

# Seeking the N in LLN

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This document was produced by the authors based on their research for the report *Seeking the N in LLN*, and is an added resource for further information. The report is available on NCVET's website: <[www.ncver.edu.au](http://www.ncver.edu.au)>.

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# Numeracy assessment tool development

The Australian Core Skills Framework (ACSF) (Department of Education Employment and Workplace Relations 2012) is a framework for describing and measuring adult English language, literacy and numeracy outcomes. It describes performance in five core skills: learning, reading, writing, oral communication and numeracy, and has a broad range of applications. In this research report it was used to inform the development of the numeracy assessment tool and to assess the numeracy skills performance of the practitioners who participated.

The numeracy assessment tool was developed specifically for this project. The tool consists of ten questions, most with multiple parts, covering a range of numeracy content areas across ACSF numeracy levels 1 to 5, all contextualised to the process manufacturing industries.

The numeracy content areas covered were identified using the following list compiled by Marr and Hagston (Marr & Hagston 2007):

- Problem solving and decision making.
- Data interpretation.
- Percentages.
- Patterns and anomalies with measurement and data.
- Scale drawings, plans and diagrams.
- Communication of mathematical information.
- Use of computers and technology.
- Graphs, charts and tables.
- Formulas.
- Mental calculations and estimations.
- Ratio and proportion.
- Measurement.
- Calculation.

The researcher mapped each of the ACSF sample activities to each numeracy content area organised by ACSF level. Then using the researchers' industry knowledge and the Essential Skills Profiles developed by the Canadian Government for occupations found in the process manufacturing industries (Human Resources and Skills Development Canada website 2011), devised the assessment questions. The occupations reviewed were:

- Plastics processing machine operators.
- Assemblers, fabricators and inspectors - industrial electrical motors and transformers.
- Chemical plant machine operators.
- Labourers in processing, manufacturing and utilities.

- Machine operators - mineral and metal processing.
- Machine operators and inspectors - electrical apparatus manufacturing.
- Machinists.
- Other assemblers and inspectors.
- Other metal products machine operators.
- Other products machine operators.
- Other wood processing machine operators.
- Plastic products assemblers, finishers and inspectors.
- Rubber processing machine operators and related workers.

The draft numeracy assessment questions were shared with two industry experts, currently employed in the process manufacturing industries, who provided feedback and suggestions that were used to inform the final version. The researchers prepared an initial ACSF numeracy level mapping of each of the questions which was then verified by a recognised numeracy assessment expert.

The researchers acknowledge that there were two content areas are not fully addressed by the numeracy assessment tool.

#### 1. Communication of mathematical information

The assessment of this content area is limited in the numeracy assessment tool to the representation of mathematical information, for example, use of the correct unit of measurement or preparation of the correct type of graph. What are not covered are the skills needed for more complex communication of mathematical information, for example, the presentation of mathematical information in a report or a verbal exchange.

#### 2. Mental calculations and estimations

The assessment of this content area was attempted without success. A couple of different approaches were considered. The first approach considered was to ask an estimation question. For example, asking participants to estimate how much longer production could run if a ten kilogram capacity hopper was half full and emptied at a rate of two kilograms per hour. The obvious problem with a question like this is that, if that the answer can be calculated, there is no way of knowing whether participants estimated or calculated the answer. The second approach that was adopted for the numeracy assessment tool was a knowledge question rather than a skill question. It asked participants to give examples that demonstrate the importance of estimation in the process manufacturing industries in an environment where results matter. However, the responses to this question were so varied in their level of complexity, scoring was not possible, and a decision was made to exclude the data collected from the findings.

Once the responses from all the numeracy assessments had been collected, scored and summarised, the ACSF mapping was revisited in consultation with a recognised numeracy assessment expert. Some questions were identified as 'misbehaving', where overall performance was not consistent with expected difficulty. For example, question 8B was initially mapped at ACSF numeracy level 4 but overall performance against this question was much lower expected compared with other ACSF level 4 questions. Consequently the level of difficulty was reassessed against the ACSF and adjusted to ACSF numeracy level 5.

A copy of the numeracy assessment tool and the ACSF mapping is provided in the appendices.

# Detailed focus group results

Participants were asked to reflect on the importance of numeracy and what it means for practitioners and existing workers in the process manufacturing industries. They demonstrated a willingness to reflect on and respond to the statements. All participants acknowledged that numeracy skills are readily overlooked in the workplace and that this is of great concern. There was agreement that a focus on numeracy skill development would greatly impact on the increased productivity of workers. Whilst vocational specialists often provided more concrete industry examples in their responses, no significant differences between the two groups were observed.

## Importance of numeracy

Participants were generally unfamiliar with the latest research findings about the importance of numeracy. There was general acceptance that there is a lack of numeracy focus.

“I don’t find it surprising but is not something that gets a lot of notice/focus” (Vocational specialist)

The first statement “there is an increasing demand for numeracy skills at all job levels in the workplace” was generally accepted as consistent with what practitioners are observing in the workplace.

“The increasing need for numeracy skills is becoming obvious.” (LLN specialist)

“Percentages, averages, calculating volume, are all important to getting it right or it costs the company money.” (Vocational specialist)

“Everyone in the workplace is now doing ‘lean’ and doing lots of measurement.” (Vocational specialist)

Some practitioners suggested that there is a correlation between increasing numeracy skills and increasing use of technology, and others questioned the relationship.

“It doesn’t surprise me - increase in use of technology.” (LLN specialist)

“How can this be when we rely on technology to assist in numeracy related tasks?” (Vocational specialist)

The second statement “numeracy potentially has a greater influence on an individual’s access to employment, higher wage levels and productivity than literacy” generated more detailed discussion. For example, some participants felt that there is a distinction between seeking and maintaining employment.

“You need LL skills to get a job, but you need N skills to stay there.” (Vocational specialist)

“Literacy is part of the initial search for work rather than numeracy.” (LLN specialist)

Some participants observed that there is a stronger focus on literacy rather than numeracy in the workplace.

