

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

Note to reviewers: This report is a working document intended to solicit feedback specifically on the learning outcomes, to determine if they require refinement.

We are asking reviewers to consider the following questions when reviewing this document

1. Do you feel 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?
2. Is the format of the document understandable to the audience of students and employers, as well as faculty members, program planners and institutional administrators?

We look forward to receiving your comments and suggestions. Any feedback you can provide will be helpful to us as we refine the document's clarity, accuracy and relevance.

A later document will be published providing a full overview of the project, its purpose, activities, alignment with existing learning outcomes initiatives, etc., and a section on assessment and measurement.

Please send your comments to Mary Catharine Lennon, Senior Research Analyst at HEQCO, at mlennon@heqco.ca. Please feel free to contact her with question or concerns at 416-314-8780.

Background

As part of a comprehensive research program, HEQCO initiated a project to identify and measure learning outcomes in specific “sectors” (i.e. social science, physical science, and life and health science) in Ontario colleges and universities. This project is intended to affiliate with, and to advance, other complementary learning outcomes projects in the European Union, the United States, and the Ontario college and university sectors.

Learning outcomes specify what students should know, understand and be able to do upon successful completion of a program, such as a postsecondary credential. International projects have varied in how they approach learning outcomes. Some take a very broad definition and seek to identify learning outcomes that generalize across all the areas that are included within a degree category, such as the B.A. or B.Sc. Others adopt a much narrower scope and seek to identify and measure learning outcomes in a specific discipline (often restricted to a single administrative department), such as history or chemistry. “Sectors,” a term now being used by the European Union, refer to the groupings that bridge the gap between the broad “degree qualification” learning outcome approaches and the narrower “discipline-based” learning outcome projects.

At HEQCO, as an initial step, we focused on the broad categories of social sciences, physical sciences, and life and health sciences. 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 are 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, Communications, Social Responsibility, Personal and Interpersonal) and one competency that is distinct for each sector (Practice and Methods). This project examines the two-year diploma, three-year diploma, four-year honours bachelor’s degree and the master’s degrees (research-based).

Purpose of Identifying Learning Outcomes

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 ensure 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 outcome process.
3. They assist student mobility and transitions through postsecondary systems (i.e. credit transfer) by establishing the evidentiary basis for what students have learned at various levels of postsecondary education and by demonstrating the similarity and differences of learning outcomes across different programs of study.
4. They ensure that teaching and learning activities and assessment are aligned, and inform ongoing program development.

Value of the HEQCO Initiative

This HEQCO project enhances other work on learning outcomes being done in Ontario and elsewhere in several ways.

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

Second, the HEQCO project links together learning outcomes exercises that are now occurring, somewhat independently, in Ontario's college and university sectors. HEQCO's project 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.

Third, the HEQCO project adopts an approach that bridges the gap between the broad "degree qualification" learning outcome approaches and the narrower "program-based" learning outcomes, adopting instead an intermediate approach. Specifically, we aimed to provide clear competency areas and provided learning outcomes that were broad enough to apply to a range of sectors, but specific enough to provide clear statements of measurable expectations.

Fourth, more than other learning outcome initiatives, this project has attended to the challenge of how to measure and assess 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 report of this work will provide examples and principles of how to assess learning outcomes.

The Activities

Since November 2011, the three sector groups of social science, physical science, and life and health science have met on a monthly basis to establish learning outcomes relevant to their sectors. Each of the meetings was facilitated by a HEQCO staff person 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 college and universities, with one student and one employer.

These dynamic groups approached the development of their learning outcomes in various manners. In developing the learning outcomes, the groups worked both inductively and deductively, pulling from established learning outcomes from Ontario, Canada, the U.S. and Europe and from frequently

examined discipline-specific learning outcomes, such as those in engineering and nursing. While the groups developed their learning outcomes independently, there were marked similarities in the first drafts of their work.

