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On Test: Skills

Summary of Findings from HEQCO's Skills Assessment Pilot Studies

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Executive Summary

Quality in higher education matters. Quality is achieved when graduates of Ontario's colleges and universities master a rounded set of skills essential to success in their lives and careers. Quality is achieved when graduates enter the labour market with skills that support the needs of a modern, knowledge-based, fast-evolving economy.

Beyond core discipline-specific skills (Can an engineer calculate the beam width required to support the load?), these include the mastery of advanced literacy and numeracy, critical thinking, communication, problem solving and interpersonal skills. These are skills employers say they are looking for in prospective hires. Given that graduates often end up working in jobs unrelated to their field of study, these transferable skills are as much the responsibility of higher education as is traditional discipline-specific content.[1]

How do we know whether we have achieved quality? Quality is demonstrated when we test for these skills. Otherwise, how can we possibly say that we have equipped our students with the skills they require? The Higher Education Quality Council of Ontario (HEQCO) and 20 institutional partners conducted two pilots — the Essential Adult Skills Initiative and the Postsecondary and Workplace Skills project — to assess literacy, numeracy, problem solving and critical thinking using field-proven tests that were administered on a voluntary basis to first-year and final-year students.

Teaching non-disciplinary skills is core business for higher education. Assessing whether we do so should be core business too.

Overall, we observed sporadically higher test scores for final-year students compared to first-year students. We also observed that a quarter of final-year students, those about to graduate, scored below the level of literacy and/or numeracy proficiency they will need for long-term success in tomorrow's labour market. This is exactly the kind of information we seek to gather so we can improve the performance of the higher education system and the outcomes of its graduates.

Our pilot studies confirmed that the implementation of this kind of skills evaluation is entirely feasible on a large scale. We also witnessed a thirst among institutions to know more, and a willingness among students to participate. As a result, we recommend the implementation of a large-scale skills assessment involving all students at an institution or faculty (not just a sample) that is integrated into students' program requirements, longitudinal in design, with more experimental control over methods and cohorts. On the basis of our pilots, we are now advancing on that goal.

1 In the literature on learning outcomes, the term "transferable skills" is sometimes used narrowly to describe communications, planning and interpersonal skills, and work ethic. HEQCO uses a taxonomy of four types of learning outcomes, including: disciplinary content, basic cognitive skills, higher-order cognitive skills and transferable life skills. However, for the purposes of this paper, which is intended for a broader, non-technical audience, we will use the term "transferable skills" more broadly, as an umbrella term to encompass the full range of skills other than discipline-specific knowledge.

Our special thanks go to our partner institutions and to our volunteer student participants without whom these pilots could not have been undertaken.

Why Testing Skills Matters

Higher education is all about learning. This is its purpose. This is its core business. To learn is why students enrol in postsecondary and contribute tuition, their time and their hard work. Society supports the sector generously so long as it is confident that the sector teaches Ontarians important skills that benefit both the individual and the economy. If the sector is not effectively teaching or fostering learning (or the right kinds of learning), then it is falling down on its core mission.

If we are going to claim that our graduates are well-equipped with skills for the workplace, then let's prove it. And, if necessary, let's improve it.

The higher education community has been good at stating, with eloquence, that preparing students for work and life is what it does and does very well. But can we prove it, particularly to what appears to be a growing group of skeptics? We are weak at assessing and demonstrating what learning takes place at our institutions and what skills our graduates have mastered.

Historically, many proxy measures have been offered up. It is claimed that learning happens because faculty have PhDs or real world experience, and are therefore knowledge experts; because programs go through a peer-reviewed quality-assurance process; because faculty-to-student ratios are healthy or acceptable, or at least not trending in the wrong direction; because student surveys indicate sufficient engagement or satisfaction; and because graduates get jobs and earn more than non-graduates.

These things may all be true, and yet do not answer the important question of whether graduates have acquired the skills they need.

