Numeracy By Measure

BUILDING THE WORKPLACE MEASUREMENT SKILLS OF VET PRACTITIONERS

A Professional Development Resource

GUIDE

Prepared by a funding recipient not related to the Commonwealth who has been funded by the Australian Government.

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DEVELOPERS

This resource was developed by Oggi Consulting Pty Ltd.

www.oggiconsulting.com.au

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ABOUT THIS RESOURCE

WHAT IS IT?

This is a professional development resource. It supports Vocational Education and Training (VET) practitioners to build their awareness of workplace measurement skills to better meet the skills needs of adults in the workplace.

The resource was developed in response to a National Centre for Vocational Education and Research (NCVER) report titled *Seeking the N in LLN* (Berghella and Molenaar 2013). This report is available for download at www.ncver.edu.au.

The resource is a companion resource to *Numeracy in Focus: Building VET Practitioner Awareness of Numeracy in the Workplace* and *Numeracy in Practice: Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners*. These resources are available for download from the AWPN website at www.awpn.com.au/resources/ and the developer's website at http://oggiconsulting.com/resources/.

The resource supports the competencies that VET practitioners need to:

- Assess and strengthen their own workplace measurement skills
- Support workplace measurement skills training
- Use the Australian Core Skills Framework (ACSF) in relation to measurement skills in the workplace context
- Use the FSK Foundation Skills Training Package in relation to workplace measurement skills

It assumes that the user has:

- Access to and a basic understanding of the purpose and structure of the ACSF
- Experience in workplace training delivery using adult learning principles and Training Packages

The resource draws on research and resources available to view at http://oggiconsulting.com/projects/numeracy/. These were current at the time the resource was published but things often change. Users are advised to access the most up-to-date information.

WHO IS THIS RESOURCE FOR?

This resource is designed to be used by VET practitioners to review and strengthen their awareness of workplace measurement skills and help them to be more responsive to the measurement skills needs of their learners in the workplace.

The roles and responsibilities of individuals involved in workplace training and assessment vary. Vocational specialists, language and literacy specialists, numeracy specialists and employers are all potential users of this resource and will need to adapt the resource to their own job role and work context.

WHY USE THIS RESOURCE?

VET practitioners need to be aware of their own skills and knowledge in relation to measurement skills in the workplace context and implement strategies to address their own identified skills gaps. The 2013 NCVER report *Seeking the N in LLN* (Berghella and Molenaar 2013) found that many VET practitioners may lack the numeracy proficiency skills and the adult numeracy training skills needed to effectively meet the numeracy skills needs of Australian workers. Engaging fully with this resource is one possible approach to addressing VET practitioner skills gaps in the area of workplace measurement.

The benefits of using this resource include:

- Raised awareness of the importance of measurement in the workplace
- Increased confidence in using the ACSF in relation to workplace measurement skills
- Strengthened awareness of measurement skills in the workplace context
- Increased confidence in using the FSK Foundation Skills Training Package measurement units:
    - FSKNUM32 Use and calculate with complex measurements for work
    - FSKNUM23 Estimate, measure and calculate measurements for work
    - FSKNUM15 Estimate, measure and calculate with routine metric measurements for work
    - FSKNUM09 Identify, measure and estimate familiar quantities for work
    - FSKNUM04 Locate, compare and use highly familiar measurements for work
- Increased responsiveness to the measurement skills needs of workers
- Reduced reluctance to assess and teach measurement skills in the workplace
- Increased skills and knowledge to complete formal training such as:
    - TAELLN411 Address adult language, literacy and numeracy skills
    - TAELLN802 Analyse and apply adult numeracy teaching practices

- Evidence of professional development for Registered Training Organisation (RTO) audits, Recognition of Prior Learning (RPL) and formal equivalence

WHAT IS INCLUDED?

The resource comprises a Guide and six Snapshots.

Note: The information and activities in the resource are generically relevant to all VET practitioners working across all industries.

The Guide provides an overview of measurement needs in the workplace and professional development guidance for developing an awareness of the skills needed to effectively support workplace measurement skills training.

The Snapshots provide detailed guidance to support the skills needed to unpack workplace measurement skills relevant to six selected job tasks.

Topics covered in the Snapshots include:

- Bicycle Fitting
- Cabinet Fitting
- Health Monitoring
- Shoe Fitting
- Smallgoods Packing
- Tyre Wall Markings

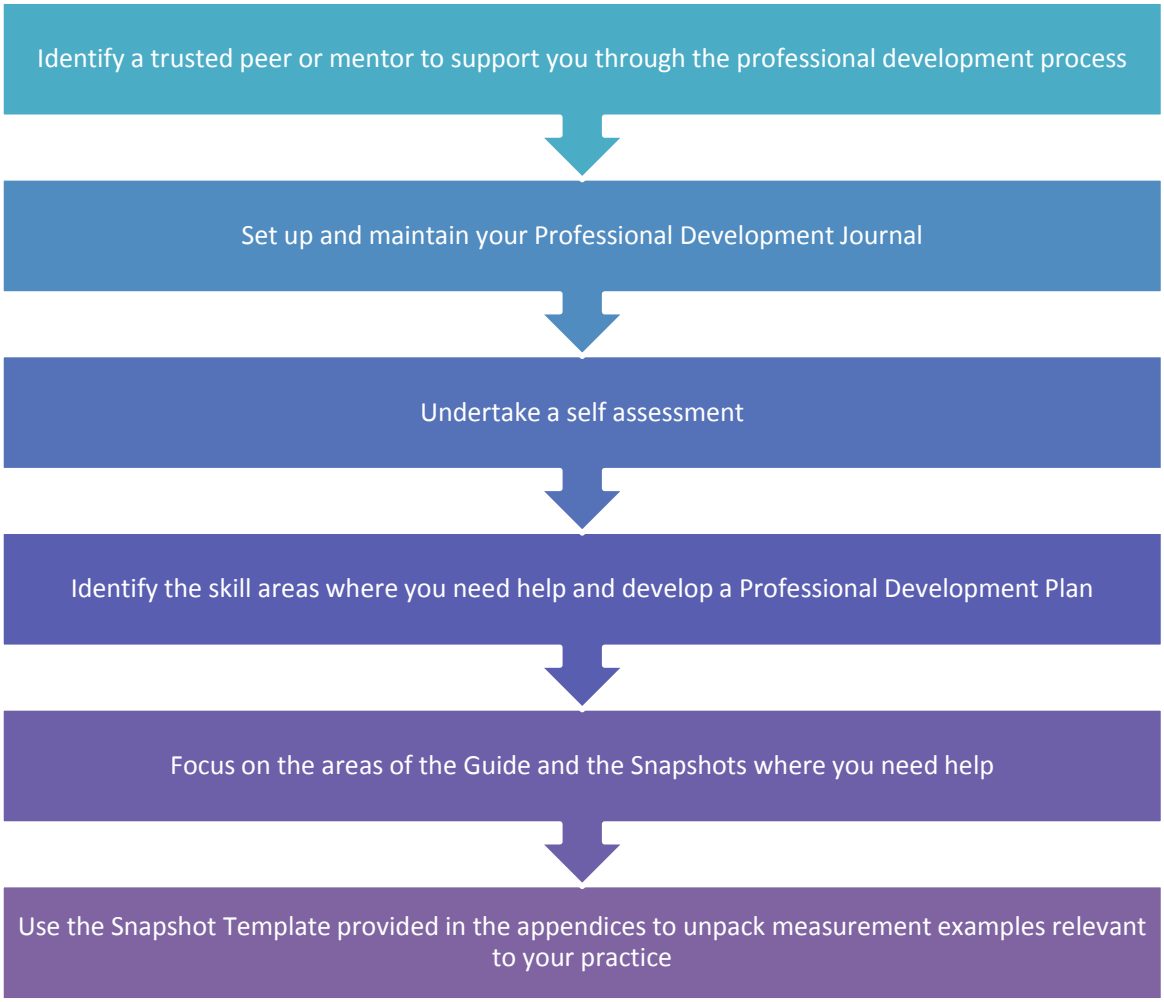
A Snapshot Template is provided in the appendices of the Guide. VET practitioners are encouraged to use the template to build their own Snapshots for other measurement activities found in the workplace and encountered in their practice.

Completed Snapshots can be used to support training in a range of ways, including:

- Ensuring all the numeracy related skills are included in training and assessment
- Identifying and addressing learner strengths and weaknesses
- Identifying and addressing practitioner strengths and weaknesses
- Accurately representing the numeracy requirements in communications with learners, employers and practitioners
- As a basis for validation and moderation activities

HOW CAN IT BE USED?

It is suggested that this resource is used in the following way:



This is a professional development resource that must not only be read. To fully benefit from the resource users should engage with it actively by completing the reflections and activities found in the dashed line boxes like this one.

PROFESSIONAL DEVELOPMENT

This section is for raising awareness of the skills needed to effectively develop workplace measurement skills. It helps VET practitioners to identify their strengths and limitations and develop a plan to address skills gaps.

The activities in this resource support a reflective practice approach to professional development. The process of reflective practice enables deep learning by helping the practitioner to:

- Explore new ideas and concepts
- Explore new ways of viewing situations and experiences
- Connect theory and practice in a meaningful way
- Gain insight into how their own thoughts and feelings impact their practice

The reflective practice tools used throughout this resource include keeping a Professional Development Journal and accessing a trusted peer or mentor.

Use a Professional Development Journal to record your thoughts and feelings as you build your measurement skills. A Professional Development Journal Template is provided in the appendices.

Discuss with a trusted peer or mentor how this relates to what you do.

Measurement skills involve using mathematics. Many people, including VET practitioners, suffer from maths anxiety. Maths anxiety is a common condition that makes it difficult for a person to access their working memory and think logically, affecting their performance as a learner and their attitude towards maths. Reflective practice can be particularly helpful for dealing with and challenging the strong thoughts and feelings associated with overcoming maths anxiety.