The advisory group reviewed the panels' work in July 2012. They 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 seeking to identify any similar learning outcomes.¹ 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 has culminated in a document that clearly defines competency areas and learning outcomes appropriate to the three sectors in a manner that we hope is relevant and understandable to faculty, course developers, program administrators, etc., in each sector, but most of all in a manner that is meaningful to students and employers.

¹An 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 become more detailed.

How to use this document

This document presents recommended competencies and learning outcomes for the life and health science, physical science and social science sectors in Ontario. It covers 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 A.

The document also presents a table indicating the characteristics associated with activities typically undertaken by students at each of these qualification levels. These characteristics describe the context in which learning outcomes should be assessed. These are characteristics of the *activities*, rather than features of learning outcomes, including the degree of autonomy, degree of interdependence, etc. These characteristics are fundamental to understanding the differences in the credential levels and in understanding the broad skill sets of students and should be considered when reviewing any of the learning outcomes to fully understand the abilities of the student.

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) Communications, 4) Social Responsibility, 5) Personal and Interpersonal, 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 (that is, diploma or degree type) 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, in the sense that a number of different learning outcomes inform each student ability. 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 that is not carried through as an outcome in a degree.

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 credentials, 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 in some of the learning outcomes.

Characteristics of qualification levels (Two-year Diploma, Three-year Diploma, Bachelor's Degree, Master's Degree)

PROCESSES AND SCOPE	REQUIRED KNOWLEDGE BASE	INTERDEPENDENCE	INNOVATION	AUTONOMY
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Competencies and learning outcomes

	COMPETENCIES	SUB-COMPETENCIES		
1	KNOWLEDGE	1.1 Theory and Concepts 1.2 Numeracy	1.3 Limits of Knowledge and Qualification 1.4 Multidisciplinary	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 Compares and Contrasts Risks and Benefits 2.6 Evaluation
3	COMMUNICATIONS	3.1 Reading Comprehension 3.2 Effective Writing	3.3 Listening Comprehension 3.4 Presentation Skills	3.5 Effective Oral Communication Skills 3.6 Graphical Communications
4	SOCIAL RESPONSIBILITY	4.1 Ethical Principles and Guidelines 4.2 Social Awareness / Impact	4.3 Professional and Legal Responsibilities 4.4 Health and Safety	4.5 Environment and Sustainability
5	PERSONAL AND INTERPERSONAL	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	PHYSICAL SCIENCE	SOCIAL SCIENCE
		6.1 Investigation / Research Methods 6.2 Resource Material 6.3 Formatting / Referencing 6.4 Practice 6.5 Ethical Research 6.6 Interdisciplinary Practice 6.7 Resource Management 6.8 Relevance of Research 6.9 Information Management	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	6.1 Information Management and Assessment 6.2 Ethics of Research 6.3 Research Methods 6.4 Methods of Analysis 6.5 Relevance of Research

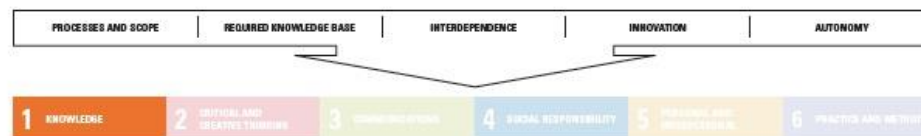
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Characteristics of qualification levels

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 method loosely prescribed and activities supervised	...require independent determination of processes and methods with periodic supervision	...involve conducting independent research with limited supervision



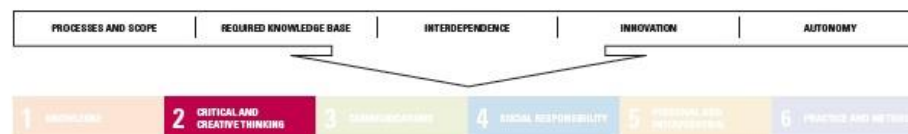
Competencies and learning outcomes



1 KNOWLEDGE					
SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
1.1	Theory and Concepts	Describe and apply the key 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 influences their analyses and interpretations	Delineate the current limits of theory, knowledge and/or practice in the field and how uncertainty and ambiguity influences analyses and interpretations
1.4	Multidisciplinary	Apply prescribed principles from related disciplines	Identify and apply principles from related disciplines	Identify and integrate principles from related disciplines	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