The exception is discipline-specific knowledge. This is the domain of learning in which students are rigorously tested throughout their programs, passed or failed, and eventually allowed to graduate after they demonstrate sufficient discipline-specific knowledge. But discipline-specific knowledge is not the only skill set and not the only kind of learning Ontario's graduates need. In fact, the data clearly indicates that many graduates will not be working in their field of study (HEQCO, 2015). Graduates can expect to have several jobs over the span of their careers, and even graduates who stay with one employer may find their jobs rapidly evolving. For these workers, non-disciplinary skills matter just as much and often more so than discipline-specific skills. For mid-career workers whose jobs may disappear, the key to successful and speedy re-entry into the labour market is a strong foundation of transferable skills that will help them pivot into a new work environment.[2]

2 For a discussion of skills and employer needs see Harrison (2017).

Are graduates appropriately numerate and literate to perform and succeed in tomorrow's labour market? Results from the 2012 OECD PIAAC[3] test of adult skills suggest many are not (Dion, 2014 and Dion & Maldonado, 2013). Do they have a mastery of critical thinking, communication, problem solving and interpersonal skills? Feedback from employers, professors and students suggests room for considerable improvement (Borwein, 2014; Business Council of Canada, 2018). Given that students overwhelmingly state that getting a good job is a primary motive for investing in higher education, do they graduate with the requisite skill sets to meet this important goal? Graduates themselves tell us: not so much.[4]

PIAAC scores revealed that one in four university-educated adults and one in two college-educated adults in Canada do not have the level of advanced literacy skills required to succeed in tomorrow's labour market. We must demonstrably improve these outcomes.

The system has slowly responded to address these concerns. In Ontario, the idea of defining and teaching the gamut of skills graduates require was formally introduced into the college system in 1990. Almost 30 years ago, the authors of that movement stated:

> "Providing the specific skills necessary to do a job — whether it is soil mechanics, computer-assisted design, or sports administration — will always be an important part of what the colleges do. But it is also essential that the students who graduate from a college…have the general knowledge and skills that will allow them to continue learning, both on and off the job, throughout their lives. There are widespread concerns — which we share — that the colleges are providing career education that is too narrowly focused on specific job skills…We define generic skills to be practical life skills essential for both personal and career success. They include language and communication skills, math skills, learning and thinking skills, interpersonal skills, and basic technological literacy." (Ministry of Colleges and Universities, 1990, pp. 33, 35)

Ontario universities have also introduced learning outcomes — the industry term for a broad set of skills and competencies graduates are expected to acquire — into system parlance and as part of the system's quality-assurance process. Across the province, more and more faculties are designing curriculums and updating course content to identify and teach those outcomes.

This important change in thinking and practice started to emerge in Ontario almost 30 years ago. For the sake of today's graduates, it is high time to complete the transformation. The third component in this long journey — as essential as defining the skills required and identifying appropriate ways to teach them — is

3 The Programme for the International Assessment of Adult Competencies. See http://www.oecd.org/skills/piaac/.
4 See, for example, Mourshed, Farrell & Barton (2013): 72% of educators say postsecondary education adequately prepares student for work, compared to 45% of graduates and 42% of employers.

assessment. Without appropriate assessment and the understanding that comes with it, it is almost impossible to improve performance in the sector's core business.[5]

Our Pilots

In partnership with 20 Ontario colleges and universities, and with funding support from the federal and Ontario governments, we conducted two skills-assessment pilots:

1) **Essential Adult Skills Initiative** (EASI): Beginning in 2016, we administered a test called Education and Skills Online,[6] the commercial, online version of the OECD's PIAAC test of adult skills. The ESO underwent an extensive and rigorous validation process and is available to test-takers in English and French. Rather than focusing simply on the mastery of the mechanics of vocabulary or arithmetic operations, ESO assesses the real-world application of literacy, numeracy and problem solving in technology-rich environments. More than 4,600 Ontario college and university students across 19 institutions participated in our pilot.[7] Our companion report, *Measuring Essential Skills of Postsecondary Students: Final Report of the Essential Adult Skills Initiative,* provides a full analysis of the initiative and its findings.

2) **Postsecondary and Workplace Skills** (PAWS): In 2016–17, we administered the HEIghten Critical Thinking assessment developed by Educational Testing Service.[8] HEIghten is based on a review of 10 previously used instruments, and is designed to evaluate the ability to analyze evidence, understand implications and consequences, and develop valid arguments. It has been tested at 35 institutions in the United States. More than 2,900 college and university students at two institutions participated in our pilot. Our companion report, *Measuring Critical-thinking Skills of Postsecondary Students*, prepared by the Education Policy Research Initiative at the University of Ottawa, provides a full analysis of the project and its findings.