“The first thing that an employer focuses on is literacy skills, not numeracy skills.” (Vocational specialist)

“Recruitment agencies focus on a person communication skills, rather than numeracy skills.” (Vocational specialist)

There are also opinions expressed about how people respond to numeracy demands in the workplace:

“Employees with poor numeracy skills are reluctant to self identify.” (Vocational specialist)

“You can fudge it with L and L skills but not with N skills.” (Vocational specialist)

“People in the workplace cover up their lack of skills.” (Vocational specialist)

“People in the workplace are intimidated by numeracy.” (Vocational specialist)

The third statement “poor numeracy skills have more impact on an individual’s life than poor literacy skills” caused the most surprise but on reflection was generally accepted by participants:

“Surprised but it makes sense because everyday life requires so much knowledge of numeracy.”  
(LLN specialist)

“We thought ‘communication skills’ would be more important - but it does make sense. Numeracy impacts on many things - petrol station, supermarket, change, banking, etc.” (LLN specialist)

“Did not expect that numeracy could have a higher impact on individual lives as literacy and numeracy come hand in hand.” (Vocational specialist)

## Relevance for practitioners

Reflections on the relevance of the research to practitioners resulted in the following participant feedback:

- The findings are relevant

“We all think that these findings are relevant to our work as trainers, in assisting people to develop the skills to do their job.” (Vocational specialist)

- Numeracy and literacy are embedded in workplace tasks

“The connection between literacy and numeracy is significant. People already have a degree of numeracy. The ability to use these skills effectively often relates to the literacy skills that enable them to understand what numeracy skills are required to be applied. Numeracy skills development for process workers is often embedded within the process/technical training. For example, complete a control process chart.”

- Practitioners need a greater focus on numeracy

“We need to ensure that people have an understanding of how to their job. We rarely consider numeracy skills as it is assumed that it is imbedded in the technical skill that we teach them. It is taken for granted, and therefore we don’t evaluate people’s numeracy skills, however there are probably many workers whose productivity would increase significantly if they had the appropriate numeracy skills.” (Vocational specialist)

“Numeracy goes under the radar in most workplaces and the importance is under rated.”  
(Vocational specialist)

- Practitioner need a greater awareness of numeracy in the workplace

“Need to be aware about work roles, time, quantities, job instruction i.e. storing of product, setting the machine, cooling time and temperature etc.” (LLN specialist)

“We pay little attention to numeracy skills in the workplace. We should by we don’t.” (Vocational specialist)

- Practitioners need up-skilling

“Be aware of our skills gaps in numeracy - up skill through professional development events.” (LLN specialist)

“Practitioners need to improve on ability to address numeracy.” (LLN specialist)

“How do I best equip trainers/staff to be competent in numeracy skills and understand the level at which they require numeracy skills?” (Vocational specialist)

“We don’t focus on our learner’s numeracy skills because of our own lack of confidence in delivering numeracy skills programs.” (LLN specialist)

## Relevance for existing workers in the process manufacturing industries

Practitioners agreed that the research is relevant for existing workers.

“High level numeracy skills are required for manufacturing workers. Even with basic operator job roles.” (Vocational specialist)

Practitioners described how numeracy skills are needed to meet job demands and contribute to productivity.

“Improved workplace confidence, function in daily work more effectively, improved efficiency and productivity, accurate report writing using numbers, accurate measurement for final products →customer satisfaction →career progression.” (LLN specialist)

“More aware/numerically competent staff would improve productivity - especially when unexpected events occur.” (LLN specialist)

They talked about numeracy skills acquisition in the workplace.

“Numeracy skills are developed as a result of natural evolution through different practices and embedded in technical processes.” (Vocational specialist)

They commented on VET products.

“Numeracy skills requirements are often included in training package technical units and not treated in isolation.” (Vocational specialist)

“There are a number of limitations/constraints with Training Package units. Few specific numeracy skills are identified to enable the identification of issues with numeracy skills.” (Vocational specialist)

They reflected on their own practice.

“Interesting how numeracy is embedded and hence not focused on.” (Vocational specialist)

“It is not until we start thinking about it that it becomes apparent to us, the numeracy skills that need to be applied in manufacturing processes and how these are largely ignored.” (Vocational specialist)

“Through our training in manufacturing processes and competitive manufacturing, we apply numeracy skills all the time and don’t even think about whether our learners have the required numeracy skills.” (Vocational specialist)

“Numeracy skills require a greater emphasis and we should all focus on the assessment of learner’s numeracy skills, in addition to technical and LL skills.” (LLN specialist)

Practitioners also related the discussion back to training and support.



“In manufacturing, the numeracy requirements are done for the workers through technology. We assume that this is all they need, however we have not considered how more productive workers could be if we concentrated on the development of numeracy skills.” (Vocational specialist)

# Detailed numeracy assessment observations

The participants had a positive and willing attitude towards the numeracy assessment and took the task seriously. Various levels of comfort were observed ranging from very uncomfortable to very comfortable. On first seeing the assessment document some participants giggled and some scratched their heads. One LLN specialist pulled out of the assessment after 5 minutes saying they were experiencing heart palpitations.

Different approaches to the assessment were observed in the different groups. Many LLN specialists were observed approaching the assessment by initially reading the document and then selecting questions. Most vocational specialists worked through the questions sequentially.

During the assessment deep sighs were heard as participants turned to new questions. In some groups calculators were used consistently. In other groups participants initially did calculations on separate pieces of paper and then switched to calculators after the first 10 minutes. Clarification was asked and given for some questions (4c, 4d, 6 and 10 - refer appendix D).

After approximately 25-30 minutes the sound of shuffling papers was heard as some participants reached the end of the assessment. Participants were observed checking and re-checking their work. Some participants checked phone messages during the exercise. Most participants completed what they could within 45 minutes.

The following observations were made by the researchers during the numeracy assessment:

- All participants have a positive and willing attitude towards the numeracy assessment.
- All participants take the task seriously and the groups are silent during the assessment.
- One LLN specialist pulls out of the assessment after 5 minutes saying they feel anxious and are experiencing heart palpitations.
- Most LLN specialists approach the assessment by initially reading the document and then selecting questions. Very few LLN specialists work through the questions sequentially.
- Most vocational specialists work through the questions sequentially.
- On first seeing the assessment document some participants giggle and some scratch their heads.
- There are deep sighs by some participants, as they turn to new questions.
- In some groups calculators are used consistently. In other groups participants initially do calculations on separate pieces of paper and then switch to calculators after the first 10 minutes.
- Clarification is asked and given for some questions (4c, 4d, 6 and 10).
- The question is asked -
  - “What if a worker is colour blind or what if a practitioner completing the numeracy test is colour blind?” (Vocational specialist)
- After approximately 25-30 minutes there is the sound of shuffling papers as the participants begin reaching the end of the assessment.

