presented within cells of a matrix, with credentials as columns and categories as rows.

Generally speaking, these abilities are viewed as incremental across the credentials. It must be acknowledged, however, that a degree is not simply a "diploma plus two years." Two-year diploma programs, for example, may include student learning outcomes relevant to the knowledge and skills that students acquire in specific programs that are not necessarily part of a four-year bachelor's degree. For example, work integrated learning may be included in the curriculum of a college diploma without being an outcome in a degree. For example, in the physical science sector, students in the college programs have very strong technical skills in testing, characterization and manufacturing, which are not points of focus for students at the four-year degree or master's levels (see Physical Science 6.1 for example). Similarly, some programs will have additional expectations based on professional designations that will not be relevant to others.

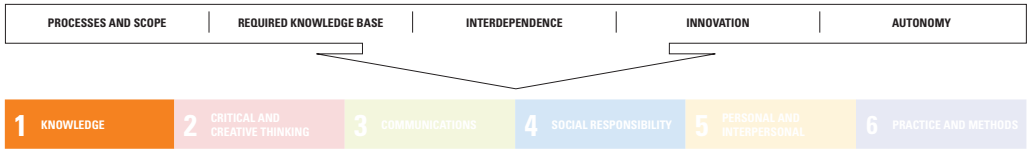
Finally, all learning outcomes reflect attainment. The outcomes are described in terms of abilities that students will be able to demonstrate upon completion of a credential, but are not meant to capture the specific level of proficiency a student may demonstrate. These outcomes are not intended to be aspirational, but rather to benchmark the current expectations. We also note that some programs will have higher expectations than others for certain learning outcomes.

Table 2. Competencies and Subcompetencies

Characteristics of Qualification Levels (Two-Year Diploma, Three-Year Diploma, Bachelor's Degree, Master's Degree)

	COMPETENCIES	SUBCOMPETENCIES		
1	KNOWLEDGE	1.1 Theory and Concepts 1.2 Numeracy	1.3 Limits of Knowledge and Qualification 1.4 Multidisciplinarity	1.5 Breadth of Knowledge
2	CRITICAL AND CREATIVE THINKING	2.1 Critical Thinking 2.2 Creativity	2.3 Problem Identification 2.4 Problem Solving	2.5 Analysis of Risks and Benefits 2.6 Evaluation
3	COMMUNICATION	3.1 Reading Comprehension 3.2 Writing Skills	3.3 Listening Comprehension 3.4 Presentation Skills	3.5 Discussion Skills 3.6 Graphical Communications
4	SOCIAL RESPONSIBILITY	4.1 Ethical Principles and Guidelines 4.2 Legal and Professional Responsibilities	4.3 Health and Safety 4.4 Social Awareness and Impact	4.5 Global Awareness 4.6 Environment and Sustainability
5	PERSONAL AND INTERPERSONAL CAPACITIES	5.1 Diversity and Respect 5.2 Teamwork	5.3 Personal Reflection 5.4 Self-Direction and Independent Work	5.5 Lifelong Learning
6	PRACTICE AND METHODS	**LIFE AND HEALTH SCIENCE** 6.1 Investigation/Research Methods 6.2 Ethical Research 6.3 Resource Material 6.4 Information Management 6.5 Formatting/Referencing 6.6 Relevance of Research 6.7 Practice 6.8 Interdisciplicary and Inter-Professional Practice	**PHYSICAL SCIENCE** 6.1 Tools, Instruments, and Equipment (Hardware and Software) 6.2 Design 6.3 Uncertainty 6.4 Troubleshooting 6.5 Models 6.6 Resource Management 6.7 Information Management	**SOCIAL SCIENCE** 6.1 Research Methods 6.2 Ethics of Research 6.3 Methods of Analysis 6.4 Social Impact 6.5 Resource Management 6.6 Information Management

Table 3. Learning Outcomes

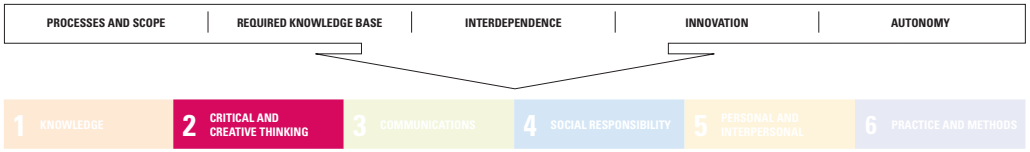


1 KNOWLEDGE*

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
1.1	Theory and Concepts	Describe and apply the major concepts, theories and practices in the discipline	Describe and apply major theories, principles and practices in the discipline	Drawing on fundamental principles, describe, apply and integrate major theories and practices in the discipline	Drawing on fundamental principles, describe, apply and integrate the major theories, research methods and approaches to inquiry and/or schools of practice in the field of study
1.2	Numeracy	Interpret quantitative information, apply quantitative reasoning and perform appropriate calculations to draw conclusions	Interpret quantitative information, apply quantitative reasoning and perform appropriate calculations to draw conclusions	Interpret quantitative information, apply quantitative reasoning and perform appropriate calculations to draw conclusions	Interpret quantitative information, apply quantitative reasoning and perform appropriate calculations to draw conclusions
1.3	Limits of Knowledge and Qualification	Describe limitations of personal knowledge and tasks for which they are qualified	Describe limitations of personal knowledge and tasks for which they are qualified	Describe the limits to their own knowledge and how uncertainty and ambiguity influence their analyses and interpretations	Delineate the current limits of theory, knowledge and/or practice in the field and how uncertainty and ambiguity influence analyses and interpretations
1.4	Multidisciplinarity	Apply prescribed principles from related disciplines to their field of study	Identify and apply principles from related disciplines to their field of study	Identify and integrate principles from related disciplines to their field of study	Identify and integrate principles of other fields of study in independent research
1.5	Breadth of Knowledge	Describe and apply basic concepts theories and practices from across the sectors	Describe and apply basic concepts theories and practices from across the sectors	Describe and apply basic concepts theories and practices from across the sectors	Describe and apply basic concepts theories and practices from across the sectors

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes



2 CRITICAL AND CREATIVE THINKING*

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
2.1	Critical Thinking	Identify and compare assumptions and arguments	Evaluate assumptions and arguments, and defend a standpoint	Evaluate underlying assumptions and arguments; develop and support a standpoint	Evaluate underlying assumptions and arguments in own work relative to your field; develop and support a standpoint
2.2	Creativity	Adapt existing ideas or techniques to respond to a specific issue	Adapt existing ideas or techniques to respond to a specific issue	Devise innovative approaches which may build on existing ideas or techniques	Devise innovative approaches which may build on existing ideas or techniques and discuss the implications for the field
2.3	Problem Identification	Identify and define a problem	Identify and define a problem	Identify and define a problem and the associated constraints and objectives	Identify and define a complex problem and the associated constraints and objectives
2.4	Problem Solving	Compare a prescribed set of solutions to a problem; choose and implement the most suitable approach	Evaluate possible solutions to a problem; adapt and implement the most suitable approach	Independently evaluate possible solutions to a problem; develop and implement a suitable approach	Independently evaluate a comprehensive range of possible solutions to a complex problem; develop and implement a suitable approach
2.5	Analysis of Risks and Benefits	Mitigate possible risks associated with solving a problem using prescribed methods	Anticipate and mitigate potential risks associated with a problem using prescribed methods	Compare and contrast the risks and benefits of different strategies for responding to various problems	Evaluate risks and benefits of different strategies, including broader implications of available options
2.6	Evaluation	Assess the quality of results and draws conclusions	Assess the relevance and reasonableness of assumptions and quality of results, draw conclusions and recommend directions for future work	Assess the relevance, reasonableness and effectiveness of assumptions, methods and quality of results, draw conclusions and recommend directions for future work	Assess the relevance, reasonableness and effectiveness of assumptions, methods and quality of results; draw conclusions and recommend directions for future work