In both pilots, student participation was voluntary and recruitment was overseen by the institutions. The goal was simply to maximize the number of students who participated. What we were collectively evaluating was not so much the individual student nor the sector as a whole from an accountability perspective, but the important business of teaching and learning itself based on the outcomes achieved, how learning of skills could be directly measured and the opportunity for improvement.[9]

5 For a discussion of the link between large-scale skills assessment and quality improvement see "The Case for Large-scale Skills Assessment" (Brumwell, Deller & Hudak, forthcoming).
6 http://www.oecd.org/skills/ESonline-assessment/abouteducationskillsonline/
7 The 19 participating Ontario institutions are listed in the companion report, *Measuring Essential Skills of Postsecondary Students: Final Report of the Essential Adult Skills Initiative*. An additional university, Quest University Canada in British Columbia, participated in the pilot but was not included in the aggregated Ontario results.
8 https://www.ets.org/heighten/about/critical_thinking/
9 Large-scale assessment is not the only way to assess the full range of student and graduate skills and competencies. HEQCO also works with Ontario institutional partners through our Learning Outcomes Assessment Consortium on approaches like assessment rubrics and scorecards, ePortfolios and peer assessment.

Our Findings

1. **Large-scale skills assessment is feasible**. Our pilots demonstrated that administering large-scale skills assessments across multiple institutions is practical, that central co-ordination (which HEQCO provided) and deployment of established online assessment tools can make the burden and cost of participation for institutions manageable, and that individual privacy can be protected.

2. **People want to know**. Our 20 institutional partners and more than 7,500 students voluntarily participated in our pilots. There is keen interest in the measurement of student skills and in developing methodologies to do so.

3. **The assessments met our expectations**. The assessments we used — Education and Skills Online and HEIghten Critical Thinking — had been rigorously developed and already had solid track records. We found them relatively straightforward to administer; there was a high completion rate by students; the results were easy to analyze and interpret; and because they are used in other jurisdictions, they allow for benchmarking.

4. **Scores increased at the aggregate**. At the aggregate level, we observed somewhat higher scores for final-year students compared to first-year students (see Figures 1 to 3). Delving into the detailed companion reports, it becomes readily apparent that these increases were not universal or uniform across our sample; there was considerable variation.

> Our pilots show some increase in literacy, numeracy and critical-thinking scores for graduating students compared to first-year students. But one in four of our graduates does not score at an acceptable level in literacy and/or numeracy.

5. **One in four graduates does not meet the bar in literacy and/or numeracy**. The ESO assessment identifies five literacy and numeracy proficiency levels. Figures 1 and 2 show the distribution of scores across these levels for graduating students who participated in our pilot. Tables 1 through 4 identify what graduates at each of these levels can do. In a labour market that will become more complex and fast evolving over the next 40 years — the career trajectory of today's college and university graduates — HEQCO has identified Level 3 as the minimum required proficiency level for Ontario's higher education graduates. Anything less carries too much risk of drag on both individuals' and the economy's performance.

   One in four of our graduating participants scored below Level 3 in literacy and/or numeracy. Moreover, less than a third of our graduating students scored at advanced Levels 4 or 5.

6. **As many questions as there are answers.** Through our two pilot projects, we learned all of what we have summarized above, and additional detail found in the companion reports. But the pilots also raised

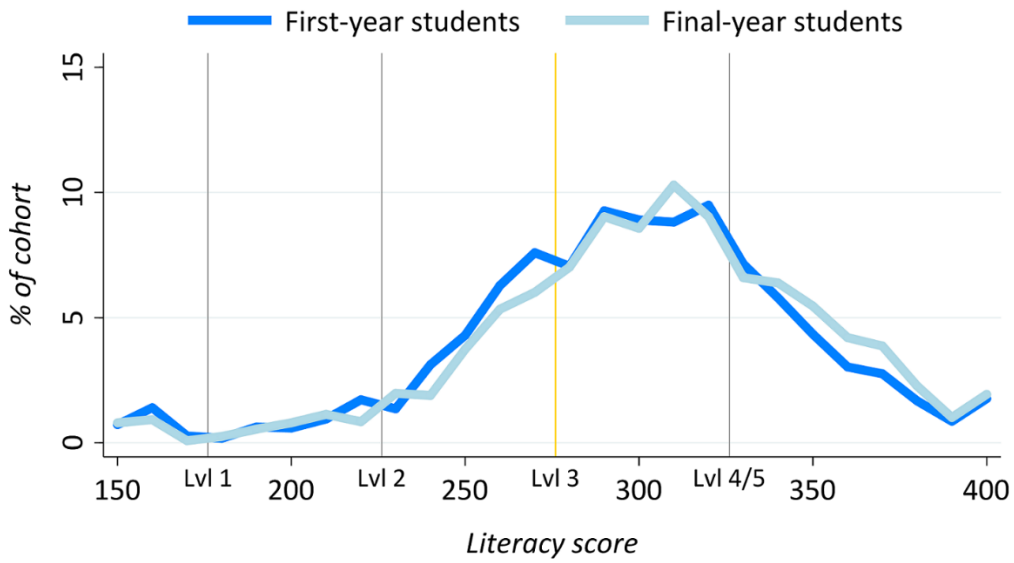
intriguing and important followup questions. Why are one in four graduates not scoring at Level 3 in literacy and numeracy, and what strategies can address that gap? Why is the degree of skills gain between incoming and graduating students haphazard, and where, for whom and for what reasons is it not occurring? What pedagogical approaches work best at teaching transferable skills, and can they be replicated at other institutions and in other programs of study? What are the outcomes at a program level, or for students from different backgrounds and starting points? Do colleges and universities face similar or different challenges instilling transferable skills in their students?