- Most participants complete what they can in 45 minutes.
- Participants are observed checking and re-checking their work.
- Some participants check phone messages during the exercise.

The following observations were made by the participants directly after the numeracy assessment:

- There was insufficient support for an ACSF level 1 or 2 assessment.
- In another, more familiar context, some participants felt that they would be able to demonstrate higher numeracy skills.

“I prepare complex training budgets and use spreadsheets, but I am not comfortable with this assessment due to the context.” (LLN specialist)

“I think that we can all do these examples if we were in an environment where we need to.” (Vocational specialist)

- Some participants thought the rulers unsuitable, the graduations too small and too hard to see to make an accurate reading.

“This test is a test for your eyesight.” (LLN specialist)

- Some participants commented on their comfort level.

“It is the exam conditions and perception that made it difficult to think.” (LLN specialist)

“I know I know, but I was nervous.” (Vocational specialist)

“I have had no specialist training but I could do this.” (Vocational specialist)

“At first it all seemed difficult until I got stuck into answering examples.” (LLN specialist)

“It took a while to get going, but once I settled down, it all came back to me.” (Vocational specialist)

“Been a while since doing test - a bit challenging.” (Vocational specialist)

- Assessment questions were thought to be realistic and representative of manufacturing.

# Appendices

## Appendix A Participant Information

### *Seeking the N in LLN – Participant Information*

Participant reference number:
-------------------------------

Name: \_\_\_\_\_

- 1 When was the last time you delivered training in the process manufacturing industries?
  - Never
  - Within the last 5 years
  - 6 or more years ago
  
- 2 Which statement best describes your training role?
  - I am an LLN specialist delivering WELL funded training.  
Years of experience as a WELL Practitioner: \_\_\_\_\_
  - I am a Vocational Trainer delivering vocational training through programs such as the Australian Apprenticeship Scheme or fee for service programs.  
Years of experience as a Vocational Trainer: \_\_\_\_\_
  
- 3 What are your qualifications?
  
  
  
  
  
  
  
  
  
  
- 4 Are you willing to participate in a follow up one-on-one interview (approximately 30 minutes)?
  - No
  - Yes

If yes, contact information: \_\_\_\_\_
  
- 5 Do you want to receive the results of your numeracy assessment via email?
  - No
  - Yes

If yes, email address: \_\_\_\_\_

## Appendix B Small Group Activity

### *Seeking the N in LLN – Focus Group Small Group Activity*

Instructions for the facilitator:

1. Ask the participants to work in groups
2. Give each group of participants the following statement:

*Research shows that:*

- *There is an increasing demand for numeracy skills at all job levels in the workplace*
- *Numeracy potentially has a greater influence on an individual's access to employment, higher wage levels and productivity than literacy*
- *Poor numeracy skills have more impact on an individual's life than poor literacy skills*

3. Ask the groups to answer the following questions and record their answers:

- In what way, if any, do these findings surprise you?
- How are these findings relevant to you as practitioners?
- How are these findings relevant to workers in the process manufacturing industries?

4. Ask representatives from each group to report their findings to the larger group

## Appendix C Individual Self Assessment

### *Seeking the N in LLN – Focus Group Individual Self Assessment*

#### **Instruction**

This activity is designed to identify your perceived numeracy skills.

Participant reference  
number:

#### **Self Assessment**

1. Looking at the ACSF Numeracy Levels in the handout, what level do you think you are?
  - Numeracy Level 1
  - Numeracy Level 2
  - Numeracy Level 3
  - Numeracy Level 4
  - Numeracy Level 5
2. What evidence did you consider to make this decision?

## *ACSF Numeracy Level 1*

### **Locates and recognises key mathematical information in simple activities or texts**

Locates and recognises key mathematical information in simple and highly familiar oral and/or highly explicit written instructions or texts, e.g. menus, bills, calendars, advertising brochures, clocks, oral directions

Locates everyday information and data given in simple texts, lists, charts, diagrams and tables

Reads and comprehends the symbolism and simple conventions relevant to mathematical knowledge of the level, e.g. whole numbers up to 100s, \$5.98,  $\frac{1}{2}$ , +, -, 12/5/07

### **Uses simple mathematical and personal problem-solving strategies in highly familiar contexts**

Relies heavily on hands-on (concrete) and real-life materials, personal experience and prior knowledge, as appropriate, to:

- use one or two pieces of mathematical information to perform a simple mathematical process
- roughly check the reasonableness of the outcome(s) with support via prompting or questioning

Recognises and compares whole number amounts (up to the 100s) and quantities, including money, in personally relevant contexts

Adds and subtracts simple whole number amounts (up to 100) and familiar monetary amounts in personally relevant contexts

Recognises and compares familiar shapes and objects

Identifies appropriate tools and uses them at a basic level in a limited range of applications, e.g. familiar measuring instruments, simple calculators

Recognises and compares familiar basic metric measurements and quantities such as length, mass, capacity, time, temperature, e.g. personal height and weight, litre of milk, vehicle height clearances

Gives simple and familiar oral directions

Follows simple and highly familiar oral and written directions

### **Uses everyday informal oral language or highly familiar written representation to communicate simple mathematical information**

Uses common, everyday, informal language and gestures for oral and some simple written jottings to convey numeracy-based information and processing, e.g. language of position, such as up, down, behind, right, left, over, through; comparative language such as taller, heavier, hotter, smaller; language of shape, size, colour, such as straight, curved, square, circle, triangle

Uses the simple symbolism, diagrams and conventions relevant to the mathematical knowledge of the level, e.g. \$5.98,  $\frac{1}{2}$ , +, -, 12/5/07, simple and highly familiar tables and graphs

### **Sample activities**

Estimates lengths of familiar objects using metric units, e.g. a person's height, lengths of fabric or lengths of wood used in everyday work

Locates and adds whole dollar price of two items in simple catalogue/advertisement

Decides whether change should be expected when purchasing items, e.g. buying coffee and paying with \$10

Identifies and discusses with group the differences in pricing of similar objects, e.g. soft drinks bought from different venues - supermarkets and vending machines

Recognises and knows safe handling weights of familiar objects, e.g. gives go ahead for fellow worker to shift a package, box or pallet with appropriate equipment

Gives oral directions, using common language of space, distance and direction, for getting from 1 familiar place to another, e.g. directions to new worker/classmate to get to canteen

Identifies and compares familiar items, their quantities, sizes and costs, e.g. checks weight and/or length of product against job ticket