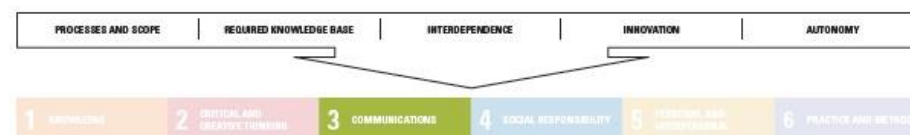


Competencies and learning outcomes



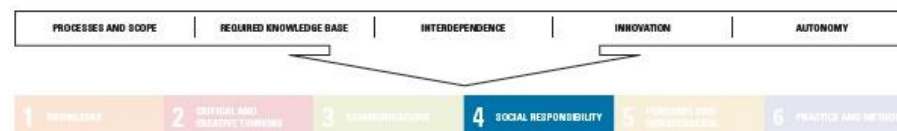
2 CRITICAL AND CREATIVE THINKING					
SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
2.1	Critical Thinking	Identify and compare assumptions and arguments	Critically evaluate assumptions and arguments and defend a standpoint/solution	Critically evaluate underlying assumptions and arguments, develop and support a standpoint/solution and address solution's applicability	Critically evaluate underlying assumptions and arguments in own work relative to your field, develop and support a standpoint/solution and address solution's applicability
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 discusses 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	Compares and Contrasts 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

Competencies and learning outcomes



3 COMMUNICATIONS					
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 and critically evaluate written material, including scholarly sources	Integrate and analyse ideas from multiple written materials, including primary sources, and synthesize diverse perspectives
3.2	Effective Writing	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 reflect critical analysis and synthesis, appropriate to audience needs	Write concise, coherent and grammatically correct materials of publishable quality that reflect critical analysis and synthesis, appropriate to audience needs
3.3	Listening Comprehension	Demonstrate comprehension of information communicated orally	Demonstrate comprehension of information communicated orally	Demonstrate comprehension and critically evaluate information communicated orally, including scholarly ideas	Integrate and analyse information presented orally, including scholarly ideas, and synthesize diverse perspectives
3.4	Presentation Skills	Present material, alone or as part of a team, in a coherent and organized form, using tools as appropriate	Confidently present material, alone or as part of a team, in a coherent and organized form, using tools as appropriate	Effectively present material in a coherent and organized form, using tools as appropriate	Effectively and confidently present material; articulate and defend a position
3.5	Effective Oral Communication Skills	Effectively exchange information and ideas orally	Speak in a confident manner to advance personal or group goals 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

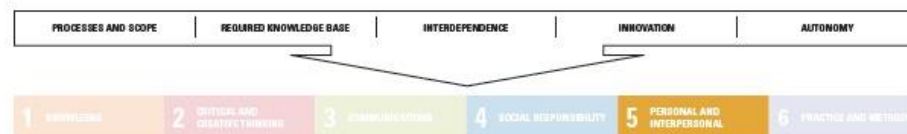
Competencies and learning outcomes



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 analyse 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	Social Awareness / Impact	Describe the impact of decisions and actions on society	Describe and evaluate the impact of decisions and actions on society	Describe and evaluate the impact of decisions and actions on society	Describe and evaluate the impact of their scholarship on society
4.3	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
4.4	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
4.5	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	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