A pilot is just that. By design, our pilot samples were neither random nor representative; our goal was to optimize participation. To compress the timeframe, the studies were not designed longitudinally; different cohorts of students were assessed in incoming and outgoing years.

To do this right — to really find out whether core skills are being mastered — we need to make testing a part of routine business.

7. **Go big.** The conclusion from these observations is obvious, sensible, pragmatic and essential to the success of the higher education sector in Ontario: We must implement large-scale assessment on a census basis, integrate it into students' program requirements, and make it longitudinal in design and repeatable over time.

Figure 1: ESO Literacy Performance by Cohort (First- and final-year college and university students)



The vertical lines in Figures 1 and 2 indicate the proficiency level cut-off points, with the coloured vertical line marking the cut-off between Level 2 and Level 3.

Figure 2: ESO Numeracy Performance by Cohort (First-and final-year college and university students)

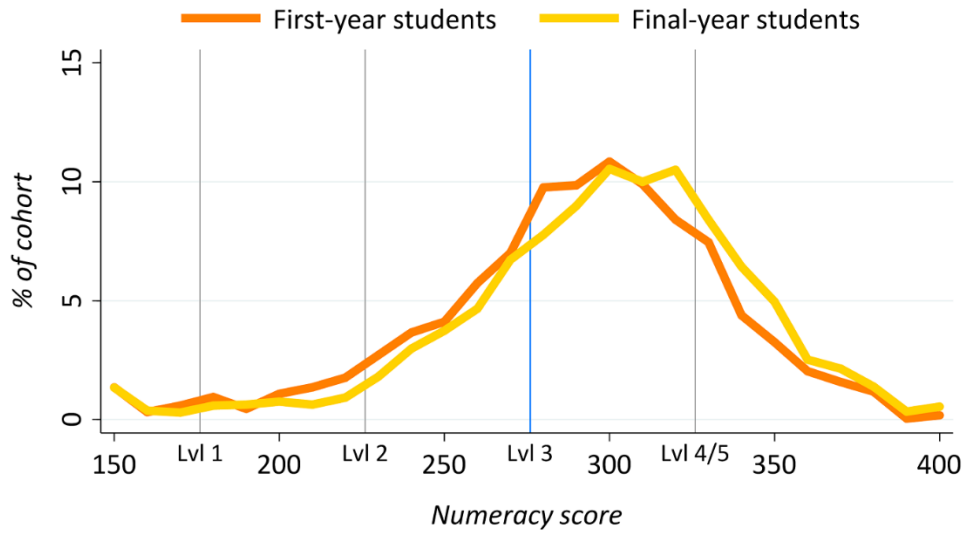


Figure 3: HEIghten Critical Thinking Score by Cohort (First- and final-year college and university students)