Reads time from digital clock

Uses calculator to add whole numbers of stock of familiar items in workplace store

Reads digital weight scales and accurately copies onto recording sheet

Names and compares common 2 dimensional shapes in familiar situations, e.g. compares 2 different road or warning signs

Uses calendar to record information related to community, workplace or public dates, e.g. class term dates, RDOs, culturally significant celebrations

Reads times in familiar texts, e.g. work roster, TV program

Discusses specific information located in simple chart or diagram, e.g. comments on most popular fruit eaten by school children from simple bar graph in newspaper, discusses results of recent newspaper/TV poll

Identifies and discusses changes in pricing, e.g. increased costs of car parking at sporting venue/workplace



## *ACSF Numeracy Level 2*

### **Identifies and comprehends relevant mathematical information in familiar activities or texts**

Identifies and comprehends mathematical meaning from familiar activities or tasks that may include some familiar mathematical symbolism, abbreviations and language that is embedded in simple texts or stimuli and which are culturally accessible

Identifies and compares the mathematical information in simple, familiar oral instructions and written texts, including data located in tables, graphs and charts

Identifies and uses familiar whole numbers including numbers up to 1000s, money and simple, everyday fractions, decimals and percentages, e.g.  $\frac{1}{4}$ ,  $\frac{1}{10}$ , 50%, 25%, 0.25

### **Selects and uses appropriate familiar mathematical problem-solving strategies to solve problems in familiar contexts**

Relies substantially on hands-on (concrete) and real-life materials, personal experience and prior knowledge, as appropriate, to:

- decide on appropriate methods of processing 1 or 2 familiar mathematical steps to solve the problem
- make estimations and check reasonableness of processes and outcomes
- relate meaning of the mathematics in an activity to other familiar, real-life situations

Uses a blend of personal 'in-the-head' methods and pen and paper or calculator/technological processes to undertake the problem-solving process

Identifies and uses whole numbers including numbers up to 1000s, money and simple, everyday fractions, decimals and percentages, e.g.  $\frac{1}{4}$ ,  $\frac{1}{10}$ , 50%, 25%, 0.25

Performs a limited range of familiar and predictable calculations with the 4 operations (+, -,  $\times$ ,  $\div$ ) with division being related to simple and familiar tasks such as equal sharing, e.g. dividing a food bill equally between five people

Orders and groups number, shape, data and measurement, explaining any simple relationships or patterns, e.g. 4-sided shapes, quantities from smallest to largest

Identifies, draws and describes common 2D shapes and some common 3D shapes, e.g. sphere, cube, cylinder

Measures length, mass, capacity, time, temperature, using simple instruments graduated in familiar units, e.g. cm, m, ml, °C, hours, minutes and seconds

Orders, where appropriate, and uses familiar data to construct simple charts and tables based on provided scales and axes (graduations of 1s, 5s or 10s)

Uses knowledge of direction and location (e.g. behind, N, S, E, W, clockwise) including simple coordinates to read familiar and simple maps/street directories/plans

## **Uses informal and some formal oral and written mathematical language and representation to communicate mathematically**

Uses a combination of informal and some formal written mathematical and general language to represent the mathematical and problem-solving process

Uses a combination of informal and some formal oral mathematical and general language to report on and discuss the mathematical and problem-solving process

Uses symbolism, diagrams, graphs and conventions relevant to the mathematical knowledge of the level, e.g. %,  $\frac{1}{2}$  of 1L, 16 cm, map reference D5, N, E, and familiar and simple tables, graphs, maps

### **Sample activities**

Uses street directory to locate position and describes route to a familiar place, e.g. locates own street and explains how to get to local shops/workplace/training institution

Compares and contrasts the value of items from 2 catalogues with regard to quantity, price, quality, additional costs, e.g. kitchen appliances, food, office stationery, hardware

Writes a purchase list and calculates cost to undertake simple task, e.g. lunch for a group of friends, planting a vegetable garden

Orders and compares familiar and predictable sets of data and comments on the data in collaboration with others, e.g. sports performances/results

Works in group to construct a simple chart/table and comment on information, e.g. number of workplace accidents over a given period

Correctly follows simple instructions and measures content in order to make product, e.g. follows ingredients in a recipe, mixes up weed control spray

Calculates cost of two items and estimates change due after making a payment

Keeps record of casual hours of work and calculates gross pay expected

Measures familiar and predictable quantities using simple and routine measuring instruments such as ruler, scales, micrometer, measuring tape

Records numbers or quantities of materials distributed or sales figures and data onto spreadsheet or familiar workplace computers or hand-held devices

Uses familiar timetables and fare information to compare different ways of making the same journey, e.g. compares cost, time taken, convenience in using different forms of transport for a familiar journey

Accesses and compares information contained in 2-column tables, e.g. calculates postage and fees for certified mail

Identifies and names common uses of shapes in a familiar environment, e.g. compares use of shapes in road or danger signs, buildings, games and sports

Compares and discusses changes and any trends in petrol pricing over past month

Reads and discusses data from simple charts or tables in a newspaper or website, e.g. road accident statistics, sports results

### *ACSF Numeracy Level 3*

#### **Selects and interprets mathematical information that may be partly embedded in a range of familiar and some less familiar tasks and texts**

Comprehends activities or tasks that may include some limited formal mathematical symbolism, abbreviations and language

Selects and interprets familiar mathematical information that is partly embedded in familiar or routine texts or stimuli including data located in tables, graphs and charts

Interprets and uses whole numbers including very large numbers and familiar or routine fractions, decimal fractions and percentages embedded in a range of familiar or routine contexts

#### **Selects from and uses a variety of developing mathematical and problem-solving strategies in a range of familiar and some less familiar contexts**

Draws on a combination of hands-on, in-context materials, personal experience, mathematical and other prior knowledge to:

- select appropriate methods of solution from a limited range of mathematical processes
- use developing estimation and other assessment skills to check and reflect on the outcome and its appropriateness to the task

Uses a blend of personal 'in-the-head' methods, pen and paper and calculator/technological processes to undertake the problem-solving process

Calculates with whole numbers and everyday or routine fractions, decimal fractions and percentages, linking equivalent forms and using these appropriate to a range of everyday or routine contexts

Uses and applies rates in familiar or routine situations, e.g. km/hr, \$/kg, \$/m

Applies knowledge of properties of 2D and 3D shapes to describe and draw everyday objects, including constructing common 3D shapes