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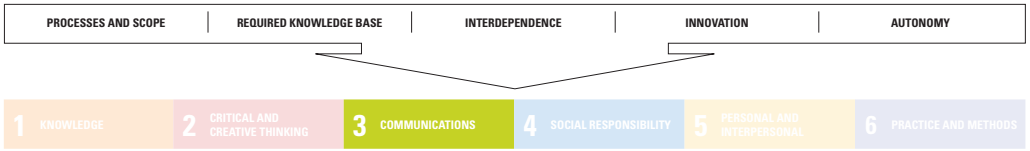
Learning Outcomes

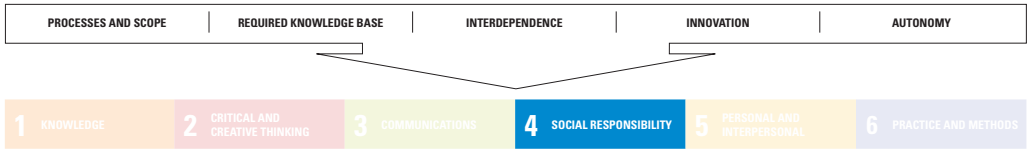


3 COMMUNICATION*

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
3.1	Reading Comprehension	Demonstrate comprehension of written material	Demonstrate comprehension of written material	Demonstrate comprehension of diverse written material, including scholarly sources	Integrate and analyze ideas from multiple written materials, including primary sources
3.2	Writing Skills	Write coherent and grammatically correct materials that meet specific objectives and audience needs	Write concise, coherent and grammatically correct materials that meet specific objectives and audience needs	Write concise, coherent and grammatically correct materials that draw on scholarly sources, appropriate to audience needs	Write concise, coherent and grammatically correct materials of publishable quality, appropriate to audience needs
3.3	Listening Comprehension	Demonstrate comprehension of information communicated orally	Demonstrate comprehension of information communicated orally	Demonstrate comprehension of information communicated orally, including scholarly ideas	Integrate and analyze information presented orally, including scholarly ideas
3.4	Presentation Skills	Present material, alone or as part of a team, in a coherent and organized form to targeted audiences, using tools as appropriate	Confidently present material, alone or as part of a team, in a coherent and organized form to targeted audiences, using tools as appropriate	Effectively present material in a coherent and organized form to diverse audiences, using tools as appropriate	Effectively and confidently present material to both general and scholarly audiences; articulate and defend a position
3.5	Discussion Skills	Effectively discuss and exchange information and ideas orally	Effectively discuss and advance a position orally in a variety of settings	Effectively discuss and debate complex ideas orally in a variety of settings	Effectively discuss and debate complex ideas orally and defend a position clearly
3.6	Graphical Communications	Interpret and clearly and creatively represent information in charts, diagrams and other visual forms	Interpret and clearly and creatively represents information in charts, diagrams and other visual forms	Interpret and clearly represent information in charts, diagrams and other visual forms; make perceptive and creative choices to convey information	Interpret and clearly represent information in charts, diagrams and other visual forms; make perceptive and creative choices to convey information

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes

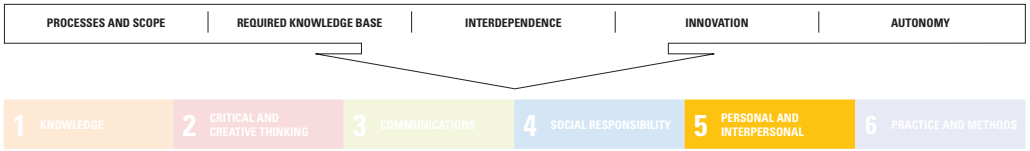


4 SOCIAL RESPONSIBILITY*

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
4.1	Ethical Principles and Guidelines	Recognize ethical issues and apply ethical principles to a variety of situations	Recognize ethical issues and apply ethical principles to a variety of situations	Recognize ethical issues, critically analyze various perspectives and apply ethical principles to complex situations	Integrate ethical doctrine, guidelines and procedures relevant for the responsible conduct of research or practice
4.2	Professional and Legal Responsibilities	Describe and demonstrate compliance with relevant laws, legislation and professional codes of practice and ethics	Describe and demonstrate compliance with relevant laws, legislation and professional codes of practice and ethics	Interpret and apply relevant laws, legislation and professional codes of practice and ethics	Interpret and apply relevant laws, legislation and professional codes of practice and ethics
4.3	Health and Safety	Adhere to applicable health and safety codes and best practices	Adhere to applicable health and safety codes and best practices, and identify underlying risk/liability issues	Interpret and apply safety codes, best practices and risk management principles	Interpret and apply safety codes, best practices and risk management principles
4.4	Social Awareness and Impact	Describe the potential impact of decisions and actions on societies, locally and globally	Describe and evaluate the potential impact of decisions and actions on societies, locally and globally	Describe and evaluate the potential impact of decisions and actions on societies, locally and globally	Describe and evaluate the potential impact of their scholarship on society, locally and globally
4.5	Global Awareness	Demonstrate awareness of worldviews and global issues and the implications for one's discipline, professional practice, and decision making	Demonstrate awareness of worldviews and global issues and the implications for one's discipline, professional practice, and decision making	Analyse worldviews and global issues and the implications for one's discipline, professional practice, and decision making	Integrate worldviews and global issues into one's discipline, professional practice and decision making as appropriate
4.6	Environment and Sustainability	Describe environmental issues and the environmental impact of decisions and actions, and incorporate sustainability into decision making	Describe environmental issues and the environmental impact of decisions and actions, and incorporate sustainability into decision making	Analyze environmental issues and the environmental impact of decisions and actions, and incorporate sustainability into decision making	Analyze environmental issues and the environmental impact of decisions and actions, and incorporate sustainability into decision making