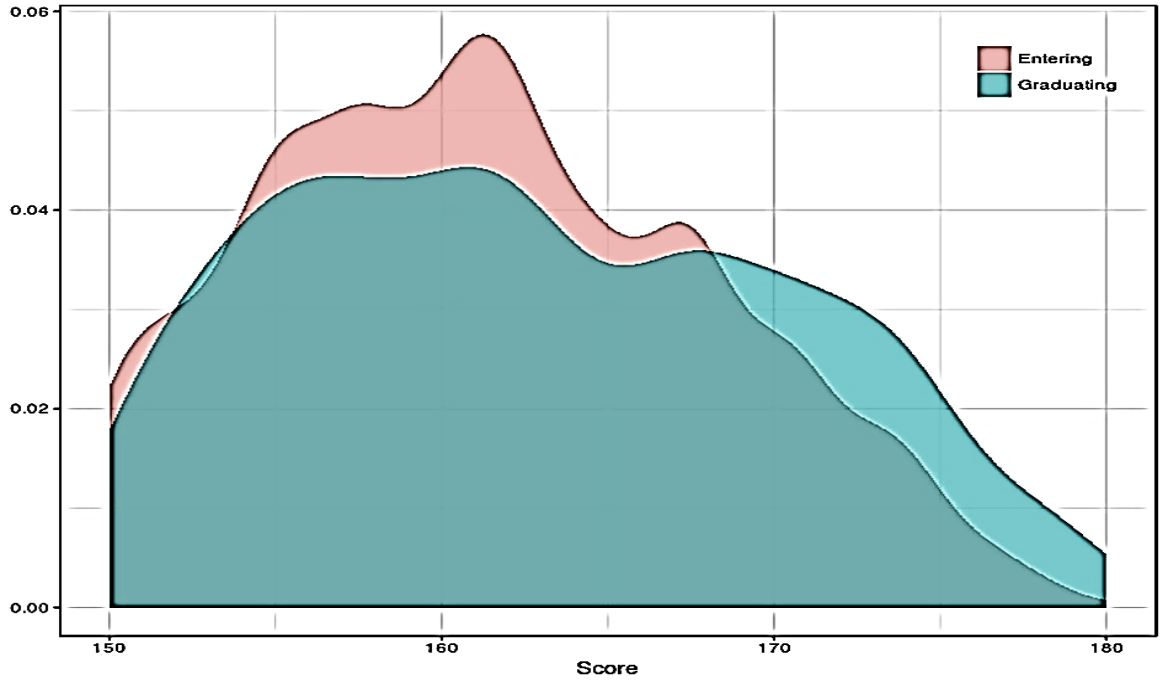


Table 1: ESO Literacy Proficiency Levels: Levels 2, 3 and 4/5

The ESO scoring mechanism captures literacy's "multidimensional" nature by including a wide array of literacy difficulty factors. In an effort to make the proficiency level descriptions more accessible, we have created high-level summaries of the descriptions for the ESO's Level 2, Level 3 and Level 4/5 literacy proficiency levels.

Please note:

- The proficiency levels are cumulative, e.g., individuals scoring in the Level 3 range are capable of the competencies described for Levels 3 and below.
- The proficiency levels do not capture the full range of a test-taker's skill set. Rather, the proficiency levels describe the level at which a test-taker is strongest or most consistently successful.

Level 2	Level 3	Level 4/5
- Can handle tasks with few steps and no more than two different information sources.	- Can handle tasks with multiple steps and multiple information sources.	- Can handle tasks with multiple steps and multiple information sources.
- Requires information to be communicated in plain language.	- Can handle moderately complex vocabulary and grammar.	- Can handle advanced vocabulary and grammar.
- Requires clearly stated instructions and obvious positioning of important information.	- Can handle long or dense text passages, where important information is not immediately obvious.	- Can handle multiple long, dense text passages, where important information is not immediately obvious.
- Can handle very small amount of competing information.	- Can identify and filter out most competing or irrelevant information.	- Can identify and filter out high volumes of competing or irrelevant information.
- Requires obvious clues to make sense of text.	- May require a few obvious clues to make sense of text.	- Does not require obvious clues to make sense of text.
- Can paraphrase, summarize or make connections within a single text, and compare/contrast two texts when criteria are provided.	- Can "read between the lines" to identify, compare and evaluate common themes, motives, arguments/opinions and conclusions within and across texts.	- Can "read between the lines" very well, within and across multiple complex texts; e.g., analyzing and evaluating arguments/opinions and conflicting information, and integrating/synthesizing information.
- Can determine whether or not a source is reliable when clear criteria are provided.	- Can determine and apply criteria to evaluate the reliability of a source.	- Can determine and apply criteria to evaluate which source (of several) is most reliable.

Level 2	Level 3	Level 4/5
- Can handle literal information and concepts, but may be less reliable with abstract or hypothetical information.	- Can handle some complex abstract or hypothetical information within a text, but may be less reliable working across multiple texts of this type.	- Can handle complex, abstract or hypothetical information within and across multiple complex texts.
Level 2 includes all Level 1 competencies.	*Level 3 includes all Level 2 competencies.*	*Level 4/5 includes all Level 2 and 3 competencies.*

Source: Adapted from OECD (2012; 2015, pp.62–68; 2016).