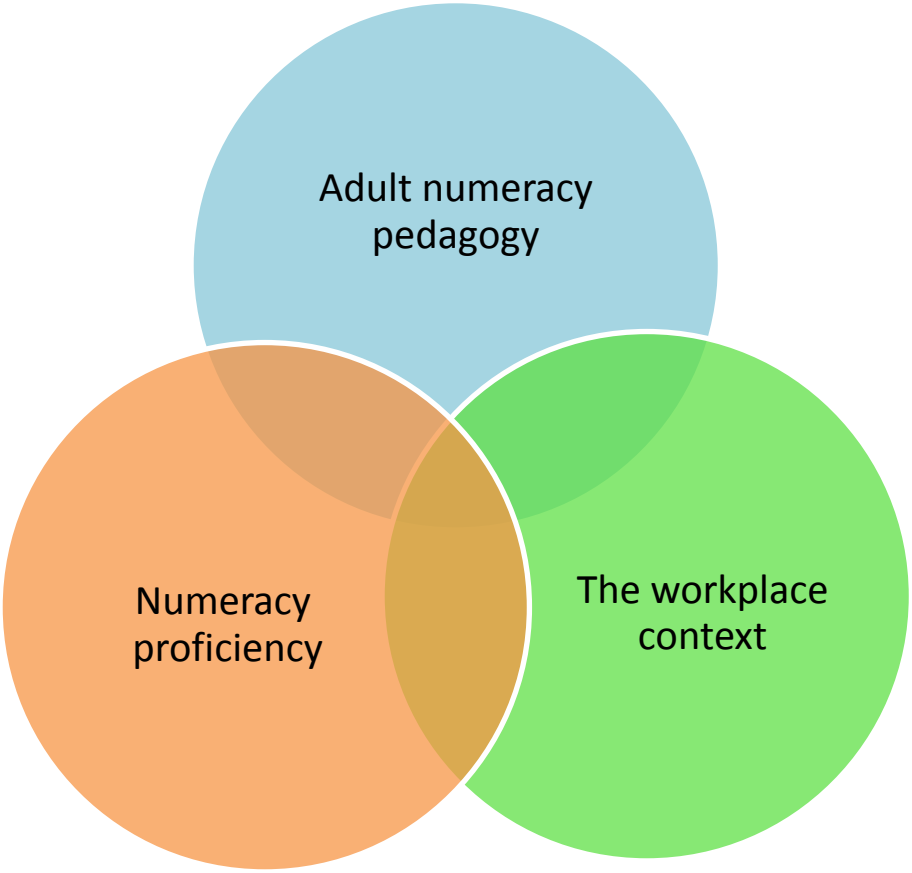
Working through this PD resource will give you insight as to how a learner might feel about and respond to you supporting them in addressing maths anxiety.

Do you feel uncomfortable about learning measurement skills? Find out more about maths anxiety and what you can do about it in ***Numeracy in Focus: Building VET Practitioner Awareness of Numeracy in the Workplace*** *and* ***Numeracy in Practice: Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners****.*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

VET PRACTITIONER SKILLS REQUIREMENTS

To support effective workplace measurement training, VET practitioners need to have strong numeracy skills, adult numeracy pedagogical training, and an in-depth understanding of the workplace context.



The 2013 NCVER report *Seeking the N in LLN* (Berghella and Molenaar 2013) found that there may be a gap between the numeracy skills needs of existing workers and the capacity of the VET workforce to meet those needs. This finding is relevant to measurement skills, an important numeracy skills area in the workplace context.

If you are feeling less than confident in your own measurement skills in the workplace context, you are not alone.

*Read the NCVER report **Seeking the N in LLN** to gain a fuller understanding of the possible gaps in VET workforce capacity in relation to addressing existing worker numeracy skills needs, including measurement skills.*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Describe your own role in supporting adults to develop their measurement skills in the workplace and where you want to be.

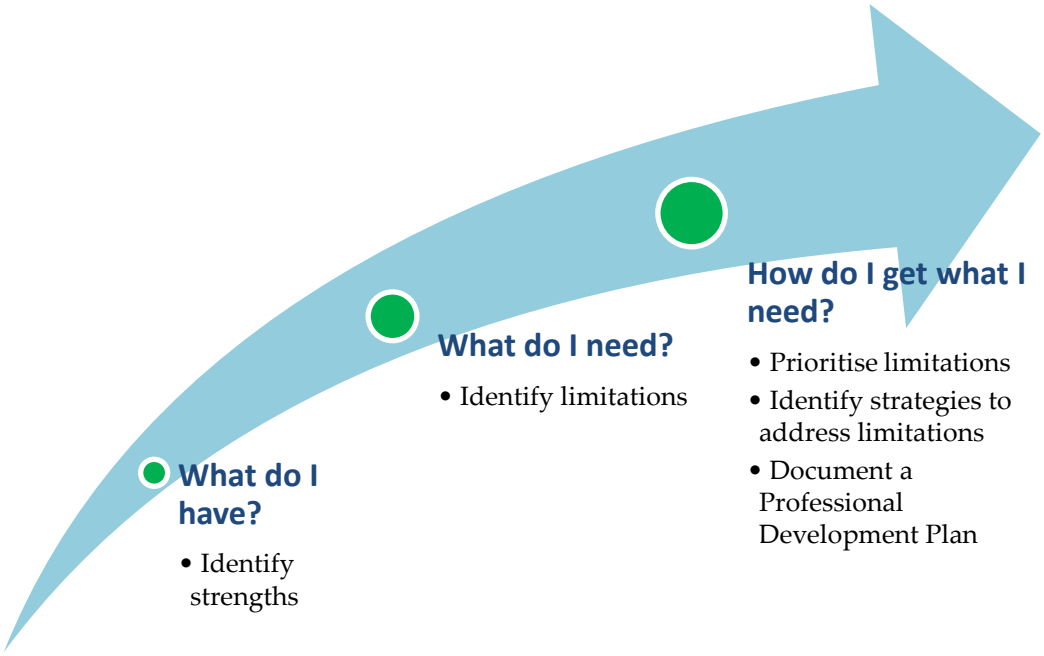
Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

SELF ASSESSMENT

Undertaking a self assessment identifies strengths and limitations. Individuals can then work to their strengths and manage their limitations by undertaking professional development or seeking appropriate help.

Helpful self assessment questions include:

- What competencies do I have that support others to strengthen their measurement skills in the workplace?
- What limits my capacity to support others to strengthen their measurement skills in the workplace?
- What do I need to do to address my limitations?



PERFORMANCE STAGE EVALUATION

The *Core Skills for Work Developmental Framework* (DIISRTE and DEEWR 2013) includes five generic descriptions of stages of performance. The stages of performance can be used to evaluate VET practitioners in relation to workplace measurement as a skill area.

The stages of performance are:

Stage	Description
Stage 1 **A novice performer**	Has little or no practical experience of the Skill Area on which to base actions Is highly reliant on explicit 'rules' (e.g. instructions, processes, procedures, models), guidance and support and priorities determined by others, to guide activities
Stage 2 **An advanced beginner**	Has some practical experience of the Skill Area and is beginning to recognise patterns (e.g. routines, regular responses, links and connections) that help understanding and influence action Is still reliant on explicit 'rules' and on assistance to identify priorities, but can apply these more autonomously in familiar, routine situations
Stage 3 **A capable performer**	Has sufficient practical experience of the Skill Area to identify patterns and organising principles and establish priorities for action Can comfortably apply the explicit and implicit 'rules' associated with familiar situations Adopts a systematic, analytical approach to tasks, especially in unfamiliar situations

Stage	Description
Stage 4 A proficient performer	Has considerable practical experience of the Skill Area in a range of contexts and is moving from reliance on externally prescribed rules to recognition of principles that guide actions Organises knowledge and practical experience as patterns, concepts and principles, which makes it possible to assess and respond to situations in an increasingly intuitive and flexible way Reverts to analysis and seeks guidance when making important decisions
Stage 5 An expert performer	Has extensive practical experience of the Skill Area, with both a big picture understanding and an eye for relevant fine detail Operates fluidly, intuitively and flexibly in highly complex situations, drawing on knowledge and practical experience organised into highly refined patterns, concepts and principles Uses a combination of informed intuition and analysis in different situations, recognising that 'it all depends' Will often reconceptualise approaches and practices to produce more effective outcomes, while also recognising which rules and principles are always applicable

*Reflect on each of the scenarios below and your own workplace measurement skills and knowledge. Use the **Core Skills for Work Developmental Framework** to identify the performance stages that you think you would need to effectively support the learners.*

- *Personal care workers needing support to monitor a client's body weight*
- *Apprentice fabricators needing support to use precision measurement tools*
- *Apprentice plumbers needing support to determine the catchment area of a roof*
- *Cleaning staff support needing to mix cleaning products*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Think about a workplace training project that you are familiar with. What performance stage of measurement skills do you think you need to effectively support the learners?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

ASSESSMENT TOOLS

Adults are notoriously unreliable at judging their own numeracy skills levels. Therefore it is always important to conduct an actual numeracy assessment to determine the numeracy skills level of an adult.

Working through this PD resource will give you insight into your own measurement skills and confidence and your capacity to support your learners.

The following tools are aligned with the ACSF numeracy core skill and can be used to self assess measurement skills:

- Numeracy in Practice: Numeracy Proficiency Assessment Tool – Process Manufacturing Industry
- Precision Consultancy ACSF Assessment Tasks
- Manufacturing Skills Australia Putting the Jigsaw Together Numeracy Indicator Tool for the Certificate III in Engineering – Fabrication Trade
- Community Services and Health Industry Skills Council WELL Skills Check

Questions in each tool that relate specifically to measurement are identified in the Tools for Self Assessment appendix.

It is strongly recommended that VET practitioners undertake an upfront skills assessment of their measurement skills using these or other assessment tools. By this process they will learn something about themselves and be better prepared to prioritise their professional development needs.

Links to the tools are available at http://oggiconsulting.com/projects/numeracy/.

Are you aware of any other assessment tools that can be used by VET practitioners to assess their measurement skills? Research what is available using the internet or by contacting an Industry Skills Council.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

If you haven't already done so, complete the suggested assessments. Commit to completing what you can in one sitting, without looking at the answers.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

DEVELOPING A PLAN

The results of the self assessment can be used to document a Professional Development Plan. A Professional Development Plan Template is provided in the appendices.