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes

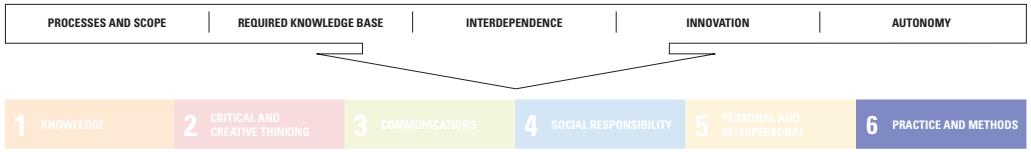


5 PERSONAL AND INTERPERSONAL CAPACITIES*

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
5.1	Diversity and Respect	Demonstrate an appreciation and respect for diversity in individuals, cultures, perspectives, values, belief systems and roles, including the limitations of one's personal perspective	Demonstrate an appreciation and respect for diversity in individuals, cultures, perspectives, values, belief systems and roles, including the limitations of one's personal perspective	Demonstrate an appreciation and respect for diversity in individuals, cultures, perspectives, values, belief systems and roles, including the limitations of one's personal perspective	Demonstrate an appreciation and respect for diversity in individuals, cultures, perspectives, values, belief systems and roles, including the limitations of one's personal perspective
5.2	Teamwork	Work in a team to achieve group goals and contribute to effective working relationships; work to resolve conflicts or seek assistance	Work in a team to achieve group goals and contribute to effective working relationships; work to resolve conflicts or seek assistance	Work in a team to achieve group goals and contribute to effective working relationships; develop strategies to address conflict	Work effectively within a team, manage team dynamics and take on a leadership role as required
5.3	Personal Reflection	Review, reflect on and make improvements to individual performance; provide and respond to feedback	Review, reflect on and make improvements to individual performance; provide and respond to feedback	Review, reflect on and make improvements to individual performance; provide and respond to feedback	Review, reflect on and make improvements to individual performance; provide and respond to feedback
5.4	Self-Direction and Independent Work	Demonstrate initiative in setting goals and completing tasks	Demonstrate initiative in setting goals and completing tasks	Demonstrate initiative in setting goals and completing tasks	Demonstrate initiative in setting goals and completing tasks necessary to conduct independent research
5.5	Lifelong Learning	Develop own goals and create a long-term plan for learning and professional growth	Develop own goals and create a long-term plan for learning and professional growth	Develop own goals and create a long-term plan for learning and professional growth	Develop own learning goals and long-term strategies for personal and professional growth

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes



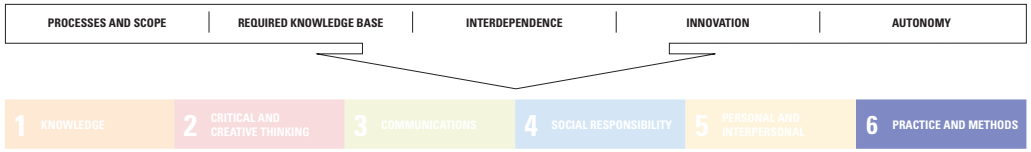
6 PRACTICE AND METHODS*

LIFE AND HEALTH SCIENCE

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
6.1	**Investigation/Research Methods**	Identify basic scientific methods to approach given problems	Apply basic scientific methods to research questions	Utilize a variety of methodologies to conduct or contribute to research	Apply existing and developing concepts, designs, techniques and current research from one or more areas of study in research application
6.2	**Ethical Research**	Recognize ethical and unethical practices in research and comply with ethical research	Comply with applicable ethical research practices and protocols (e.g., Tri-Council, Good Laboratory Practice)	Comply with applicable ethical research practices and protocols (e.g., Tri-Council, Good Laboratory Practice)	In accordance with applicable ethical research practices and protocols (e.g., Tri-Council, Good Laboratory Practice), design and carry out research in anethical manner
6.3	**Resource Material**	Use provided criteria; evaluate and select specific information to meet a need from prescribed sources	Evaluate and select reliable information from self-selected sources	Use self-determined criteria; identify, critically evaluate and access a range of reliable information	Use self-determined criteria; identify, critically evaluate and access a comprehensive range of reliable information
6.4	**Information Management**	Locate, organize and integrate information using appropriate information systems	Locate, organize and evaluate information using appropriate information systems	Locate, organize and critically evaluate a range of information, including scholarly sources and databases, using appropriate information systems	Locate, organize and critically evaluate a range of information, including a comprehensive range of scholarly sources and databases, using appropriate information systems
6.5	**Formatting/Referencing**	Reference source material accurately and in prescribed format	Reference source material accurately and in prescribed format	Reference source material accurately and in prescribed format	Reference source material accurately and in prescribed format
6.6	**Relevance of Research**	Apply research knowledge in a practical setting	Apply research knowledge in a practical setting	Evaluate the implications of research for theoretical arguments and evidence-based resolution for the problem under investigation	Critically assess the broader implications of practice and research for theories, methods and future investigations
6.7	**Practice**	Apply knowledge, skills and behaviours acquired in an academic setting to a variety of practice settings	Apply knowledge, skills and behaviours acquired in an academic setting to a variety of practice settings	Apply knowledge, skills and behaviours acquired in an academic setting to a variety of practice settings	Apply knowledge, skills and behaviours acquired in an academic setting to a variety of practice settings
6.8	**Interdisciplinary and Inter-Professional Practice**	Work collaboratively within a multidisciplinary team	Work collaboratively within a multidisciplinary team	Work collaboratively within a multidisciplinary team	Work collaboratively within a multidisciplinary team

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes



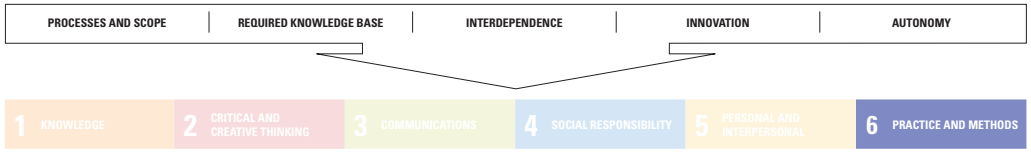
6 PRACTICE AND METHODS*

PHYSICAL SCIENCE

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
6.1	**Tools, Instruments, and Equipment (Hardware and Software)**	Conduct practical building, experimentation, testing and measurement using specialized and standard tools, instruments and equipment	Conduct practical building, experimentation, testing and measurement using and adapting specialized and standard tools, instruments and equipment	Apply and adapt standard tools, instruments and equipment	Apply and adapt a variety of tools, instruments and equipment
6.2	**Design**	Design and conduct a simple experiment or build a simple product to solve a well-defined problem	Design and conduct an experiment or build a product to solve a specific problem	Design and conduct/implement an experiment, product, process or system to answer a question or solve a problem	Define, design and conduct/implement an experiment, product, process or system to answer a question or solve a problem
6.3	**Uncertainty**	Recognize and list uncertainties in analysis, interpretation and measurement	Describe the nature and possible causes of uncertainties in analysis, interpretation and measurement	Describe the nature and possible causes of uncertainty in analysis, interpretation and measurement, and evaluate uncertainty in conclusions	Describe the nature and possible causes of uncertainty in analysis, interpretation and measurement, and evaluate uncertainty in conclusions
6.4	**Troubleshooting**	Apply prescribed troubleshooting processes to resolve issues	Apply and adapt troubleshooting processes to resolve issues	Apply and adapt problem solving approaches to troubleshoot issues	Apply and adapt problem solving approaches to troubleshoot issues
6.5	**Models**	Recognize and apply models (mathematical representations, flowcharts, block diagrams) of systems in appropriate contexts	Select and adapt assumptions and models to suit the nature of the problem and needs of the solution	Create and apply a model of a system to resolve a problem	Create and apply a model of a system to resolve a problem
6.6	**Resource Management**	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks
6.7	**Information Management**	Locate, organize and integrate information using appropriate information systems	Locate, organize and evaluate information using appropriate information systems	Locate, organize and critically evaluate a range of information, including scholarly sources and databases, using appropriate information systems	Locate, organize and critically evaluate a range of information, including a comprehensive range of scholarly sources and databases, using appropriate information systems