Table 2: ESO Literacy Proficiency Levels: Examples

	Test-takers scoring in this level are likely able to…
Level 2	- Submit a vote for or against a new workplace dress code on an employer's web page.
	- Identify information in a camera store's single web page that explains how this year's photo contest rules differ from those in previous years.
	- Name two reasons stated in an employee newsletter for an increase in company sales.
Level 3	- Find out whether a utility company accepts the same type of payment if paid by mail or online using information from a monthly billing statement.
	- Use a music store's web page to compare and contrast several reviews to determine which song to download based on the price and the type of music you like.
	- Search several web pages of a national health organization for evidence supporting the claim that exercise can lead to greater work productivity.
Level 4/5	- Evaluate posts in a discussion forum on health remedies by comparing the information they provide against that in a website from a well-known medical centre.
	- Use several links in a city's transportation web page to locate information about special fares or services on holidays.
	- Determine which claims in a newspaper article about the benefits of sleep are supported by information and graphs in two long research article.

Source: Adapted from OECD (2015), pp. 65–68.

Table 3: ESO Numeracy Proficiency Levels: Levels 2, 3 and 4/5

For the ESO, proficiency in numeracy depends on both mathematical skills as well as the extent to which an individual can integrate those skills with their "broader reasoning, problem-solving skills and literacy skills" to successfully respond to numeracy-related problems in real-life situations (OECD 2012, p. 38). In an effort to make the proficiency level descriptions more accessible, we have created high-level summaries of the descriptions for the ESO's Level 2, Level 3 and Level 4/5 numeracy proficiency levels.

Please note:

- The proficiency levels are cumulative, e.g., individuals scoring in the Level 3 range are capable of the competencies described for Levels 3 and below.
- The proficiency levels do not capture the full range of a test-taker's skill set. Rather, the proficiency levels indicate the level at which a test-taker is strongest or most consistently successful.

ESO Numeracy Proficiency Levels

Level 2	Level 3	Level 4/5
- Can handle tasks where mathematical information is delivered in everyday contexts.	- Can handle tasks where mathematical information is delivered in new or unfamiliar contexts.	- Can handle tasks where mathematical information is delivered in abstract contexts, such as academic texts.
- Can handle limited competing information so long as relevant information is clearly stated.	- Can handle moderate amounts of competing or complex information.	- Can handle competing and complex information, including advanced mathematical and statistical ideas.
- Can handle basic tasks involving two or more steps.	- Can handle tasks requiring several steps.	- Can handle tasks requiring several steps.
- Can respond to a task using a given problem-solving or mathematical strategy when the strategy is clearly stated in the task question.	- Can identify and apply the necessary problem-solving and mathematical strategies to solve a given task, with few prompts.	- Can evaluate and explain choice of problem-solving or mathematical strategies and draw conclusions about arguments and solutions.
Associated math skills: - Calculations with whole numbers and common decimals, percentages and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.	***Associated math skills:*** - Application of number sense and spatial sense; recognizing and working with mathematical relationships, patterns, and proportions expressed in verbal or numerical form; and interpretation and basic analysis of data and statistics in texts, tables and graphs.	***Associated math skills:*** - Analysis and complex reasoning about quantities and data; statistics and probability; spatial relationships; rates of change; proportions; and formulas.
Level 2 includes all Level 1 competencies.	*Level 3 includes all Level 2 competencies.*	*Level 4/5 includes all Level 2 and 3 competencies.*

Source: Adapted from OECD (2012; 2015, pp. 69–73; 2016).

Table 4: ESO Numeracy Proficiency Levels: Examples

	Test-takers scoring in this level are likely able to…
Level 2	- Figure out the price of a shirt that will be discounted by 25%.
	- Determine the price of a single bottle of water when given the cost of an entire case of bottles.
	- Determine how many months in a year had sales above the mean sales for the year from a table of monthly sales.
Level 3	- Identify which predicted monthly gasoline price was most accurate based on line graphs of predicted and actual gasoline prices for a year.
	- Determine the amount of concentrated lemonade flavouring and water needed to make a large container of lemonade that is in the same ratio of flavouring to water as a smaller amount of lemonade.
	- Read a complex graph, comparing the amount of salt, sugar and fat in a typical diet for men versus a typical diet for women, to determine the amount of sugar consumed by men.
Level 4/5	- Convert the number of students enrolled in a university each year into percentages, and then compute the change in the percentage of students enrolled each year.
	- Determine how much medicine to give to a child when the dosage is based on the child's body weight.
	- Calculate profit from a table containing lists of income and expense sources.

Source: Adapted from OECD (2015), pp. 69–73.

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