The following strategies for addressing limitations may be helpful:

Here's an example of what a Professional Development Plan might look like:

Professional development goal	Strategies to achieve this goal	Outcomes
1. Increase awareness of workplace measurement	*Work through Numeracy By Measure*	
2. Learn how to measure temperature	*Identify an example of temperature measurement in the workplace and explore how it is measured, why it is measured and how the measurement is used*	
3. Learn how to map measurement tasks to the ACSF	*Identify an example of measurement in the workplace and build a Snapshot using the template provided in the Snapshot Template appendix in this Guide*	

If you haven't already done so, prepare your Professional Development Plan. Commit yourself to implementing the strategies to achieve your goals.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

You can build your own measurement skills and understanding in a number of ways. Identify as many examples you can find of typical measurements and instruments found in the workplace. Take a tour of a workplace and talk to people about measurements, including:

- How do they measure?
- What are the measurements used for?
- Why are measurements important?
- Who uses measurements?
- How are measurements used?
- How and where are measurements reported and recorded?

You can also find examples of typical measurements outside of the workplace. For example, in the home, many measurements exist, such a person's height and weight, the dimensions of a window and the area of a room or a garden bed. Volumes of common household products can be analysed, such as food containers, cleaning and garden products, and household water usage. Next time you go shopping, look at how all the products are measured. What units are used? When is weight used compared to volume?

Practise taking measurements with different measuring instruments found in the workplace or home, and check your answers with others. You can always ask a trusted peer or mentor to challenge you to extend your skills and introduce you to new measures and how they are measured, and in what units.

You can use the internet, or friends and colleagues, to research questions about measurement such as:

- What is the difference between mass and weight?
- What is the difference between volume and capacity?
- What is the SI system of units?
- What are derived units of measures?
- What imperial units of measure are still used in Australia? Are there any still used in your workplace?

Review

This section focuses on the skills VET practitioners need to effectively support measurement skills strengthening in the workplace.

Take a few minutes to reflect on this section by answering these questions:

- *What did you learn?*
- *How does what you learnt relate to your practice?*
- *What actions will you take?*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

This contributes to the achievement of the following units of competency:

- TAELLN411 Address adult language, literacy and numeracy skills (TAE Training and Education Training Package)
- TAELLN802 Analyse and apply adult numeracy teaching practices (TAE Training and Education Training Package)

If you think that you need to further develop your knowledge and skills in this area, add these units of competency to your Professional Development Plan. Record this in your Professional Development Journal.

MEASUREMENT SKILLS AT WORK

This section provides a broad overview of measurement skills in the workplace context.

THE IMPORTANCE OF MEASUREMENT

Measurement underpins the success and welfare of modern workplaces and touches almost every part of working life. To develop and manufacture products and deliver services, organisations need to measure quantity, quality and performance. In some industries the need for accurate measurement is critical. For example, organisations manufacturing precision engineering components used in aero engines work to tight specifications and measure size, material composition and performance to high levels of accuracy. In health care knowing that any treatment has been appropriately measured throughout its development, trials and then final delivery to the patient is vital to confidence in its safe application.

The ability to tell time is based on measurement principles. How chaotic would the working world be if it was impossible to measure the passage of time. Understanding weight is crucial. In transport, how much weight is too much for a plane to take off or a truck to carry efficiently? How much fuel is needed to reach a certain point and how long will it take to get somewhere? In building and construction, the basis of most work undertaken is related to the measurement and calculation of dimensions and quantities.

Another important measurement skill is that often we do not need or have an exact answer so we need to make an estimation of the quantity being measured. Assessing 'is this object too heavy to pick up by myself or do I need to use something to lift it?' includes estimations of weight and load capacity. In sales, how long will it take to drive across town to see a client? In local government, how big a room is needed for the public meeting?

Measurement skills demands differ from job to job, workplace to workplace, industry to industry. Some measurement skills are familiar and common across all jobs. For example, starting work on time requires time measurement and estimation skills. Other measurement skills are specialised. For example, healthcare workers use a blood pressure monitor (also known as a sphygmomanometer) to measure blood pressure.

> *At the root of all activity in all case studies were processes of measurement. Measurements are taken manually, using instruments (often digital technologies) or produced in an automated way by machines. Some quite basic issues around people's capabilities to take, understand and appreciate the role, power and use of measurements were evident. (Hoyles, Wolf et al. 2002)*

Many workplace tasks that don't include undertaking measurements or measurement related calculations do require the ability to read, understand, interpret and communicate measurement information. An example is a travel agent explaining a tour schedule or a warehouse operator checking a delivery docket.

Working through this PD resource will alert you to the importance of the workplace context.

In the workplace, measurement is everywhere. Measurement skills are needed by all workers across all jobs in all industries. Measurement is a vital part of work.

Update your awareness of the broad range of numeracy skills found in the workplace by reading the section on measurement in ***Numeracy in Focus: Building VET Practitioner Awareness of Numeracy in the Workplace.***

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

AUSTRALIA'S MEASUREMENT SYSTEM

Australia's national measurement system is a standards and conformance infrastructure that ensures a consistent basis for measurement in Australia that is internationally recognised.

> *A world without standards and conformance would soon descend into chaos. Transport and trade would become impossible. The Internet would not function. Hundreds of thousands of systems dependent on information and communication technologies would falter or fail – from government to banking, healthcare to air traffic control and emergency services to disaster relief. (Department of Innovation, Industry, Science and Research 2011)*

The Australian Commonwealth Constitution section 51 (xv) gives the Federal Government the power to create measurement laws.

The *National Measurement Act 1960* provides for a national measurement system including its coordination and operation. It brings about a uniform national system of units and measurement

standards, and their use. The National Measurement Act is about ensuring that 'measurements are what they claim to be'.

The National Measurement Regulations 1999, the National Measurement Guidelines 1999 and the National Trade Measurement Regulations 2009 support the National Measurement Act.

The Federal Government, through the Department of Industry, works with the following four key standards and conformance organisations to maintain the national measurement system:

- The National Measurement Institute (NMI) is responsible for measurement infrastructure and maintaining Australia's units and standards of measurement
- Standards Australia is responsible for developing standards
- The National Association of Testing Authorities (NATA) is responsible for accrediting testing laboratories
- The Joint Accreditation System of Australia and New Zealand is responsible for accrediting certification bodies

Find out more about Australia's national measurement system and the roles and responsibilities of the Federal Government and peak bodies by reading Australia's Standards and Conformance Infrastructure: An Essential Foundation.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT WITH PURPOSE

It is impractical to measure everything. For example, consider measuring a box. Properties that can be measured include height, width, depth, surface area, volume, weight, strength, flammability, temperature, colour, resistance and density to name a few.

Think about a simple item that you use every day, for example, a pen, a fork or a shoe. Brainstorm all the properties that can be measured. Imagine that you are the manufacturer – what do you think are the most important properties to be measured? Why?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Deciding what to measure is dependent on the purpose of the measurement. For example, the size and weight of a parcel is measured for the purpose of determining freight costs.

In the workplace the purpose of measurement is to support the achievement of business goals. Common business goals include maximising profits, controlling costs, minimising safety and environmental risks, and delivering a quality product or service. VET practitioners need to understand how measurement activities support the achievement of business goals in a workplace.

Working through this PD resource will support you to confirm and strengthen your understanding of the workplace context.

Business goals differ from workplace to workplace. In health care, the weight of a patient is measured so that a correct dosage can be administered safely, and in logistics, the pressure of a forklift tyre is measured to minimise safety risks and control wear and tear costs. In building and construction, the water content of concrete slab flooring finishes is measured to ensure structural integrity, and in food processing, refrigeration temperatures are measured to ensure food is safe and suitable to eat.

Because different workplaces have different business goals, some properties are more important in some workplaces than others. For example, ambient temperature measurement is more important in a meat packaging workplace than a plastics recycling workplace.

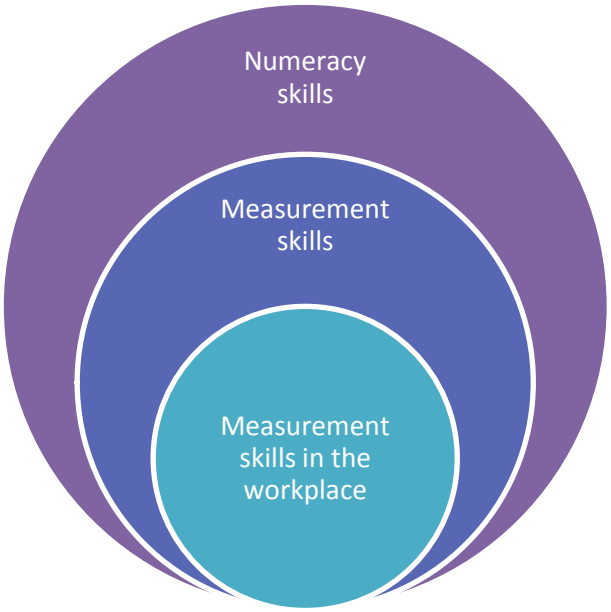
Think about a workplace that you are familiar with. What are the business goals? What properties are measured? How does the measurement of these properties support the achievement of business goals? Contrast this with another workplace that you are familiar with.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT SKILLS NEEDS

In 2011/2012 more than half (55%) of Australian adults and 48% of employed adults were assessed as lacking the numeracy skills needed to cope with everyday life and work (Australian Bureau of Statistics 2013).

Measurement skills are a subset of numeracy skills and adult numeracy skills are a key economic driver influencing both labour force participation and wage levels.