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Learning Outcomes



6 PRACTICE AND METHODS*

SOCIAL SCIENCE

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
6.1	Research Methods	Identify the basic social scientific method(s) (e.g., qualitative and quantitative) appropriate for a given problem	Apply the basic social scientific method(s) (e.g., qualitative and quantitative) appropriate for a given problem	Select and apply the appropriate social scientific method(s) (e.g., qualitative and quantitative) to investigate a given problem	Design social scientific research that provides empirical testing of a variety of theoretical perspectives
6.2	Ethics of Research	Recognize ethical and unethical practices in research (e.g., Tri-Council ethics protocols)	Recognize ethical and unethical practices in research (e.g., Tri-Council ethics protocols)	Recognize ethical and unethical practices in research and comply with applicable ethics protocols (e.g., Tri-Council)	Recognize ethical and unethical practices in research and implement applicable ethics protocols (e.g., Tri-Council)
6.3	Methods of Analysis	Calculate and comprehend descriptive statistics, and critically evaluate claims that are based on these statistics	Calculate and comprehend descriptive statistics, and critically evaluate claims that are based on these statistics	Evaluate or apply the appropriate analytical techniques (e.g., qualitative and quantitative) to address theoretical hypotheses across various research designs, identifying possible causes of uncertainties in the analysis, interpretation, measurement and conclusions	Select and apply complex area-specific analytical techniques (e.g., qualitative and quantitative) to address theoretical hypotheses with respect to a specific problem, identifying uncertainties in conclusions, the causes of those uncertainties and potential ways of resolving them
6.4	Social Impact	Identify, articulate and discuss the social impact of research they are exposed to in terms of its effects on both public policy and practice	Identify, articulate and discuss the social impact of research they are exposed to in terms of its effects on both public policy and practice	Identify, articulate and discuss the social impact of research they are exposed to in terms of its effects on both public policy and practice. Be prepared to perform social research	Study and perform research that can inform positive changes in social policy and practice
6.5	Resource Management	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks	Select and manage resources effectively to complete projects/tasks
6.6	Information Management	Locate, organize and integrate information using reliable information sources	Locate, organize and evaluate information using reliable information sources	Locate, organize and evaluate information, with emphasis on primary sources	Locate, organize, synthesize and critically evaluate information, with emphasis on primary sources

*Learning Outcomes are assessed in the context of activities described in the Characteristics of Qualification Levels (Table 1)

Section 3: Measuring and Assessing Learning Outcomes

Overview

How to assess and demonstrate student achievement is an on-going challenge for governments, institutions, programs and faculty members alike. The needs of students must also be considered in the process: How do they know what they know, and do they have the means to demonstrate it? Given the variety of reasons for demonstrating learning outcomes, a number of different activities of assessment, measurement and demonstration of achievement are being tested around the world (Lennon, 2010). For this reason, a number of resources on various student assessment techniques are included in Appendix G of this report.

The following section, therefore, is not intended to provide a framework for implementing learning outcomes, but rather highlights ways in which various stakeholders can use and benefit from incorporating and demonstrating them. While we work here with the Tuning learning outcomes, any similar set of learning outcomes could be used in a similar way.

Institutions assess students on an ongoing basis for both summative and formative purposes. In the case of summative assessments, there has been a significant deal of research into large-scale tests (e.g., Kuh & Ikenberry, 2009; Neusche, 2008; OECD, 2013; Tremblay, Lalancette & Roseveare, 2012). These can assess student capabilities in any number of areas, including information literacy[12], generic skills[13] and professional skills (as in engineering and nursing accreditation assessments).[14] These types of assessments provide information on student capacity and serve some purposes well, particularly those of institutions and governments.[15] Similarly, a summative assessment is appropriate at the end of a course to measure how well students have mastered the material.

Formative assessments support the ongoing development of learning and similarly assist programs and faculty members in the development of teaching and learning goals. At the same time, assessments can also be used to inform student learning (Chambers & Wickersham, 2007). Proper learning outcomes can clarify student goals, allowing them to reflect on and assess their own accomplishments (Jarrott & Eubanks Gambrel, 2011). Formative assessments are extremely valuable for teaching and learning, providing faculty and students with feedback on progress. However, these formative assessments rarely leave the classroom, remaining instead in the domain of the faculty member and the student.

By integrating learning outcomes from top to bottom at an institution, and particularly in a program, it is possible to have faculty members make curriculum and assessment decisions while still demonstrating that the broader learning outcomes have been achieved without exclusively relying on summative assessments. Achievement can then be signalled to both institutional administration and students alike.

The remainder of this report highlights a few examples of how learning outcomes can be integrated in programs, assessed by faculty members and demonstrated by students. For simplicity, the example imagines a bachelor's degree program in physical science.