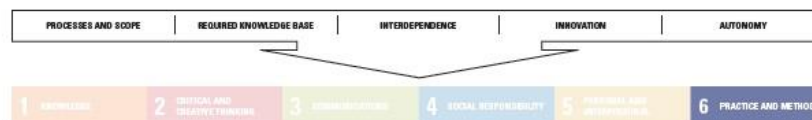
Competencies and learning outcomes



5 PERSONAL AND INTERPERSONAL					
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 as needed	Work in a team to achieve group goals and contribute to effective working relationships; work to resolve conflicts or seek assistance as needed	Work in a team to achieve group goals and contribute to effective working relationships; develop strategies to address conflict as required	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, and provide and respond to feedback	Review, reflect on and make improvements to individual performance, and provide and respond to feedback	Review, reflect on and make improvements to individual performance, and provide and respond to feedback	Review, reflect on and make improvements to individual performance, and 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

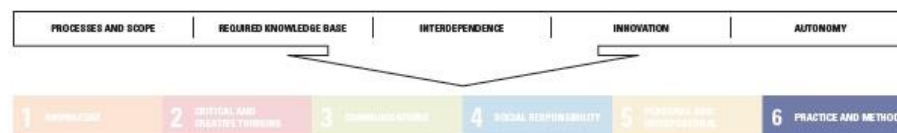


Competencies and learning outcomes



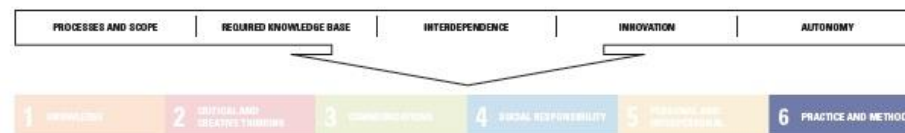
6 PRACTICE AND METHODS		1				2		3		4		5		6 PRACTICE AND METHODS	
LIFE AND HEALTH SCIENCE															
SUBCOMPETENCY		TWO-YEAR DIPLOMA		THREE-YEAR DIPLOMA		BACHELOR'S DEGREE		MASTER'S DEGREE							
6.1	Investigation / Research Methods	Identify basic scientific methods to approach given problems		Apply 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	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, including scholarly sources		Use self-determined criteria; identify, critically evaluate and access a comprehensive range of reliable information, including scholarly sources							
6.3	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							
6.4	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							
6.5	Ethical Research	Recognize ethical and unethical practices in research and comply with ethical research		Comply with applicable ethical research practices and protocols (ex. Tri-Council, Good Laboratory Practice)		Comply with applicable ethical research practices and protocols (ex. Tri-Council, Good Laboratory Practice)		Design and carry out research in an ethical manner							
6.6	Interdisciplinary 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							
6.7	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							
6.8	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							
6.9	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							

Competencies and 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	Independently apply and adapt 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	Independently 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 problem solving approaches to troubleshoot issues	Apply problem solving approaches to troubleshoot issues
6.5	Models	Recognize and apply models (mathematical representations, flow-chart, block diagrams) of systems in appropriate contexts	...and 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

Competencies and learning outcomes



6 PRACTICE AND METHODS

SOCIAL SCIENCE

SUBCOMPETENCY		TWO-YEAR DIPLOMA	THREE-YEAR DIPLOMA	BACHELOR'S DEGREE	MASTER'S DEGREE
6.1	Information Management and Assessment	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, and with the goal of identifying opportunities for further contributions to the field of study or practice
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	Research Methods	Identify the basic social scientific method(s) appropriate for a given problem	Apply the basic social scientific method(s) appropriate for a given problem	Select and apply the appropriate social scientific method(s) to investigate a given problem	Design social scientific research that provides empirical testing of a variety of theoretical perspectives
6.4	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 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 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
6.5	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

Appendix A

Glossary

Abstract thinking—Thinking characterized by the ability to use concepts and to make and understand generalizations, such as of the properties or pattern 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 to either 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 discovered.

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 (GDLE’s)— 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—Relating to, measuring, or measured by the quality of something rather than by its quantity.

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 which is only used for particular applications in this sector, may have wide usage but is only familiar to a limited group of graduates in this sector, and which is not commonly available

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

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

Tri Council – The organisations of Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, 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.