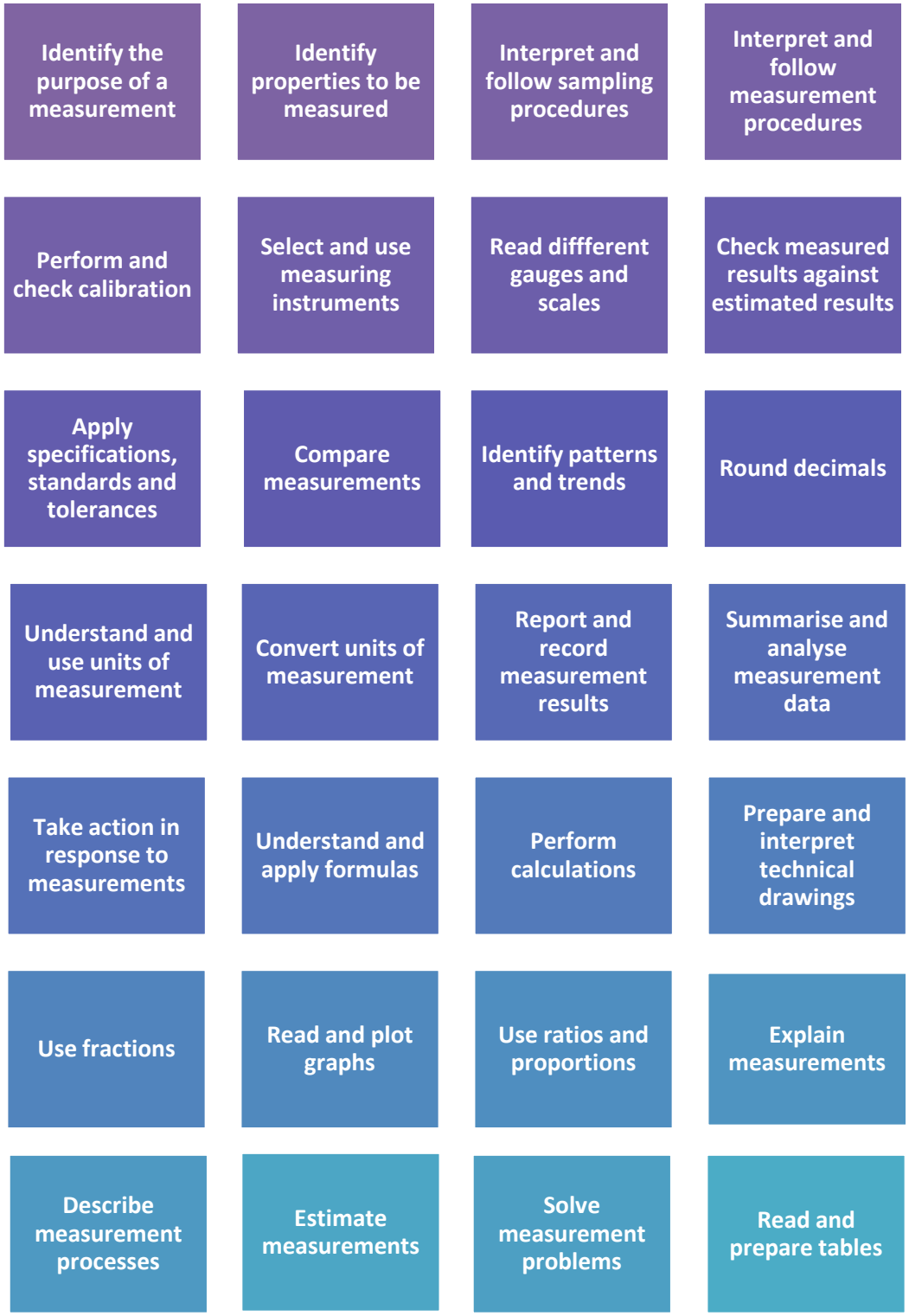
Every workplace depends on accurate and reliable measurements. For example, a building contractor depends on the new window fitting in the space allowed and a supermarket relies on the freezer keeping frozen products safely chilled. Reliable measurements depend on the measurement skills of workers.

Update your understanding of international research into the importance of numeracy skills, including measurement skills, by reading the summary of the latest research findings in ***Numeracy in Focus: Building VET Practitioner Awareness of Numeracy in the Workplace.***

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT SKILLS AREAS

Measurement skills include a broad range of complementary and interrelated numeracy skills. The skills needed depend on the nature of the measurement activity. For example, when taking measurements, a worker may need numeracy skills to:



Think about a workplace measurement task that you are familiar with. How many of the numeracy skills shown above does the task involve?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Review the list of numeracy skills on the previous page and do a quick self assessment. Do you have these skills? Do you have the underpinning knowledge? How can you be sure?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT SKILLS IN CONTEXT

When it comes to measurement skills, like all numeracy skills, context is critical. Measurement skills in the workplace context are very different from measurement skills in a personal and community context or an education and training context.

TRANSFERABILITY

In the report *No More Excuses* (Industry Skills Councils 2011), Manufacturing Skills Australia gives an example of measuring length in two different contexts, the community and the workplace. In the community, length is commonly measured in centimetres using a tape measure marked in centimetres. In the workplace, length is commonly measured in millimetres using a tape measure marked in millimetres.

The task of measuring the same property (length) of the same object using the same measuring instrument (tape measure) has significantly different skill demands in relation to the mathematical information that must be read and understood, the scales used, and the mathematical information that must be represented and communicated. Therefore the transfer of measurement skills between the two contexts of community versus workplace cannot be assumed.

COMPLEXITY

Measurement skills that may be considered basic in a personal and community context or a training and education context are not basic in a workplace where they are embedded in workplace tasks.

For example, consider the measurement skills needed to read and record a digital temperature readout. In a learning environment this is a straightforward reading and recording task. In the workplace, the task is made more complex by the context and may include task time demands (e.g. read and record every 30 minutes), safety requirements (e.g. equipment surfaces are over 200 °C), internal customer demands (e.g. records are used by a supervisor to make important workplace decisions), process monitoring demands (e.g. result is checked against process specification), quality implications (e.g. action is taken to quarantine product if result is outside specification), and productivity targets (e.g. quarantined product leads to under-production, disrupted workflow and unmet customer orders).

OVERTNESS

In the workplace, measurement skills demands are often hidden in job tasks, concealed by processes and technology, and only revealed when something goes wrong. For example, an outdoor recreation worker uses a GPS to lead a hiking group. If the GPS breaks down or loses signal, the worker may need skills to use a topographical map and a hand-held compass.

Think about a measurement task in a workplace that you are familiar with. How does this compare with a similar measurement task in a personal and community or an education and training context? Consider the task in relation to transferability of skills and complexity due to context and overtness.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Increase your awareness of the importance of context in relation to numeracy skills by reviewing the section on workplace context in ***Numeracy in Practice: Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners.***

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

BUILDING WORKPLACE MEASUREMENT SKILLS

VET practitioners need specialist teaching skills and knowledge to effectively support people to develop measurement skills in the workplace.

Working through this PD resource will support you to confirm and strengthen your measurement teaching skills.

The following strategies are examples of good practice adult numeracy teaching applied to measurement skills building in the workplace.

- Encourage the learner to talk about measuring. Ask them to talk about the objects they must measure including what measurements are used for and why they are important, how they are used, and how and where the measurements are reported. What measurement tools are used? What units of measurement are used? What conversions need to be undertaken?
- Check this information against workplace requirements and identify what the learner needs. They may need support in one or more of the numeracy indicators, they may be suffering from maths anxiety or they may lack the complementary vocational skills needed to perform the task, such as correct understanding of the workplace procedures for using rates.
- Draw on what the learner already knows and challenge them by sequencing the training according to the learner's individual needs. For example, they may be skilled in reading a ruler but need support with metric conversions. As appropriate to the workplace, incorporate a range of different measurements and tools and workplace conditions. For example, include examples of different objects to measure using different measuring instruments in the workplace.
- Ask questions to extend the learner, such as 'What if you had to explain to someone else how to take a measurement?' or 'What if accuracy was not important?' Mix up questions that do and do not require metric conversions for additional challenge.

- Provide plenty of opportunities for practice without fear of failure and with time for reflection. During training support, this might involve working with measuring the length of objects gathered from the workplace and discussing the results. It should also include developing the skills to estimate measures by guessing the measurement value of the object before taking the actual measurements. Outside training support, this may involve removing avoidance strategies, such as relying on another team member to take the measurements and pairing with a buddy or mentor.
- Ask the learner to reflect on what they have learnt, the challenges encountered and how they were overcome.

*Familiarise yourself with the research base principles underpinning good practice adult numeracy teaching by reading the implications for training delivery in **Numeracy in Practice: Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners**.*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Review

This section provides a broad overview of measurement in the workplace context.

Take a few minutes to reflect on this section by answering these questions:

- *What did you learn?*
- *How does what you learnt relate to your practice?*
- *What actions will you take?*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

This contributes to the achievement of the following units of competency:

- TAELLN411 Address adult language, literacy and numeracy skills (TAE Training and Education Training Package)
- TAELLN802 Analyse and apply adult numeracy teaching practices (TAE Training and Education Training Package)

If you think that you need to further develop your knowledge and skills in this area, add these units of competency to your Professional Development Plan. Record this in your Professional Development Journal.

MEASUREMENT SKILLS IN VET

This section is an overview of Australian Government initiatives in the VET sector that support measurement skills building in the workplace.

NATIONAL FOUNDATION SKILLS STRATEGY FOR ADULTS

The National Foundation Skills Strategy for Adults (Council of Australian Governments Standing Council on Tertiary Education Skills and Employment 2012) was launched by the Australian Government in September 2012.

It is a 10-year national framework, which aims that by 2022 two thirds of working age Australians will have literacy and numeracy skills at level 3[1] or above. Numeracy skills include measurement skills.

Did you know that you are included in the Strategy and that by buildng your own workplace measurement skills you are helping to implement the Strategy? Find out more by reading the ***National Foundation Skills Strategy for Adults*** *(Council of Australian Governments Standing Council on Tertiary Education Skills and Employment 2012).*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

AUSTRALIAN CORE SKILLS FRAMEWORK

The Australian Core Skills Framework (ACSF) provides:

- A consistent national approach to the identification of the core skills requirements in diverse personal, community, work and training contexts
- A common reference point for describing and discussing performance in the five core skills areas

[1] Note that level 3 refers to Adult Literacy and Life Skills (ALLS) (Australian Bureau of Statistics 2008) level 3 not ACSF level 3. Recent NCVER research, *Does 1=1? Mapping measures of adult literacy and numeracy* suggests the levels may not be equivalent at the higher levels and that ALLS level 3 is higher than ACSF level 3 for numeracy.

The ACSF describes levels of performance across five core skills areas comprising learning, reading, writing, oral communication and numeracy. It describes each core skill across five levels of performance, four performance variables and three domains of communication. Levels of performance are described using indicators, focus areas, performance features and sample activities.