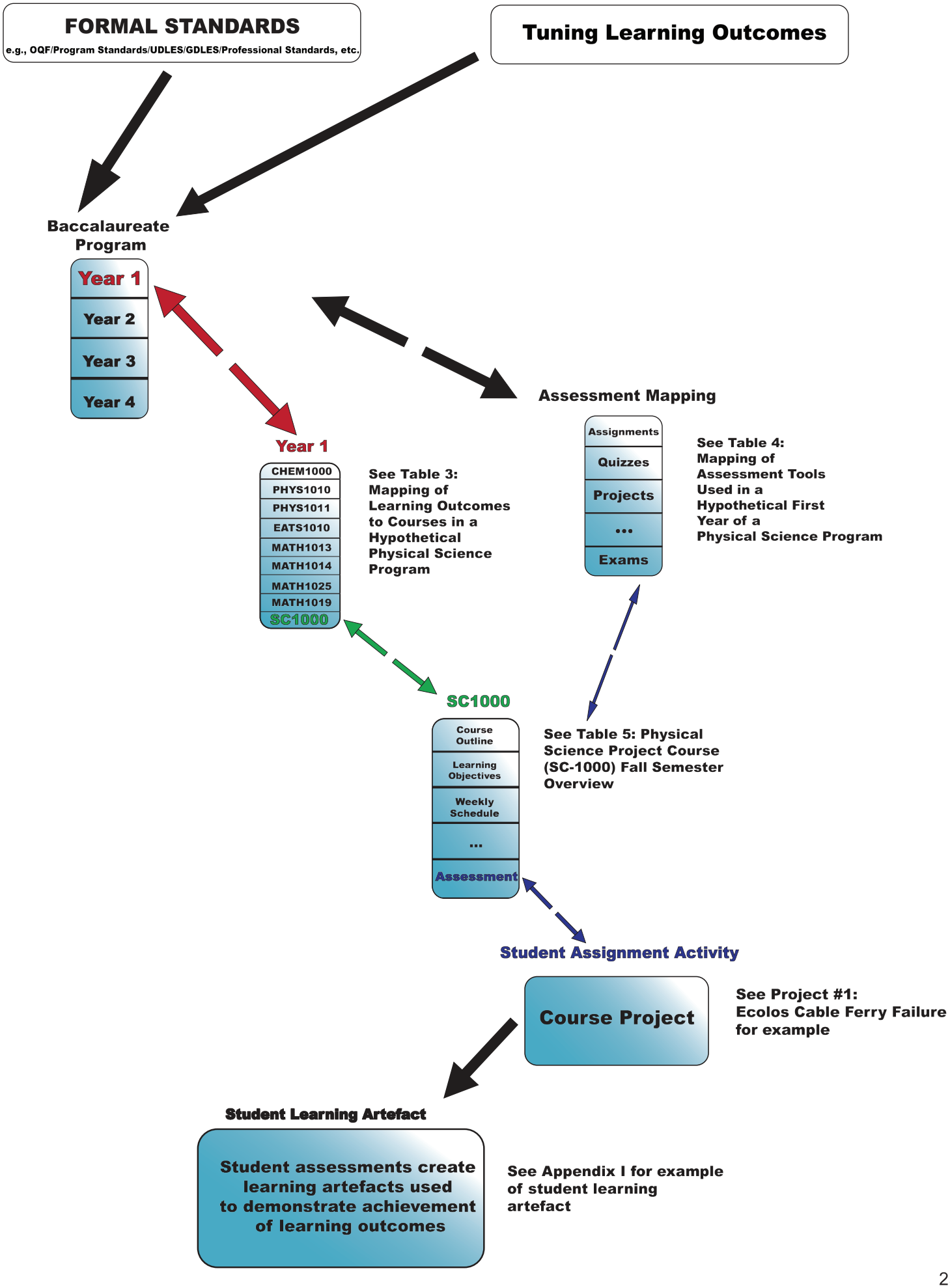
[12] For example, see the Information Literacy Test Madison Assessment, available at http://www.jmu.edu/assessment/resources/prodserv/instruments_ilt.htm
[13] For example, see the Collegiate Learning Assessment, available at http://cae.org/performance-assessment/category/cla-overview/
[14] See the Measuring Quality Inventory (2012) for a comprehensive list of assessment tools.
[15] See Appendix G for a list of tools used internationally and their purposes (available online at www.heqco.ca).

Integrating Learning Outcomes into Programs

Programs face considerable pressures to comply with external quality assurance measures such as government accountability frameworks, quality assurance frameworks, or the standards set forth by professional accreditation bodies. These formal standards are an important aspect of curriculum design and inform all levels of activity. Presented below in Figure 1 is a representation of learning outcomes integration.[16] Note that learning outcomes do not typically come from the top down but rather inform each other at every stage and can be mapped in both directions. Consider, then, that it is possible to begin the process of learning outcomes curriculum mapping at any point, working backward or forwards.

[16] Note that there are a variety of models and methods for mapping learning outcomes to a curriculum. See Appendix F for a list of references.

Figure 1: Integration of Learning Outcomes



If we begin by considering the needs of department heads/chairs, or those of a committee responsible for program-wide curriculum development, the Tuning learning outcomes map nicely to most Ontario formal standards. For example, Appendix B, C and D clearly show how the Tuning learning outcomes provide specific, measurable learning outcomes to the broad competencies set out in the OQF, UDLEs and GDLEs[17]. By mapping the Tuning learning outcomes to those competencies required for quality assurance purposes, department chairs or representatives can use the Tuning learning outcomes to respond to the requirements and demonstrate compliance. Thus the Tuning learning outcomes become a useful tool to map backwards for accountability/quality assurance purposes.

They are also useful at the program level when mapping from the top down, as they provide clear direction for programs, courses and curriculum development. Having set out the overall learning outcomes for a program, it is necessary to understand where, when and how the student will engage with certain learning outcomes, what form of assessment will take place and what learning artefacts students will gain.

Many programs find it helpful to identify clearly the mapping between the outcomes expected in the program and the current curriculum. The curriculum mapping table below (Table 4) connects the Tuning learning outcomes to the first year of a hypothetical baccalaureate program in the physical sciences. In this table, outcomes are listed as being taught (T) in a specific course, utilized (U) in that course but not explicitly taught, and/or assessed (A) in that course.[18] The course Physical Science Project Course, highlighted in red, will be examined in more detail later.

[17] Appendix B, C and D are available on the HEQCO website.
[18] Scales are commonly used in the mapping process to indicate the level of evaluation. For example, one could use numbers (say 0 to 5) to reflect the extent to which a specific course or activity exercises a specific subcompetency. Alternatively, one might wish to specify whether the subcompetency is taught, utilized or assessed (T, L, A), or whether the specific subcompetency is being introduced, reinforced or mastered (I, R, M).

Table 4: Mapping of Learning Outcomes to Courses in a Hypothetical Physical Science Program

Curriculum Map for Tuning Learning Outcomes in Sample Program		Chemistry I	Physics I	Physics II	Earth & Space Science	Calculus I	Calculus II	Linear Algebra	Discrete Mathematics	Physical Science Project Course
T=Taught, U=Utilized, A=Assessed		*CHEM -1000*	*PHYS -1010*	*PHYS -1011*	*EATS -1010*	*MATH -1013*	*MATH -1014*	*MATH -1025*	*MATH-1019*	*SC-1000*
Credits		3	3	3	3	3	3	3	3	6
1	**Knowledge**									
1.1	Theory and Concepts	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A
1.2	Numeracy	U	T,A	T,A	U	U	U	U	U	T,A
1.3	Limits of Knowledge & Qualification									T,A
1.4	Multidisciplinarity		T,A	T,A		T,A				T,A
1.5	Breadth of Knowledge									
2	**Critical and Creative Thinking**									
2.1	Critical Thinking	U	U	U	U	U	U	U	T,A	T,A
2.2	Creativity	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A
2.3	Problem Identification	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A	T,A
2.4	Problem Solving	U	U	U	U	U	T,A	U	T,A	T,A
2.5	Analysis of Risks and Benefits									T,A
2.6	Evaluation									T,A

3	**Communication**									
3.1	Reading Comprehension	U	U	U	U	U	U	U	U	U
3.2	Writing Skills									U,A
3.3	Listening Comprehension	U				U				U
3.4	Presentation Skills									U,A
3.5	Discussion Skills									U,A
3.6	Graphical Communications									U,A
4	**Social Responsibility**									
4.1	Ethical Principles and Guidelines									T,A
4.2	Professional and Legal Responsibilities									T,A
4.3	Social Awareness and Impact									T,A
4.4	Health and Safety									T,A
4.5	Global Awareness									
4.6	Environment and Sustainability									T,A
5	**Personal and Interpersonal Capabilities**									
5.1	Diversity and Respect									
5.2	Teamwork		U	U						T,A
5.3	Personal Reflection									T,A
5.4	Self-Direction and Independent Work									T,A
5.5	Lifelong Learning									T,A

6	**Practice and Methods (Physical Science)**									
6.1	Tools, Instruments, and Equipment (Hardware & Software)									T,A
6.2	Design		U	U						T,A
6.3	Uncertainty									T,A
6.4	Troubleshooting		U	U						U
6.5	Models		T,A	T,A		T,A	T	T	T	T,A
6.6	Resource Management									
6.7	Information Management					T,A				T,A

Assessment in the Classroom

Just as learning outcomes are valuable when determining goals at the course level, different types of assessments support different aspects of learning. From an administrative perspective, an overview of which courses assess which learning outcomes and how these outcomes are assessed is useful. Furthermore, with knowledge of what types of assessments are being carried out in each course across a program, students can be provided with a variety of assessment types that support the range of learning outcomes (e.g., using oral presentations, simulations, written essays to assess different outcomes). In addition, administrators and faculty can use these tables to determine whether students are being assessed by a range of assessment approaches.