Measures length, mass, capacity, time, temperature using everyday or routine measuring instruments and converts between metric units by applying understanding of prefixes, e.g. centi, milli, kilo, and as appropriate, micro, mega

Collects and organises familiar data and constructs tables, graphs and charts, manually or with spreadsheets, using simple and familiar or routine scales and axes

Uses distance, direction, coordinates, simple scales, labels, symbols and keys to read and use everyday maps and plans

#### **Uses a combination of both informal and formal oral and written mathematical language and representation to communicate mathematically**

Uses a combination of both informal and formal written mathematical and general language and representation to document and report the mathematical and problem-solving process and results

Uses a combination of both informal and formal oral mathematical and general language to present and discuss the mathematical and problem-solving process and results

Uses symbolism, diagrams, graphs and conventions relevant to the mathematical knowledge of the level, e.g. %, km/hr, \$/m, NE, and routine and familiar tables, graphs and maps

## Sample activities

Compares the costs of purchasing everyday items in different sized containers to work out the best way to purchase, e.g. compares the cost of buying drinks in 3 different sized containers (500 ml, 1.25 litre or 2 litre), taking into account rate of usage and wastage

Gives instructions including a sketch map and estimate of distance and travel time for a everyday route, e.g. for a friend to drive to their house from where they work

Works in a group to undertake a simple survey and documents the results including at least 1 everyday or routine graph, e.g. a workplace survey of worker's OHS knowledge, accident rates

Works in team to organise and cater for a meal/party, e.g. a breakfast at the start of term, an afternoon tea for someone's farewell, and decide on the cost per person

Selects, totals and orders items from a catalogue within budgetary constraints, e.g. workplace stationery order, food for special event

Correctly adjusts quantities and follows recipe/operating instructions including measuring quantities in order to make a product of a smaller or larger size than specified, e.g. adjusts and follows a recipe specified for six people for a group of 12 people

Correctly enters data onto an electronic cash register and undertakes end-of-day summaries and balancing of till

Uses appropriate technological devices to measure and record data and report and act on results, e.g. blood pressure machine, micrometer, temperature gauge

Uses a calculator to compare costs for the purchase of a particular item from different outlets, e.g. sale/discount from catalogues/shops/internet, decides on the best buy and explains the reasons behind the choice

Compares and contrasts costs of alternate types of travel, e.g. travel options for three people using plane, bus, train, taxi and hire car for a journey between two large cities

Reads and explains costs, data and graphical information on a bill or invoice from a utility/organization, e.g. a phone/gas/electricity/water bill

Identifies and explains uses and application of shapes in different contexts, e.g. use of 2D and 3D shapes in house or building construction, construction of domestic or industrial packaging

Collects data and information about a community or social issue from newspapers or the internet and writes a report presenting the information using everyday tables and graphs, e.g. impact of a drought on a community, road accident statistics for a dangerous local intersection, sporting team results

## *ACSF Numeracy Level 4*

### **Extracts and evaluates the mathematical information embedded in a range of tasks and texts**

Extracts and evaluates the mathematical meaning from activities or tasks that include some formal mathematical symbolism, abbreviations and language that is embedded in relevant texts or stimuli including data located in tables, graphs and charts and which are culturally accessible

Interprets and flexibly uses fractions, decimal fractions and percentages including their equivalent values

Interprets and uses signed numbers and numbers given in index or scientific notation form in relation to relevant real-life situations

### **Selects from and applies an expanding range of mathematical and problem-solving strategies in a range of contexts**

Draws on prior mathematical knowledge and experience, diagrammatic and other mathematical processes to:

- represent the mathematical information in a form that is personally useful as an aid to problem-solving, e.g. table, summary, sketch
- select appropriate methods of solution from an expanding range of mathematical processes
- use estimation and other assessment skills to check the outcomes and decide on the appropriate accuracy for the outcome
- reflect on and evaluate own performance, the mathematics used and outcomes obtained relative to internal mathematical knowledge and understanding, and personal and real-world implications

Uses mental, pen and paper and calculator/technological processes, including using a range of calculator functions, e.g. memory, square roots on a scientific calculator, and the use of spreadsheet software

Uses and applies ratio, rates and proportion, e.g. scales on maps and drawings, magnification factors, mixing chemicals

Calculates with fractions, decimal fractions and percentages, and flexibly uses equivalent values for fractions, decimal fractions and percentages

Calculates with relevant signed numbers and numbers given in index or scientific notation form

Uses knowledge about space and shape including angle properties, symmetry and similarity to describe, draw or construct relevant common 2D and 3D shapes

Estimates, accurately measures and calculates quantities using appropriate measuring instruments and relevant formulae and can convert between metric units

Collects, represents, summarises and interprets a range of types of data appropriately in a variety of ways, e.g. tables, spreadsheets, graphs, plots, averages (such as mean, median, mode) and simple measures of spread

Uses, calculates and interprets information based on maps including scales, bearings, travel distances, speeds and times, time zones

Develops, interprets, and uses simple formulae and algebraic representation that describe relationships between variables in relevant contexts, e.g. sport, repair charges, mixing chemicals, area and volume, specific workplace formulae

### **Uses a range of informal and formal oral and written mathematical language and representation to communicate mathematically**

Uses a combination of informal but mostly formal written mathematical and general language, including some specialised mathematical language and terminology and representation to document, interpret and communicate the processes, results and implications of the mathematical investigation

Uses a combination of informal and formal oral mathematical and general language, including some specialised mathematical language and terminology, to discuss and explain the processes, results and implications of the mathematical investigation

Uses mathematical symbolism, diagrams, graphs, algebraic representation and conventions relevant to the mathematical knowledge at the level, e.g.  $\sqrt{}$ ,  $3.75 \times 10^3$ ,  $-5^\circ\text{C}$ , relevant formulae, some complex and specialised tables, graphs and maps

### **Sample activities**

Draws up a scale plan and uses simple formulae and rates to calculate and interpret dimensions, quantities and costs required for making a personally relevant item, e.g. constructing a child's playhouse, furniture or garden shed, painting the exterior of a house, the design of a outside patio area

Develops a detailed weekly or monthly budget for a household activity including income and expenses, and creates a matching spreadsheet, e.g. a yearly budget, budget for a holiday, budget for the purchase of a car

Works in a group to investigate and report on the options and costs for the use of a fleet of vehicles for the running of a business, e.g. comparing the use of cars versus motor bikes for a courier service, or on leasing cars versus outright purchase