Measurement skills are described in the numeracy core skill of the ACSF in the indicators, focus areas and performance features.

*Become more familiar with the purpose and structure of the **Australian Core Skills Framework** (ACSF) by reading its Introduction. What are the possible benefits of using the ACSF in your work?*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

NUMERACY PERFORMANCE LEVELS

Numeracy performance and therefore measurement performance is described across five performance levels. As performance levels go up, an individual needs less support, the context becomes less familiar and broader, the text complexity increases and the task complexity increases, as described in the ACSF Performance Variables Grid.

For example, at level 1 a worker reads a digital 12-hour clock and records and compares the results with the help of a mentor. At level 3, a worker reads analogue and digital clocks using 12-hour and 24-hour time, does time estimations and calculations and explains how they got the results and what they mean. At level 5, a worker reads and understands highly complex sets of information about time, does complex calculations with time and uses specialised mathematical and general language to explain how they got the results and what they mean.

*The **Snapshots** provide detailed guidance to support the skills needed to use the ACSF to pack workplace measurement skills relevant to six selected job tasks.*

Select a Snapshot and read it. How was the ACSF level determined? Do you agree?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

The performance levels remind us that measurement skills, like all numeracy skills, involve much more than simply 'how hard the maths is'.

Think about a workplace measurement task that you are familiar with. What support is available? How familiar is the context? How complex is the text? How complex is the task? Use the ACSF Performance Variables Grid on page 7 of the ACSF to make a judgement about the ACSF level of the workplace measurement task.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

NUMERACY INDICATORS

There are three numeracy indicators, .09, .10 and .11.

Indicator .09

Identifying mathematical information and meaning in activities and texts

- Identify mathematical information
- Interpret mathematical information

Indicator .10

Using and applying mathematical knowledge and problem solving processes

- Select problem solving strategy
- Apply problem solving strategy
- Reflect on outcomes

Indicator .11

Communicating and representing mathematics

- Represent the outcomes
- Communicate the results

Measurement skills include all three numeracy indicators, often in combination. For example, many small business owners keep a vehicle log book. The measurement skills needed to keep a vehicle log book include:

- Skills to identify and interpret what measurements are needed (indicator .09)
- Skills to use a diary, watch and odometer to read dates, times and mileage, add and subtract numbers and reflect on whether the readings and calculations are reasonable (indicator .10)
- Skills to record the measurements in the vehicle log book and talk about the results, how they were produced and what they mean (indicator .11)

Working through this PD resource will alert you to the meaning of numeracy as much more than the ability to do mathematics.

The Snapshots provide detailed guidance to support the skills needed to use the ACSF to unpack workplace measurement skills relevant to six selected job tasks.

Select a Snapshot and read it. To what extent is each indicator involved? Do you agree?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

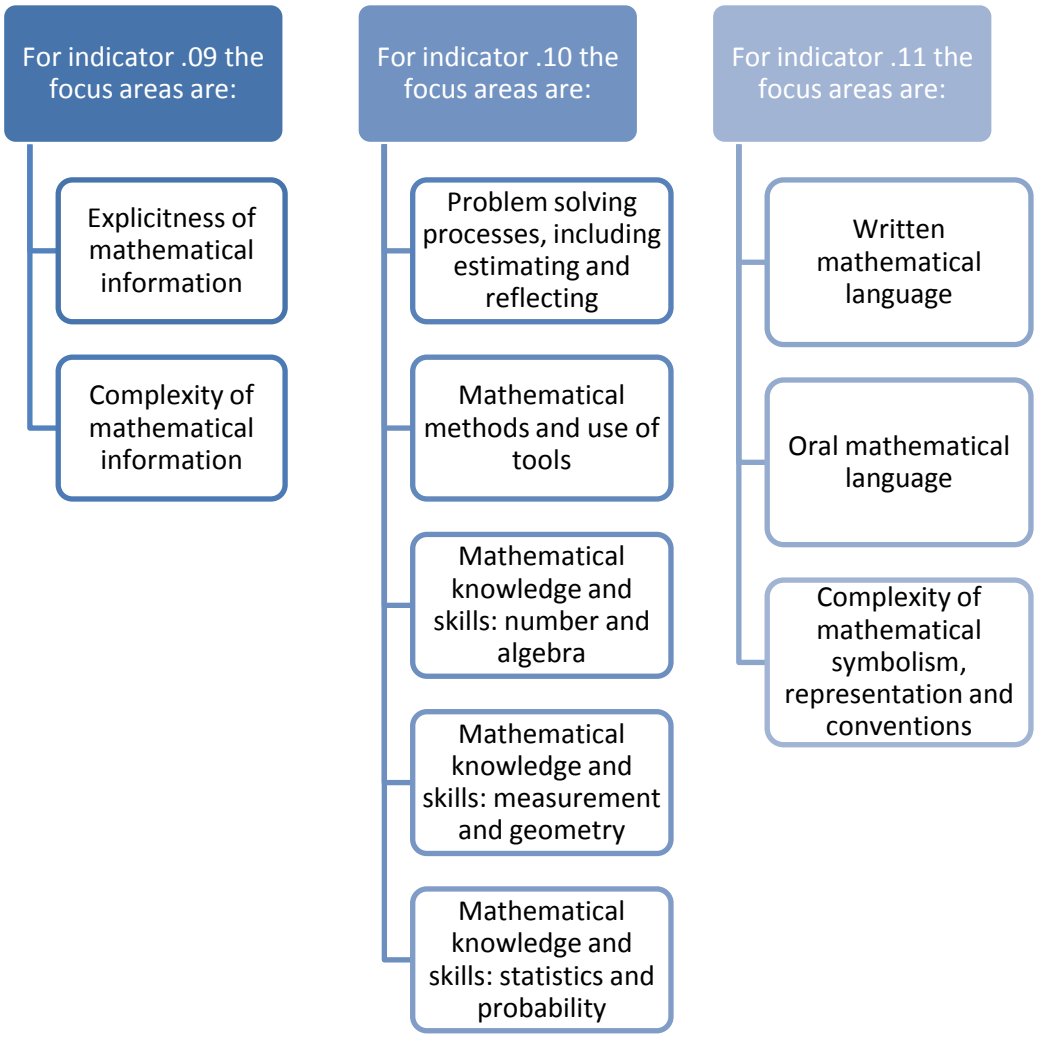
The indicators remind us that measurement skills, like all numeracy skills, involve much more than simply the ability to 'do the maths'.

Think about a workplace measurement task that you are familiar with. What measurement skills are needed? Which numeracy indicators are involved?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

NUMERACY FOCUS AREAS AND PERFORMANCE FEATURES

Each numeracy indicator includes focus areas that are common across the ACSF numeracy levels.



Although only one focus area explicitly refers to measurement, multiple focus areas are needed to describe the skills needed to complete a measurement task. For example, consider the following example of a worker following an instruction to take and record a temperature.

Task requirement	Indicator	Focus area
Identify and interpret the mathematical information in the instruction	.09	Explicitness of mathematical information Complexity of mathematical information
Select an appropriate method for taking a temperature	.10	Mathematical methods and use of tools Mathematical knowledge and skills: measurement and geometry
Estimate the result	.10	Problem solving processes, including estimating and reflecting Mathematical knowledge and skills: measurement and geometry
Use a thermometer	.10	Mathematical methods and use of tools Mathematical knowledge and skills: measurement and geometry
Read the thermometer scale	.09 .10	Explicitness of mathematical information Complexity of mathematical information Mathematical knowledge and skills: measurement and geometry
Check that the result is reasonable	.10	Problem solving processes, including estimating and reflecting Mathematical knowledge and skills: measurement and geometry
Record the result	.11	Written mathematical language Complexity of mathematical symbolism, representation and conventions
Use mathematical language to discuss the result	.11	Oral mathematical language Complexity of mathematical symbolism, representation and conventions

Focus areas also include detailed descriptions of what an individual is able to do at each level. These are called performance features. For example, at ACSF level 2, indicator .09, focus area complexity of mathematical information, the performance features specify that an individual should be able to identify and interpret familiar and simple length, mass, volume/capacity and temperature measures. Detailed information about the performance feature is found in the ACSF.

Reflect on a workplace measurement task that you are familiar with. As per the table above, use the ACSF as a tool to unpack the numeracy skills aligned with each indicator and focus area. Challenge yourself further by aligning the task with the performance features.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

The Snapshots provide detailed guidance to support the skills needed to use the ACSF to unpack workplace measurement skills relevant to six selected job tasks.

Select a Snapshot and read it. Which focus areas and performance features are involved? Do you agree?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MAPPING JOB TASKS

The activity of mapping the numeracy skills demands of a job task to the ACSF requires:

- An in-depth understanding of the job task in action
- An in-depth understanding of the ACSF numeracy core skill and its application
- Practice wisdom gained through ACSF numeracy skill mapping and moderation experience
- Reasoning skills to critically reflect on the process and the outcome and exercise professional judgement

Familiarise yourself with all the Snapshots included with this resource. How do the Snapshots assist your understanding of applying the ACSF?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Select a measurement example in a workplace. Use the Snapshot Template provided in the appendices to build your own Snapshot.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

VET PRODUCTS

VET products include training packages and accredited courses. They specify the skills and knowledge required to achieve an accredited training outcome.

VET product developers must make numeracy requirements explicit and recognisable.

Sometimes measurement skills are highly explicit. For example, there are specific measurement such as *CUVLLN201 – Use basic measuring and calculating skills* and *MSFKB3003 – Check and measure fit of cabinets*.

Working through this PD resource will support you to confirm and strengthen your own measurement skills.

However, not all units contain such explicit measurement skills information. For example, in *MARO001 – Perform basic lookout duties*, VET practitioners must use their knowledge of the industry, the workplace, the job role and workplace tasks in combination with unit of competency trigger words to reveal the measurement skills demands. Some examples of possible measurement trigger words include:

Interpret	Requirement	Collect data	Tolerance	Convert
Estimate	Monitor	Verify	Calibrate	Proportion
Ratio	Check	Specification	Test	Comply
Weigh	Chart	Measure	Adjust	Determine
Compare	Prepare	Mix	Schedule	Draw

Reflect on the units of competency that you use. Are there measurement skills hidden in the units of competency? How do you know? What are the trigger words? How can you check if you are correct?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

FOUNDATION SKILLS TRAINING PACKAGE

The FSK Foundation Skills Training Package is designed to support individuals to:

- Acquire the foundation skills that will enable them to participate successfully in education and training
- Build the foundation skills that underpin vocational competence

FSK comprises 91 units of competency that describe learning, reading, writing, oral communication, numeracy and digital technology skills.