The relatively simple activity of mapping assessments to learning outcomes can lead to improvements in how objectives are met and performance is measured. Table 4 below shows an example of the types of assessments that could be found in courses in a typical first-year physical science program. Faculty members may already be aware of some of these tools, and there is a growing literature on how these assessment methods can best be utilized to achieve learning outcomes.[19] It can be a useful exercise to think of these tools in the context of each course and of the program as a whole.

[19] For examples of good assessment practices, see the National Institute for Learning Outcomes Assessment website at http://www.learningoutcomeassessment.org/CaseStudiesInstitutions.html

Table 5: Integration of Learning Outcomes Mapping of Assessment Tools Used in a Hypothetical First Year of a Physical Science Program

	Cases and Open Problems	Computer-Based Assessment	Direct Observation	Essays	Learning Logs/Diaries	Mini-Practicals	Multiple Choice Questions	Poster Sessions	Presentations	Group Projects	Oral Communication and Participation	Questionaires and Report Forms	Online Participation and Submission	etc.
Chemistry I				X	X	X	X		X				X	
Physics I						X	X						X	
Physics II	X					X	X			X		X		
Earth & Space Science	X		X				X	X	X					
Calculus I							X						X	
Calculus II					X		X					X	X	
Linear Algebra	X						X							
Discrete Mathematics							X				X			
Physical Science Project Course		X		X			X	X	X		X	X		

For information on ways to determine appropriate assessment plans and techniques, please see Appendices G and I. For more detail, readers are recommended to review Banta et al. (2009) and Biggs & Tang (2011).

Example: Physical Science Project Course (SC-1000)

We will now turn to the Physical Science Project Course (SC-1000) described above as an example of how an instructor can link key disciplinary expectations to the Tuning learning outcomes. Some competencies are more commonly developed in more student-directed experiences like laboratory investigation courses, thesis courses and project-based courses. The Physical Science Project Course, an example of this latter type of course, is examined in more detail below. SC-1000 is an example of a full-year integrative course that is increasingly common in engineering curricula. Such a course applies knowledge from mathematics and science courses to projects that emulate activities in students' discipline. The projects also explicitly target fundamental academic skills like critical thinking and problem solving (Tuning competency 2) and communication (Tuning competency 3), and situate problems in realistic scenarios that allow students to consider the social impact of their work (Tuning competency 4). The projects are team-based, and students receive instruction in effective teamwork (Tuning competency 5).

In this example we examine how the course instructor of SC-1000 could plan to assess multiple learning outcomes in the integrative projects. Table 5 shows an example of a course planning table that links course learning outcomes in the first semester of the course to the Tuning learning outcomes and to course activities. This course has weekly lectures and computer studios that support two four-week projects. Instruction focuses on critical thinking, problem solving, communication and other fundamental academic skills. A mathematics software tool, MATLAB, is also taught to enable students to model physical systems in their projects.

As shown in Table 5, the fall semester of this hypothetical course targets Tuning competencies 2: Critical Thinking, 3: Communication, 4: Social Responsibility, and 6: Practice and Methods. These competencies are developed using activities described in the Characteristics of Qualification Levels on p. 10. As a bachelor's-level program, students are expected to complete activities defined by processes and scope that "require abstract thinking where processes are not immediately apparent; have a wide scope; often involve ambiguous or uncertain information", that have knowledge base involving "a focus on theoretical knowledge as it relates to practical knowledge", and with expectation for innovation involving "creative use of principles." These characteristics, suitable for an introductory level, are used to define the projects in SC-1000.

The first project for the course is highlighted in red in week 5 of Table 5, which is followed by the course assignment. The grading rubric that follows lists the relevant Tuning learning outcomes(s) in the leftmost column and shows how reports could be scored using learning outcomes.

Table 6: Physical Science Project Course (SC-1000) Fall Semester Overview

Course learning outcomes (CLOs): Students will be able to:

1. Apply a prescribed process for solving complex problems. (Tuning LO 2.3, 2.4, 2.5, 2.6 – Problem solving)
2. Select and apply appropriate quantitative model and analysis to solve problems. (Tuning LO 6.5 – Models)
3. Effectively communicate in a written document following a prescribed format and using standard grammar and mechanics. (Tuning LO 3.2 – Writing Skills)
4. Apply concepts including occupational health and safety principles, economics, law and equity to engineering problems. (Tuning LO 4.1, 4.2, 4.3 – Profession, health, safety)
5. Apply critical and creative thinking principles to solve contextualized problems. (Tuning LO 2.1, 2.2 – Critical and creative thinking)
6. Apply a numerical modeling tool to create a model used for solving complex problems. (Tuning LO 6.5 – Models)
7. Critically evaluate information on prescribed criteria. (Tuning LO 6.5 – Models)

Week	Lecture Concepts	Student Activity	Evaluation
1: Sep 10	Motivation, course overview, models, self-regulation. Introduction to MATLAB	Lecture group activity: Modelling	Critical thinking pre-test (CLO5) Writing pre-test (CLO 3)
2: Sep 17	Lecture: Complex problem solving and critical thinking overview, asking good questions, materials science	Lecture group activity: Work through a sample complex problem together Computer studio: Using variables and operators in MATLAB	Occupational Health and Safety online test (CLO4) MATLAB quiz 1
3: Sep 24	Lecture: Concept maps, establishing objectives and constraints, safety and hazard analysis	Lecture group activity: Process for resolving assignment 1 problem Computer studio: Data importing and functions	MATLAB quiz #2
4: Oct 1	Lecture: Effective argumentation, brainstorming	Lecture: Analyze past assignments for effective argument Computer studio: Curve fitting	MATLAB quiz #3
5: Oct 8	Lecture: Effective Teaming	Lecture: Teaming activities Computer studio: Conditional statements	Project 1: Cable ferry failure (CLO1,2,3,4,5,6, 7) MATLAB quiz #4
6: Oct 15	Etc.		

Below is the assignment provided to the students in the SC-1000 course. The grading rubric that follows is also provided to the students. However, for the purposes here, the learning outcomes are outlined in the leftmost column. This demonstrates how the scoring can be linked to the learning outcomes.