Works in a team to plan and develop an operating budget for a task/project/activity including income/revenue from different sources, (e.g. government funding, membership fees, sales) and expenses (e.g. staffing, materials, marketing, overheads, travel, training, IT support)

Uses a job or task description or set of instructions for making up a mixture based on ratios and selects, measures and makes up the mixture to any required amount correctly and according to OHS constraints (e.g. chemical spray, or industrial recipes)

Establishes criteria and categories for the budgeting and financial management of a project/task/activity for an organisation, and sets up a spreadsheet that allows the monitoring of income and expenditure against these categories on a monthly basis

Collects and records data (e.g. measurements, quantities, digital outputs) accurately onto appropriate device (graph/chart, spreadsheet, hand-held device), interprets results and outcomes, identifies any anomalies or errors and can respond appropriately by acting to correct processes or inputs

Uses a calculator or spreadsheet to analyse and compare the repayments on an expensive item (e.g. plasma TV, car, piece of machinery) by two different means, e.g. credit card versus personal loan, lease versus outright purchase

Interprets and uses ratios and scales to read and discuss the design and dimensions on the plan of a property in order to allocate working space and furniture, e.g. a building/workplace, a sports building/facility

Represents statistical system information and data, e.g. customer satisfaction survey results, phone calls/enquiries data, customer profiles, and analyses and interprets the data using graphical and numerical processes, e.g. graphs, charts, averages, to demonstrate different interpretations and influences

Works in a group to undertake a survey and document the results including at least 1 graph, e.g. writes the questionnaire, collects the data and produces a report of the results of a survey of people's attitudes to building a toxic dump in their suburb

Plans and works in organising and running a community event including costs, promotion and budgeting, e.g. a fund-raising barbeque, a sports competition, a dance

## *ACSF Numeracy Level 5*

### **Analyses and synthesises highly embedded mathematical information in a broad range of tasks and texts**

Extracts and analyses relevant information from a text or activity and, where necessary, gathers additional information from other sources

Comprehends texts or tasks that include formal mathematical symbolism, abbreviations, language, mathematical conventions and unfamiliar information that can be highly embedded in complex texts or stimuli

Interprets concepts and techniques from specialist areas of mathematics relevant to study or workplace needs, e.g. trigonometry, statistics, geometry, algebraic manipulation, introductory calculus

Flexibly interprets and uses rational and relevant irrational numbers

### **Selects from and flexibly applies a wide range of highly developed mathematical and problem-solving strategies and techniques in a broad range of contexts**

Uses prior mathematical knowledge and experience, diagrammatic, symbolic and other mathematical representation to:

- organise and represent the mathematical information in an alternative, useful form, e.g. table, summary, sketch, graph
- select appropriate methods of solution from an expanded range of processes
- use developed estimating and assessment skills to check the outcomes and decide on the appropriate degree of accuracy required for the outcome
- critically review the mathematics used and outcomes obtained to reflect on and question real-world implications

Uses mathematical processes flexibly and interchangeably selecting from pen and paper and mental and technologically assisted processes, including scientific or graphics calculators for calculations using trigonometrical, statistical or algebraic functions

Calculates with rational and relevant irrational numbers

Uses and applies the concepts of probability and chance

Uses and applies knowledge about space and shape including angle properties, symmetry and similarity to describe, draw or construct accurate 2D and 3D shapes and scale plans and drawings

Estimates, accurately measures and calculates quantities using appropriate measuring instruments and formulae including accurate conversion between units

Collects, organises and statistically analyses data (including grouped data) using averages, percentiles, measures of spread, and interprets and draws conclusions about possible trends and data reliability

Uses and solves a range of equations using a variety of algebraic techniques



Applies graphical techniques to analyse and solve algebraic relationships and equations including the connections between formulae, their graphical representations and the situations they represent, e.g. linear, exponential, inverse relationships

**Uses a wide range of mainly formal, and some informal, oral and written mathematical language and representation to communicate mathematically**

Uses a combination of formal, written specialised mathematical and general language and representation to document, interpret and communicate the mathematical thinking, problem-solving processes, outcomes and implications of the mathematical investigation

Uses a combination of oral specialised mathematical and general language to discuss, explain and interpret the processes, results and implications of the mathematical investigation

Flexibly uses mathematical symbolism, diagrams, algebraic representation, graphs and conventions relevant to the mathematical knowledge at the level, e.g.  $\sin/\cos/\tan$ ,  $\sqrt{a^2 + b^2}$ ,  $y = mx + c$ , complex and specialised tables, graphs and diagrams

**Sample activities**

Designs an item using geometry and trigonometry or Computer Assisted Drawing (CAD) software package (e.g. pet cage/enclosure, new packaging, carport) and builds a model of the item; including deciding on required size and shape and producing scale drawings, quantities of and costs of materials to be used to make full sized item, constructing a scale model, assessing process and results and discussing ways to improve the design

Researches and investigates statistical data gathered through individual research or experimentation, organises data into groups in a frequency table, represents data graphically, calculates and records measures of central tendency and spread, and analyses and discusses the results including their relevance and impact on the topic of research/investigation

Uses algebraic and graphical techniques to measure, record and analyse data obtained by experiment, records relevant data electronically and constructs tables and graphs to ascertain any relationship between the variables, and establishes type of relationship, e.g. parabolic, hyperbolic, exponential, and the variation it explains, and extracts key information from graphs to create formula connecting variables, and, if possible, tests formula against experimental data

Investigates personal loan financing options: decides on major purchase to be financed by a loan; researches types and conditions of each loan, calculates interest payable using appropriate interest formulae and calculates monthly repayments over a chosen repayment period, compares and contrasts information gathered, and decides on best loan deal relative to repayment affordability and conditions offered

Given particular financial constraints and personal/family requirements, investigates and analyses the options for where to best rent or buy a home or holiday house based on location, prices and availability, and makes recommendations including cost comparisons

Works in a team to research, investigate and analyse data gathered through workplace or community group on a selected topic (e.g. accident rates, sales figures, causes of contamination/pollution), writes a detailed report based on a comprehensive statistical analysis and develops recommendations based on the analysis

Works in a team to research, investigate and analyse options for the establishment of a community enterprise including identifying ideas and any issues, testing the feasibility of the enterprise/business and its services or products, undertakes estimates and costings, and develops a budget and draft business plan