Included in FSK are 39 numeracy units across all ACSF levels. Five FSK units specifically relate to measurement. These FSK measurement specific units are:

ACSF level	Units of competency	
5	FSKNUM32	Use and calculate with complex measurements for work
4	FSKNUM23	Estimate, measure and calculate measurements for work
3	FSKNUM15	Estimate, measure and calculate with routine metric measurements for work
2	FSKNUM09	Identify, measure and estimate familiar quantities for work
1	FSKNUM04	Locate, compare and use highly familiar measurements for work

Note that measurement tasks involve a combination of complementary numeracy skills. For example, to measure an area, an individual needs measurement skills as well as numeracy skills for using numbers, using formulas, calculating, recognising 2D shapes and reading diagrams. These skills are described in other FSK numeracy units.

Become more familiar with the FSK Foundation Skills Training Package by reading the Implementation Guide.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Review

This section provides a broad overview of workplace measurement skills and the VET sector.

Take a few minutes to reflect on this section by answering these questions:

- *What did you learn?*
- *How does what you learnt relate to your practice?*
- *What actions will you take?*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

This contributes to the achievement of the following units of competency:

- TAELLN411 Address adult language, literacy and numeracy skills (TAE Training and Education Training Package)
- TAELLN802 Analyse and apply adult numeracy teaching practices (TAE Training and Education Training Package)

If you think that you need to further develop your knowledge and skills in this area, add these units of competency to your Professional Development Plan. Record this in your Professional Development Journal.

MEASUREMENT SKILLS UNPACKED

This section explores some of the many different skills and knowledge content areas associated with measurement in the workplace.

PROPERTIES

A measurement is mathematical information about a property, such as the depth of a cavity, the temperature of a coolroom or the speed of a truck.

Working through this PD resource will position you to better support your learners.

Properties are classified as physical properties or chemical properties. Physical properties are properties that can be measured without changing the substance of the thing being measured. For example, measuring the length and width of a piece of paper does not change the substance of the paper. Therefore length and width are physical properties. Chemical properties are properties that when measured change the substance of the thing being measured. For example, measuring the flammability of a piece of paper changes the substance of the paper to soot. Therefore flammability is a chemical property.

There are many different properties that can be measured. Common physical properties measured in workplaces include linear dimensions, area, weight, time, volume, pressure, speed, and temperature. VET practitioners need to be familiar with the properties that workers must measure.

How familiar are you with the common properties measured in workplaces?

Think about a workplace that you are familiar with. What properties are measured? Write a plain English definition of the properties and then check your answer using a dictionary. Some properties are easier to define than others.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Representations

A measurement is usually expressed in two parts – a magnitude expressed as a number and a dimension expressed as a unit of measurement. An example is: 2 cm.

There are many ways in which a measurement can be represented. For example, the same measurement can be represented using different units of measurement and the unit of measurement can be represented using words, abbreviations or symbols.

Here are some typical examples of different representations of measurements:

Property	Example
Linear dimensions	2 km, 78 metres, 33 light years, 6 inches, 5', 28 µm
Area	249 m^2, 6 square feet, 20 acres, 67 hectares
Weight	65 kg, 76 oz, 200 grams, 56 lbs, 2000 tonnes
Time	90 min, 3 days, 16 years, 5 seconds, 6 centuries
Volume	23 L, 34 cm^3, 65 cubic inches, 3 gallons, 4 barrels, 6 cups
Pressure	985 kPa, 7 N, 33 psi, 7 N/m2, 89 $kg{\cdot}m^{-1}s^{-2}$, 20 mmHg, 2 atmospheres
Speed	60 km/hr, 26 feet per second, 20 m/s, 4 knots, 10 miles/hour
Temperature	45°C, 200 K, minus 43 degrees Fahrenheit

How familiar are you with the different ways in which measurements can be represented?

Think about measurements that you see in the workplace and in the community. Find examples of measurements that are represented differently in different contexts and applications. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

SYSTEMS

A system of measurement is a set of units of measurement. These are the agreed standards that are used to measure properties. For example, a minute is the agreed standard used to measure time.

The most common systems in use today are the imperial system (imperial units), the Metric System and the International System of Units (SI units), a modern form of the metric system (metric units).

The imperial system includes units such as feet for length and pounds for weight. In Australia, the imperial system was replaced by the metric system many years ago, though some imperial units, such as acres (e.g. land size) and psi (e.g. tyre pressure), are still widely used. Also, many Australian businesses import from and export to countries that use imperial units, such as the United States of America, which uses the US customary measurement system. Other non-standard units are also common in the workplace, such as cups and tablespoons (e.g. cookery) and hands (e.g. racing).

Here are some typical examples of SI and imperial units of measurement:

Property	SI units	Imperial units
Linear dimensions	metre	yard
Area	square metre	square foot
Weight	kilogram	pound
Time	second	second
Volume	cubic metre	cubic foot
Pressure	kilograms per square metre	pounds per square inch
Speed	metres per second	feet per second
Temperature	degrees Celsius	degrees Fahrenheit

How familiar are you with the systems of measurement used around you?

Think about units of measurement that you see in the workplace and in the community. Find examples of imperial units of measurement and metric units of measurement. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

SI UNITS

The International System of Units (SI) consists of base units and derived units. There are seven base SI units associated with seven properties (known as base quantities).

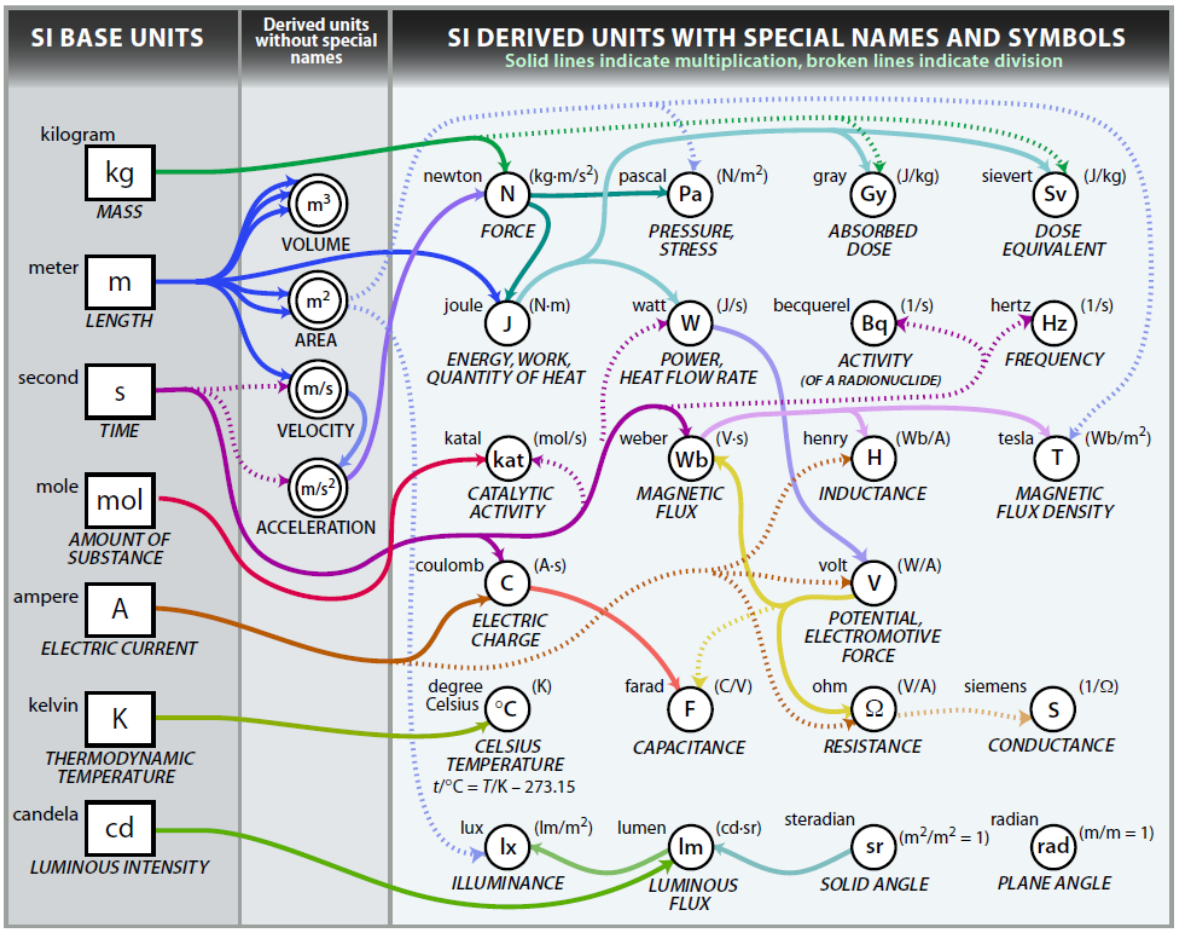
SI base quantity	SI base unit
Time	second
Length	metre
Mass	kilogram
Ampere	ampere
Mole	amount of substance
Luminous intensity	candela
Temperature	kelvin

SI derived units are created from the base units. For example, the SI unit for area is a square metre and the SI unit for volume is a cubic metre. Some derived units have special names. For example, the SI unit for temperature, derived from the kelvin, is known as degrees Celsius.

*Find out more about SI units and their history by visiting the **Bureau International des Poids et Mesures website**.*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

The following diagram shows the relationships between SI base units and SI derived units. As the arrows travel across the diagram from left to right, the units increase in complexity and specialisation, drawing on higher level numeracy and science literacy skills. While it is beyond the scope of this resource to explain the diagram and the units, practitioners should be aware of the breadth of units that may be encountered in the workplace, and be knowledgeable about the units of measurement that are common and familiar in the industries in which they work. For example, the hertz is a complex and specialised unit of measure that is common and familiar in the music industry.