Physical Science Project Course (SC-1000)

Project #1: Ecolos Cable Ferry Failure

Objectives

This activity is intended to develop the ability to resolve engineering problems by applying mathematical models, critical thinking and professional judgement. Specific objectives of this include:

- Problem analysis (defining a problem, complex problem solving, modeling)
- Professionalism (importance of public safety in engineering practice, risk assessment)
- Critical thinking (asking useful questions, assessing the credibility of information, argumentation)
- Communications (English mechanics, report formatting)

As you complete your report, ensure that you are focusing on these overall objectives.

Scenario Background

In this scenario your team has been asked to conduct a Transportation Safety Board of Canada (TSB) investigation into the failure of the *Ecolos* Cable Ferry.[20] A preliminary investigation team has provided preliminary information (to be provided separately) in advance of your visit to the site. Like any information source the information presented to you by the on-site team may be suspect, so you should look out for information that is not realistic. You have been asked to submit an **investigation proposal report** addressed to the Transportation Safety Board that describes the process your team will follow to investigate this incident, provides an analysis of hypothetical situations that may have caused failure using some simple MATLAB models, and what factors may have led to the failure. In the scenario this report is intended to help determine what to investigate and what questions to ask. It is expected that you apply principles for complex problem solving, critical thinking and safety analysis.

Your report must include a description of relevant information for defining the problem and conducting the investigation, a description of your proposed process for conducting the investigation, a description of how you will model the failed system in order to describe the likely cause of failure, conclusions from your model, safety recommendations and a self-assessment of your work. A grading rubric for your report is shown on in the next page; ensure that you review that to ensure you are meeting the expectations.

[20] Available online at http://www.tsb.gc.ca/eng/rapports-reports/marine/2010/m10c0092/m10c0092.asp

Grading

	0-2 (below)	***3-4 (marginal)***	***5-6 (expectation)***	***7-8 (outstanding)***
Information summary *Tuning LO 6.9*	Little useful information, or information directly copied from assignment	Some important information or biases not identified, or trivial/incorrect information included	Summarizes and assesses credibility of information used; evaluates uncertainty and biases	**Meets expectations and:** Includes information from authoritative sources to inform process, model and conclusions
Proposed process *Tuning LO 2.4*	No or inadequate process	Process identified misses some important factors; some assumptions left unidentified or unjustified	Creates justified process for solving problem, supported by information	**Meets expectations and:** Comprehensive process model; comparison with other possible approaches
Model *Tuning LO 6.5*	No analysis, or model/analysis selected is inappropriate	Model is not sufficient to make reasonable conclusions; errors in analysis or inappropriate assumptions	Creates and compares quantitative models in MATLAB using reasonable approximations and assumptions	**Meets expectations and:** Sophisticated model used incorporating several effects; uncertainty in model's input variables shown by range of output values
Safety analysis *Tuning LO 2.5*	No or trivial analysis	Analysis includes some factors, but some important factors missed	Assesses risk; makes supported conclusions about failures and recommendations for improvement	**Meets expectations and:** Comprehensive range of risks analysis, qualitative where possible
Model results *Tuning LO 2.6, 6.3, and 6.5*	No evaluation of solution	Superficial evaluation of solution	Evaluates validity of results and model for error, uncertainty, drawing well-supported conclusions	**Meets expectations and:** Evaluates model conclusions and presents potential improvements to the models
Self-assessment *Tuning LO 1.3 and 2.6*	No or superficial assessment	Analysis of team and individual work identifies few areas for improvement	Critical analysis that identifies limitations, potential biases, potential inaccuracy, etc.	**Meets expectations and:** Comprehensive and deep analysis applied with clear proposals for potential improvement
Argumentation *Tuning LO 2.1 and 2.3*	Unsupported or trivial arguments	Arguments include some but not all critical elements	Makes claims supported by data and backing, with appropriate qualifiers	Claims supported by authoritative backing and comprehensive description of context in which they apply
Communication *Tuning LO 3.2*	Report difficult to understand	Understandable but not formatted following guidelines; many grammatical errors	Clearly formatted following guidelines with few grammatical errors	**Meets expectations and:** Concise, varied transitions, attractively formatted, no grammatical errors

The student work, or learning artefact, associated with this assignment is provided as an example in Appendix I[21].

Demonstrating Learning Outcomes to Students and Employers

The exercise above reveals that an alignment exists between the existing quality assurance frameworks and the Tuning learning outcomes, and shows how the learning outcomes can be incorporated into both the program and course learning outcomes of a typical Bachelor of Science program.[22] In addition, the level of each subcompetency was congruent with those of the existing learning outcomes within the program and related course.

What is paramount, however, is providing students with clear indications of what they have achieved. It not only allows them to understand what they have learned, but it also provides them with learning artefacts that they can use to demonstrate achievement and mastery to others.

The value of providing students with transparent documentation of their accomplishments is considerable. It:

- creates a record of student achievement for employment marketability
- provides prior learning assessment tool
- promotes self-reflection and evaluation
- provides a progressive approach to self-learning
- enables a multi-dimensional approach to student progress
- highlights achievements

There are a variety of ways to provide students with clear documentation of their achievements, including diploma supplements, learning passports, badges or e-portfolios. The following section briefly highlights some of these possibilities in order to demonstrate ways to support students' understanding and engagement with learning outcomes.

Since 2005, European countries have provided students with a Diploma Supplement that functions as a recognition instrument to indicate to employers, institutions, the general public and the individual the content of the qualification and the structure of the system from which it came (Europe Unit, 2006). Beyond a simple transcript, the Diploma Supplement addresses "information on the Contents and Results Gained" broken down into four categories: knowledge and understanding, intellectual (thinking) skills, practical skills (subject-specific) and key skills.[23]

Institutions in the United States are also exploring the added benefits of providing students with content-based transcripts (Fain, 2013). The University of Northern Arizona, for example, has developed a program that provides student with a competency report, which describes his or her abilities, skills and level of mastery in an employer-friendly format so that it can easily be shared.[24] The competency report does not replace the traditional transcript but instead supplements it with additional information on specific skills.

Another European example of demonstrating achievement in a way that is understandable to employers is the Europass.[25] The Europass intends to "help people make their skills and qualifications clearly and easily understood." It provides a template for five documents: a CV, language passport, Europass Mobility (which

[21] Appendix I is available at www.heqco.ca.
[22] This mapping process was also conducted in the social science program of child and youth care workers and life and health discipline of nursing with the same results.
[23] See the European Commission for more information: http://ec.europa.eu/education/lifelong-learning-policy/ds_en.htm
[24] For an example of the report, see http://www.insidehighered.com/sites/default/server_files/files/Competency%20Transcript%20Draft%20v12.pdf
[25] See the European Commission for more information: http://ec.europa.eu/education/lifelong-learning-policy/europass_en.htm

documents foreign work or educational activity), a Certificate Supplement and/or Diploma Supplement (Europass, 2013). This provides a common template that students can easily populate in a way that employers can quickly review and understand.

These activities, though simple, highlight student abilities and help translate academic achievements into a format that employers can understand.

Badges and e-portfolios are another way for students to signal their abilities to employers after graduation. They can also be useful for teaching and learning purposes. Using badges or an e-portfolio, students can demonstrate the knowledge, skills and attitudes gained over time in accordance with the competencies and expectations set out by a course or program. The student can produce a record of progress and record personal growth through reflection pieces. These tools also enable students to take ownership of their learning and establish a foundation for lifelong learning.