Investigates financial options for a business or organisation, e.g. decides on a major purchase that would need to be financed by a loan and compares options including interest paid and repayment schedules, and recommends the best loan deal relative to repayment affordability and conditions offered

Investigates and analyses an organisational and logistical problem and documents and explains a mathematical solution to the problem, e.g. given time constraints and working times, allocates staffing to fill out a known roster that meets the designated requirements; given a simple networking problem such as delivering materials to 4 different sites knowing their travelling times/distances finds the most economical delivery route; using simultaneous equations and graphs analyses and work out the best options for choosing between different service providers whose charges are based on different initial fixed charges and hourly rates

Researches and investigates issues related to gambling including in financial and social terms, and includes the chances of winning different games and the returns to the casinos and government and the loss to individuals and the community

Researches and investigates the impact of an environmental issue, and gathers data through research on the selected issue (e.g. pollution, traffic, green house emissions), and undertakes a statistical analysis of the data including presenting data graphically, using measures of central tendency and spread, and analyses and discusses the data and outcomes including their relevance to topic of research/investigation

## Appendix D Individual Numeracy Assessment

### *Seeking the N in LLN – Focus Group Individual Numeracy Assessment*

Participant reference  
number:

#### **Instruction**

The following activity is designed to identify your current numeracy skills relevant to the process manufacturing industries.

Each question has been contextualized to the process manufacturing industries and range from ACSF Numeracy Levels 1 through to 4.

You will be allocated 20 minutes to complete the activity during which you are required to work on your own and answer each question to the best of your ability. It's OK to leave a question if you do not think that you can answer it.

Note that the activity is a test of your numeracy skills not your literacy skills. Please inform the facilitator if you need literacy support to complete the activity. If required, the activity can be administered orally.

By the end of 2011 the activity and the correctly worked answers will be posted on [www.wellpractitioners.com.au](http://www.wellpractitioners.com.au).

If you wish to be informed of your individual result, make sure you let us know on the Participant Information Form and we will email it to you.

**Question 1**

An operator uses the dial indicator below to monitor environmental conditions in the factory.

**Question 1a**

On the dial the minimum temperature is indicated by the blue pointer. What is the minimum temperature in degrees Celsius?

**Question 1b**

The red pointer indicates the maximum temperature. How many degrees Fahrenheit are there between the minimum and maximum temperatures?



## Question 2

An operator prepares batches of polyurethane coating by blending a resin solution (Part A) with a curing agent (Part B).



### Question 2a

The mixing ratio of Part A to Part B is 4:1 by volume.

To prepare a 20L batch how many millilitres of Part A and Part B must the operator add to the blend?

### Question 2b

Each batch has a maximum shelf life of 20 hours. If the operator makes a batch at 14:30, at what time does it reach its shelf life?

### Question 2c

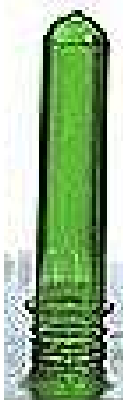
After 10 hours on a warm day the batch thickens. The operator can thin the batch by adding 5% solvent. How many millilitres of solvent can the operator add to the 20L batch?

### Question 2d

The operator only has 755ml of Part B but plenty of Part A. What is the maximum amount of polyurethane coating the operator can mix?

### Question 3

Blow moulding is a manufacturing process used to make plastic bottles where preforms are heated and inflated to fit the mould of a plastic bottle.



Preform



Plastic bottle

An operator monitors a blow moulding process that processes 32 preforms every 20 seconds.

#### Question 3a

What is the rate per hour?

#### Question 3b

How many seconds does it take to produce 100 bottles?

#### Question 3c

A production run started at 11.13am and finished at 8.43pm. The machine stopped between 12.17pm and 12.32pm for adjustment. How many plastic bottles were produced?

**Question 4**

An operator checks the length of tubing made on the production line every hour.



**Question 4a**

Select and measure the length of three pieces of tubing using the ruler provided.

Record the piece number (written on the size of the piece) and the length of each piece in millimetres in the table below.

Piece number	Length (mm)

**Question 4b**

What is the average measurement?

**Question 4c**

What is the range?

**Question 4d**

The product specification for export to the US is  $2.4' \pm 0.5'$  where  $1' = 24.5\text{mm}$ .

Does the average measurement you calculated meet the specification?

### Question 5

An operator at a gel coating operation is preparing a mix of gel coat using a batch formulation. The batch is prepared by measuring the ingredients by weight and adding them to a drum ready for mixing.

The batch formulation includes both liquids and solids. The liquids are specified by volume (litres) and the solids are specified by weight (grams). To add the liquids the operator must use Specific Gravity\* to convert the volumes to weights.

\*Specific Gravity (SG) is the heaviness of a substance compared to that of water, and it is expressed without units. The SG of water is 1 where 1 litre of water is equal to 1 kilogram.



Batch Formulation		
Ingredient	Amount	Specific Gravity
Ingredient A	1500 grams	1.36
Ingredient B	850 grams	1.22
Ingredient C	15 litres	0.80
Ingredient D	2.5 litres	0.72
Ingredient E	2 litres	0.95

What is the total weight of the batch in grams?



### Question 6

An operator receives the following daily production report:

<u>Daily Production Report</u>
Total items produced: 528 units
Hours worked: 12 hours
Scrap: 32 units
Downtime: 38 minutes

#### Question 6a

What was the production rate (items/hour)?

#### Question 6b

The target scrap rate is <5%. What was the actual scrap rate and was the target met?

### Question 7

The following Certificate of Conformance was received with the shipment of a part.

ABC Metals P/L			
Certificate of Conformance			
Job number:	672836		
Part number:	BELT8973		
Date of manufacture:	15/1/2011		
Test	Unit	Specification	Result
Tensile strength	Mpa	15 minimum	16.1
Elongation at break	%	350 minimum	502
Abrasion	mm <sup>3</sup>	250 maximum	198

### Question 7a

What is the specification for tensile strength?