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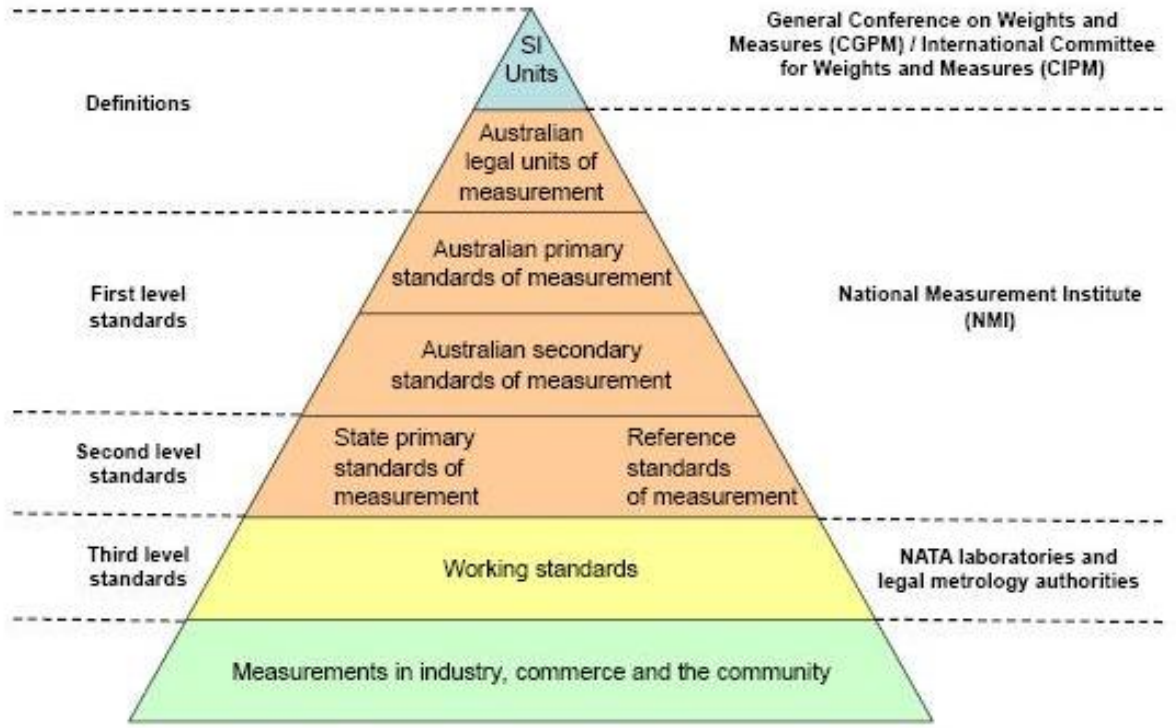
AUSTRALIAN LEGAL UNITS OF MEASUREMENT

Australia's legal units of measurement comprise the following hierarchy of standards linked to the International System of Units.



Source:
http://www.measurement.gov.au/measurementsystem/Pages/HowAustraliasMeasurementSystemWorks.aspx

The National Measurement Regulations 1999 prescribe the Australian legal units of measurement, including:

- SI base units of measurement (kilogram, mole, metre, second, candela, kelvin and ampere)
- SI derived units of measurement with special names
- Non-SI units of measurement used with SI units of measurement
- Additional derived units of measurement
- Additional legal units of measurement and the purposes for which they may be used

The National Measurement Guidelines 1999 prescribe the way in which units of measurement can be combined to produce an Australian legal unit of measurement.

*Find out more about Australian legal units of measurement by visiting the **National Measurement Institute** website.*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT LANGUAGE

Measurement skills include the ability to identify, extract and interpret measurement information, and the skills to communicate and represent measurement information.

Measurement uses a combination of specialised and common language symbols. Sometimes the meaning of a measurement term may be the same as common language or it may be specialised for measurement. For example, the word 'error' has different meanings in common language and specialised measurement language. This is explained on page 59 in the section on Uncertainty.

At low skill levels, measurement language involves simple comparisons, such as bigger, smaller, or coldest, hottest. As the level increases, the language becomes more specialised, for example, understanding the difference between volume and capacity. At the highest levels, measurement language is highly specialised and scientific.

In spoken language, the same term can be used for very different metric and imperial units. For example, when a person says 'a mil', they could be referring to a thousandth of an inch or a millimetre.

How familiar are you with the language of measurement?

Obtain a technical manual from a measuring instrument and reflect on your measurement language skills. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

How familiar are you with the language of measurement?

Write plain English definitions for the words 'volume' and 'capacity' and then check your answer using a dictionary.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

How familiar are you with the language of measurement?

Keep a note of the measurement words you encounter as you work through this resource. Write plain English definitions and then check your answers using a dictionary.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

ABBREVIATIONS AND SYMBOLS

A unit of measurement can be expressed as either words or abbreviations and may include the use of symbols.

The National Measurement Regulations 1999 describes in detail the abbreviations and symbols allowed for Australian legal units of measurement and specifies how they should be represented.

ABBREVIATIONS

Units are usually abbreviated using lower case letters. However, there are exceptions for units derived from proper nouns, for example, degrees Celsius becomes °C and volt becomes V.

Metric unit abbreviations are unchanged by plurals (for example, 1 kg, 2 kg). Imperial unit abbreviations may use an 's' for plurals (for example, 1 lb, 2 lbs).

Some imperial unit abbreviations don't include a period and others can include a period. For example, m. or m is the abbreviation of mile and mph is the abbreviation for miles per hour. Metric unit abbreviations do not include a period.

SYMBOLS

Mathematical language includes the use of symbols. Mathematical symbols are used in units of measurement.

Working through this PD resource places you in the role of the learner.

Examples include the division slash (for example, m/s), the power (for example, m^2) and the multiplication dot (for example, N·m).

Symbols are also used as unit abbreviations. For example, the non standard SI unit abbreviation for second is ".

Here are some examples of unit abbreviations and symbols:

Property	SI unit		Imperial	
	Unit	Abbreviation/ Symbol	Unit	Abbreviation/ Symbol
Linear dimensions	metre	m	yard	yd.
Area	square metre	m^2	square foot	ft^2 or sq ft
Weight	kilogram	kg	pound	lb. or lb
Time	second	s or "	second	sec. or sec
Volume	cubic metre	m^3	gallon	gal. or gal
Pressure	pascal	Pa	pounds per square inch	psi
Speed	metre per second	m/s	foot per second	ft/s, ft/sec or fps
Temperature	degrees Celsius	°C	degrees Fahrenheit	°F

How familiar are you with the abbreviations and symbols used in measurement?

Think about units of measurement that you see in the workplace and in the community. Find examples of the abbreviations and symbols used with units of measurement. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

PREFIXES AND SYMBOLS

In the metric system, scales of measurement increase and decrease by multiples of ten, represented by a prefix.

The National Measurement Regulations 1999 prescribe 20 prefix names and symbols, each representing an order of magnitude. Multiple prefixes must not be used. The kilogram (kilo) is the only base unit with a prefix as part of its name and symbol.

Here are examples of prefix names and symbols:

Prefix	Symbol	Factor	Decimal equivalents	Example
kilo	k	10^{3}	1 000	kilojoule (kJ)
centi	c	10^{-2}	0.01	centimetre (cm)
milli	m	10^{-3}	0.001	millilitre (ml)
micro	µ	10^{-6}	0.000001	microgram (µg)

How familiar are you with the prefixes used in measurement?

Think about units of measurement that you see in the workplace and in the community. Find examples of different prefixes. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

UNIT CONVERSIONS

Unit conversion is the process of converting a quantity expressed as one unit of measurement to another unit of measurement using a conversion factor. Unit conversion calculations are only allowed for quantities of the same property.

The easiest way to convert units is to use a conversion factor. The National Measurement Regulations 1999 prescribe conversion factors for Australian legal units of measurement.

The metric system is based on the decimal, or base ten, number system. Therefore the conversion factor is usually a multiple of ten. This makes metric conversions, the conversion of one metric unit of measurement to another metric unit of measurement, the easiest type of conversion.

Consider converting 20 centimetres to millimetres. There are 10 millimetres in a centimetre. For example, 20 centimetres = 20 x 10 = 200 millimetres.

An important exception to this rule is converting units of measurement associated with time which are not base ten calculations.

Consider converting 3 hours into seconds. There are 60 minutes in an hour and 60 seconds in a minute. Therefore the conversion factor is 60 x 60 = 3600 and 3 hours becomes 3 x 3600 = 10 800 seconds.

The imperial system is not based on the decimal, or base ten, number system and therefore the conversion factors are not multiples of ten. This makes converting between metric and imperial units of measurement and converting between imperial units more complicated, but again the procedure is the same.

Consider converting 35 pounds to grams. There are 453.6 grams in 1 pound. Therefore the conversion factor is 453.1 and 35 pounds becomes 35 x 453.1 = 15 876 grams.

Practise doing unit conversions. Include base units, derived units and imperial units. Reflect on your own unit conversion skills and confidence. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

*The **National Measurement Institute** includes an online unit converter. Practise doing conversions manually and then check your answers using the website. Reflect on your own unit conversion skills and confidence. What does this mean for your practice?*

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT MATHS

There are many ways in which measurement data is used in mathematical problem solving processes in the workplace, in addition to the unit conversions described previously. The following represent some examples found in workplaces.

NUMBER AND ALGEBRA

Measurement data is used in number and algebra processes in the workplace.

For example, measurements of volume are used with ratios, rates and proportions.

Ratio	A cleaner uses a ratio to mix cleaning fluids.
Rate	A farmer measures the volume of water in a water tank before and after use to calculate a usage rate.
Proportion	A caterer adjusts the volume of ingredients in a recipe according to the number of servings needed.

Think about real workplace examples of number and algebra problem solving processes that use measurement data. Practise doing the calculations. Reflect on your own number and algebra skills. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

MEASUREMENT AND GEOMETRY

Measurement data is used in measurement and geometry processes in the workplace.

For example, measurements of linear dimensions are used to calculate perimeters, areas, volumes and surface areas using formulas.