Just as the girl guides have long since used them to demonstrate mastery of a skill, a badge can indicate successful achievement of a learning outcome. The open-source software company Mozilla[26], which provides an online platform supporting badges, notes that badges can "signal traditional academic attainment of the acquisition of skills such as collaboration, teamwork, leadership, and other 21st century skills" (Goodrich, 2011). The acquisition of new badges in an online forum can allow students to demonstrate their growing capabilities.

Many institutions have utilized portfolios for different purposes and have integrated them to varying degrees at an institution, program or course level.[27] The Nova Scotia Community College, for example, provides all of its students with an e-portfolio, as well as support to help them develop it (NSCC, 2013).

A portfolio may be self-directed or faculty-guided, and course-mandated or independently managed. The focus of the portfolio could be for academic achievement or employment purposes, the establishment of personal and/or career goals, or the demonstration of personal and professional growth. Portfolios can be used as a means for formative assessment, to provide examples of achievement of learning outcomes through course work, or can be assessed as part of a capstone course or assignment for summative assessment, with completion recorded on a transcript (see Appendix F for examples of e-portfolios).

[26] See Mozilla for more information: http://openbadges.org/
[27] A sample of examples has been provided for review in Appendix H (available at www.heqco.ca).

Summary

The Tuning learning outcomes presented here are intended to contribute to the enhancement of the quality of higher education in Ontario. Our intention was to provide meaningful and measurable information on graduating students' capacities that would contribute to the quality assurance conversation. We hope that this report will be a tool that will be used in this way by government, institutions, programs and faculty members. By articulating learning outcomes at the four credential levels and grouping them into six competency areas, with clearly defined subcompetencies, we aimed to make the "black box" of education more transparent. We also provide an example of how a program might apply these learning outcomes for curriculum development and teaching and learning purposes. Finally, we close with brief comments on how learning outcomes can be made useful to students and employers. This is a critical function of learning outcomes: They are intended provide students with understanding and ownership of their capacities.

Of course, this Tuning work is but a part of the larger conversation on learning outcomes in Ontario and around the world. Several areas remain to be developed further. For example, the Ontario Tuning learning outcomes can be used by Canadian or international jurisdictions to map and compare credentials, or by institutions as a starting point for discipline-specific Tuning projects, which dig deeper into curriculum alignment. They can be used to support credit transfer by simplifying the identification of generic skills. This work can also contribute to the development of measures of learning outcomes: The commonalities identified here might make it possible to design assessments that are suitable for a sector that we did not address, or perhaps to formulate generic skills assessments across all sectors. Finally, we hope that institutions, programs and faculty members will incorporate the Tuning learning outcomes into their planning, and provide feedback to HEQCO on their activities.

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Appendix E: Glossary

Abstract thinking – Thinking characterized by the ability to use concepts and to make and understand generalizations, such as of the properties or patterns shared by a variety of items or events.

Advocacy – The act or process of supporting a cause, idea, policy or proposal, including arguing in favour of something or the use of forceful persuasion.

Allied health professions – Those health professions that are distinct from medicine, dentistry, pharmacy and nursing.

Applied learning – Hands-on, practical learning experience where students apply what they know.

Assessment – The process of gathering information that accurately reflects how well a student is achieving the curriculum expectations in a course or program. Typical methods used either to evaluate the learner's achievement in a course unit or module (i.e., summative assessment) or to inform further learning (i.e., formative assessment) include written assessments, oral assessments, laboratory, practical tests/examinations, projects, performances and portfolios.

> **Formative assessment** is on-going assessment to inform learning. It is intended to improve an individual student's performance, to pursue student learning outcomes at the course or program level, or to improve overall institutional effectiveness. Thus the focus of the assessment is on finding ways to improve rather than on quantifying current levels of competency.
>
> **Summative assessment** is assessment intended to determine whether or not overall goals have been achieved and to provide either information on performance for an individual student or statistics about a course or program for internal or external accountability purposes. Grades are the most common form of summative assessment.

Best practice – A best practice is a method or technique that has consistently shown results superior to those achieved by other means and that is used as a benchmark. In addition, a "best" practice can evolve to become better as improvements are made.

Competencies – Competencies are broad categories of integrated skills, knowledge and abilities.

Degree and diploma – An academic credential awarded upon successful completion of a prescribed set and sequence of requirements at a specified standard of performance at a recognized institution.

Discipline – An area of study in higher education; a branch of knowledge, research or teaching (e.g., English, mathematics, engineering, psychology).

Ethics – Ethics refers to well-founded standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues. In the academic context, appropriate ethical behaviours are sometimes referred to as "codes of academic conduct." Some educational contexts teach formalized ethical codes related to the discipline or techniques of inquiry or practice (e.g., the Tri-Council code of ethics dictating the rules of human and animal research, legal ethics, professional ethics, medical ethics, etc.)

Exemplar – A high-quality or typical specific example of some more general concept.

Field – An area of specialization or concentration within a discipline (e.g., chemical engineering or cognitive psychology) or, in a multi/interdisciplinary program, a clustered area of specialization.

Graduate Degree Level Expectations (GDLEs) – Guidelines for Graduate Degree Level Expectations developed by the Ontario Council of Academic Vice-Presidents.

Learning outcomes – Clearly defined and measurable statements of learning that reflect the scope and depth of performance; what a learner is expected to know, understand and be able to demonstrate after completion of a process of learning.

Model – A simplified representation of a system or process designed to assist understanding, calculation and prediction, or to test hypotheses.

Practice setting – The place where the student applies the knowledge and skills developed in the academic setting.

Qualitative research – Involves the analysis of any unstructured data, including open-ended survey responses, literature reviews, audio recordings, pictures and web pages. Focus groups, in-depth interviews, content analysis, ethnography, evaluation and semiotics are among the many approaches that are used.

Quantitative reasoning – Involves the application of mathematical concepts and statistical analysis to formulate arguments and solve problems.

Scholarly information – Information derived from original research and experimentation; criticism and reviews written by experts or scholars, usually published in peer-reviewed journals or books produced by academic presses or presented at professional conferences.

Sectors – A grouping of academic discipline clusters. For example, psychology is in the social sciences, and physics in the physical sciences. The groupings of disciplines are largely determined by the Ontario Government Classification system.

Specialized (tools or equipment) – Equipment that is only used for particular applications in a sector, may have wide usage but is only familiar to a limited group of graduates in sector, and which is not commonly available.

Standard (tools or equipment) – Equipment with which all graduates in a sector are expected to be familiar, is widely used, and which is commonly available.

Subcompetencies – A cluster of related learning outcomes embedded within the broader competency (e.g., the competency is knowledge, whereas the subcompetency is numeracy).

Tri-Council – The collective name for the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada, and the Social Sciences and Humanities Research Council of Canada.

Undergraduate Degree Level Expectations (UDLEs) – Guidelines for University Undergraduate Degree Level Expectations developed by the Ontario Council of Academic Vice-Presidents.

Appendix F: Additional Resources

Learning Outcomes Literature

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