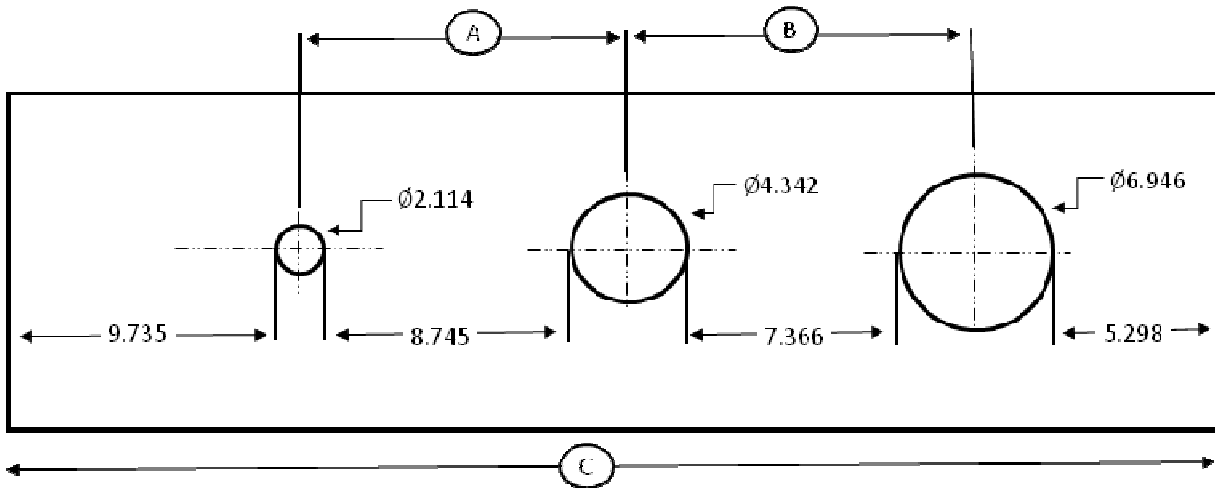
### Question 7b

Does the part conform to the specification?

### Question 8

An operator is cutting sheet materials to order using the drawing below.

The measurements are in millimetres and the  $\varnothing$  symbol is used to indicate that the measurement relates to a diameter.



Not all the measurements that the operator needs are included in the drawing. Use the information provided in the drawing to calculate the missing measurements.

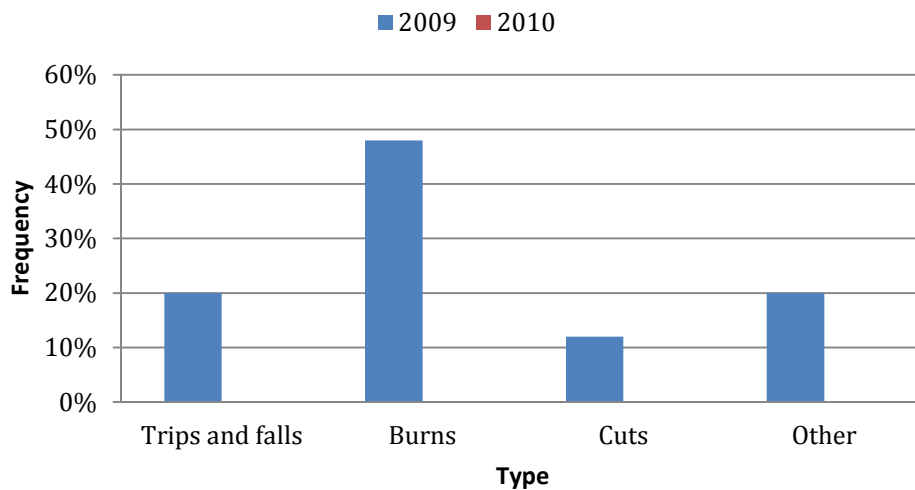
Measurement A	
Measurement B	
Measurement C	

### Question 9

Below is a table showing a summary of the number of incidents per year by incident type and a bar graph for 2009 by percentage of incidents.

Type	Number of incidents	
	2009	2010
Trips and falls	5	3
Burns	12	16
Cuts	3	5
Other	5	2

## Incidents



### Question 9a

What percentage of incidents were trips and falls in 2009?

### Question 9b

Using the data provided in the table for 2010, calculate the percentages and plot the results on the bar chart.

**Question 10**

Give two examples that demonstrate the importance of estimation in the process manufacturing industries in an environment where results matter.

## Appendix E Answer Sheet with Answers and ACSF Mapping

Question	ACSF Level	Answer
1a	3	15 °C
1b	3	30°F or 31°F or 32°F
2a	4	Part A: 16,000ml                      Part B: 4,000ml
2b	2	10:30 am (the next day)
2c	3	1,000ml
2d	4	3,775ml
3a	3	5,760 preforms/hour
3b	3	62.5 seconds
3c	3	53,280 bottles
4a	2	+/- 1mm of reference sheet
4b	4	calculate
4c	4	calculate
4d	4	(46.55mm – 71.05mm)              Yes /No
5	4	18,050g
6a	3	44 units/hour
6b (actual)	3	Actual scrap rate: 6%
6b (target)	3	Target met: No
7a	1	15 Mpa minimum
7b	2	Yes
8A	4	11.973mm
8B	5	13.010mm
8C	4	44.546mm
9a	1	20%
9b	4	Draw on graph 11.5%, 61.5%, 19.2%, 7.7%
10.1	?	
10.2	?	

## Appendix F Interview Questions

### *Seeking the N in LLN – Interview questions*

Participant reference  
number:

1. Generally describe your experience of working in the VET sector.
2. What experience do you have delivering training in the process manufacturing industries?
3. What experience do you have delivering numeracy skills training to adults?
4. What experience do you have delivering numeracy skills training in the process manufacturing industries?
5. Have you ever completed a qualification or professional development activities related to developing your numeracy or numeracy teaching skills? If so, please describe.
6. How do you define numeracy?
7. Do you think numeracy skills are important in industry? Why/why not?
8. Thinking about the numeracy needs of workers in the process manufacturing industries, do you think that you have the necessary numeracy skills and knowledge to address those needs? Please explain.
9. The results of your numeracy self assessment were: XXX  
The results of your numeracy assessment were: XXX  
Do you have any comments you would like to make in relation to these results?
10. Are you interested in developing your numeracy skills for the purpose of delivering numeracy skills training in the process manufacturing industries?
11. If yes, what activities do you think would be effective in assisting you to do this?

# References

Department of Education Employment and Workplace Relations 2012, *Australian Core Skills Framework*, DEEWR, Canberra.

Human Resources and Skills Development Canada website, 2011, viewed 25 January 2012, < [www.hrsdc.gc.ca](http://www.hrsdc.gc.ca) >.

Marr, B & Hagston, J 2007, *Thinking beyond numbers: learning numeracy for the future workplace*, NCVET, Adelaide.