Perimeter	The perimeter of a room is calculated and then used to calculate the length of skirting required for a room.
Area	The area of a landholding is calculated to prepare it for subdivision.
Volume	The volume of an office building is calculated and used to determine heating and cooling requirements.
Surface area	The surface area of a building is calculated and used to calculate cladding requirements.

Think about real workplace examples of measurement and geometry problem solving processes that use measurement data. Practise solving problems. Reflect on your own measurement and geometry problem solving skills. What does that mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

STATISTICS AND PROBABILITY

Measurement data is used in processing statistics and probability problems in the workplace.

For example, measurement data is often summarised in charts and tables using calculations of measures of central tendency.

Chart	The blood pressure of a patient is measured and recorded on a chart.
Table	The distances travelled by a sales representative are recorded in a vehicle log book.
Measures of central tendency	The diameter of five screws is measured and used to calculate an average.

Think about real workplace examples of statistics and probability problem solving processes that use measurement data. Practise solving problems. Reflect on your own statistics and probability problem solving skills. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

INSTRUMENT TYPES

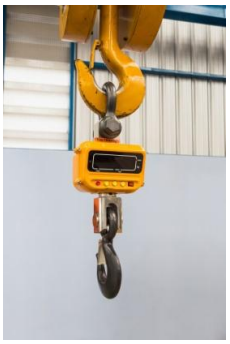
A measuring instrument is a tool that is used to measure a property. For example, a clock is a type of measuring instrument for measuring time.

Often there is more than one type of measuring instrument that can be used to measure the same property. For example, the speed of a car can be measured using a speedometer or a radar gun. Both of these tools use very different technologies to measure the same property.

Here are some examples of measuring instruments and the properties they measure:

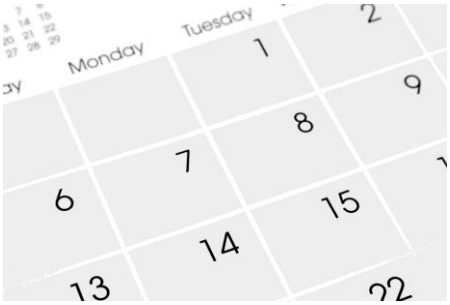
Linear dimensions

Weight



Temperature

Time



Volume

Pressure

Speed

Look at the images of instrument types displayed in this section. Are they familiar to you? Find out what they are and how they are used in the workplace.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Think about the measuring instruments that you see in the workplace and in the community. Notice how the same property can be measured using different types of measuring instruments in different contexts.

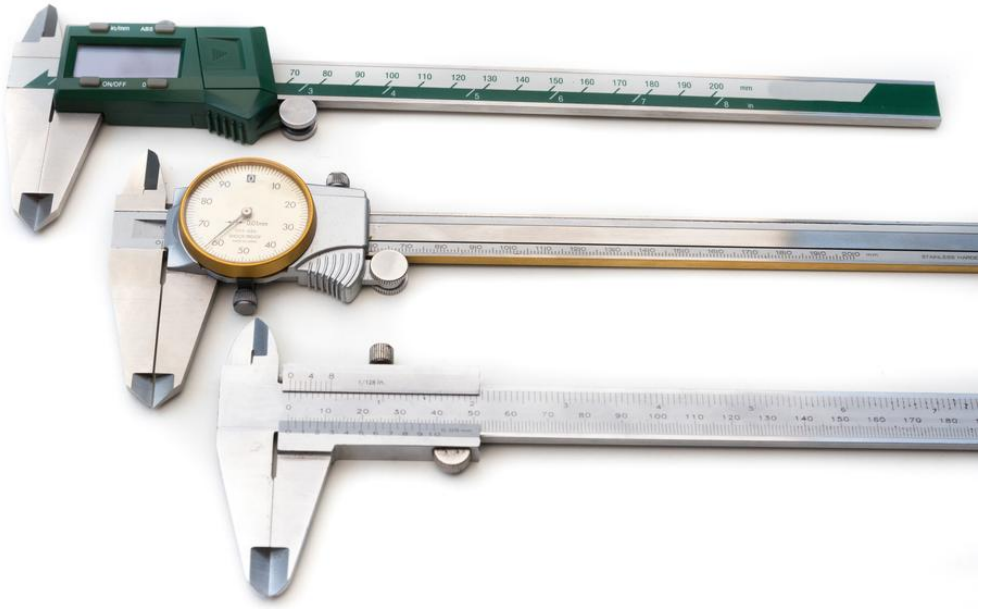
Practise taking measurements. Reflect on your own skills using measuring instruments. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

INSTRUMENT DISPLAYS

There are many different ways in which measuring instruments can display the value of a measurement.

For example, consider the following display types found on a Vernier calliper.



There are also variations of the same type of display. For example, a dial indicator can include a single property, multiple properties, revolutionary counters and both analogue and digital displays.

Working through this PD resource will not make you a numeracy specialist but it will help you to better support your learners.

Here is an example of an analogue dial indicator that includes a single property and a revolutionary counter.

Look at the images of instrument displays presented in this section. Are they familiar to you? Find out how they work.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Look at the different ways in which measurements are displayed in the workplace and in the community. Are some types of displays more common in some contexts than others?

Practise reading different displays. Reflect on your own skills reading displays. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

INSTRUMENT SCALES

To take a measurement, the measurement display must be read. Depending on the display type, this may require the skills to read a scale.

The scale used on measuring instruments is called an interval scale. An interval scale is a numeric scale where an equal interval represents an equal difference. For example, on the following tape measure the intervals between 2 and 3 and between 4 and 5 are equal and represent the equal difference of 1 cm.

MARKS

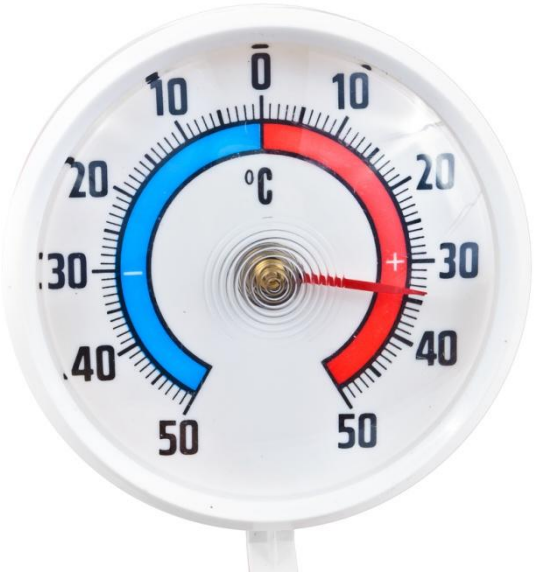
There are many different ways in which scale divisions are displayed. For example, the thermometers below show two different ways of representing degrees Celsius.

MULTIPLE SCALES

Some measuring instruments include multiple scales. For example, the speedometer below displays two different units of measurement on a dual scale.

ZERO

The zero on an interval scale is arbitrary not absolute. For example, 0 °C is arbitrarily assigned to the freezing point of water and temperatures can fall below zero. Therefore scales can include positive and negative numbers.



Look at the images of instrument scales displayed in this section. Are they familiar to you? Find out how they work.

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Look at different ways scales are used in the workplace and in the community. What makes some scales more complex to read than others?

Practise reading different scales. Reflect on your own skills reading scales. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

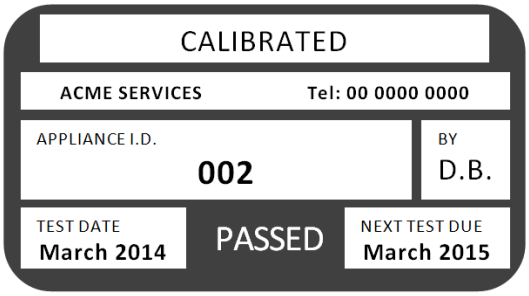
INSTRUMENT CALIBRATION

Calibration is the process of checking and adjusting the accuracy of a measuring instrument using standard samples of a known quantity. It minimises the risk of poor quality measurement information due to inaccuracy of the measuring instrument.

In the workplace calibration activities may be performed internally or outsourced to a specialist National Association of Testing Authorities (NATA) accredited laboratory.

Calibration is a process that must be performed regularly. Calibration frequency depends on how often the measuring instrument is used, the type of instrument and the level of accuracy needed.

Calibration labels are attached to measuring instruments and provide information about when the next calibration is needed. Measuring instruments with lapsed calibration dates cannot be relied on to give accurate measurements.



Think about the measuring instruments that you see in the workplace and in the community. How do you know if they are measuring accurately? What are the risks if they are not? What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

UNCERTAINTY

The uncertainty of a measurement is the doubt that exists about its value. The true value is not known; it can only be estimated using measurement. There is always doubt about whether the measured value is the true value.

The difference between a measured value and a true value is called error. Each time the same measurement is taken, the result may vary because conditions in which measurements are taken are not perfect. For example, all measurement instruments are not perfect and therefore have an instrument error. Information about an instrument's error can usually be found in the manufacturer's specification or marked on the instrument itself.

Measurement error is not the same as making a mistake and getting the wrong answer. Mistakes are caused by poor technique and human error. For example, not reading the scale correctly, not checking the calibration sticker or not taring the equipment.

Although commonly represented in two parts (e.g. 2.2 mm), a measurement consists of at least three pieces of information: a measured value, a unit of measurement and a degree of uncertainty.

The degree of uncertainty is the range of values within which the true value is likely to fall. For example, a measured value of 2.2 mm may have a degree of uncertainty of ± 0.1 mm. This means that the true value is likely to fall somewhere between 2.1 mm and 2.3 mm. One way of expressing this is 2.2 mm ± 0.1 mm.

Sometimes a measurement may also include a fourth piece of information, a confidence interval, for example, 2.2 mm ± 0.1 mm, at a 95% confidence interval. This means that it is 95% sure that the true value lies between 2.1 mm and 2.3 mm.

There are many ways in which uncertainty can be expressed. Research a measuring instrument and practise expressing the uncertainty in at least three different ways.

Reflect on your own skills in relation to measurement uncertainty. What does this mean for your practice?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

ACCURACY AND PRECISION

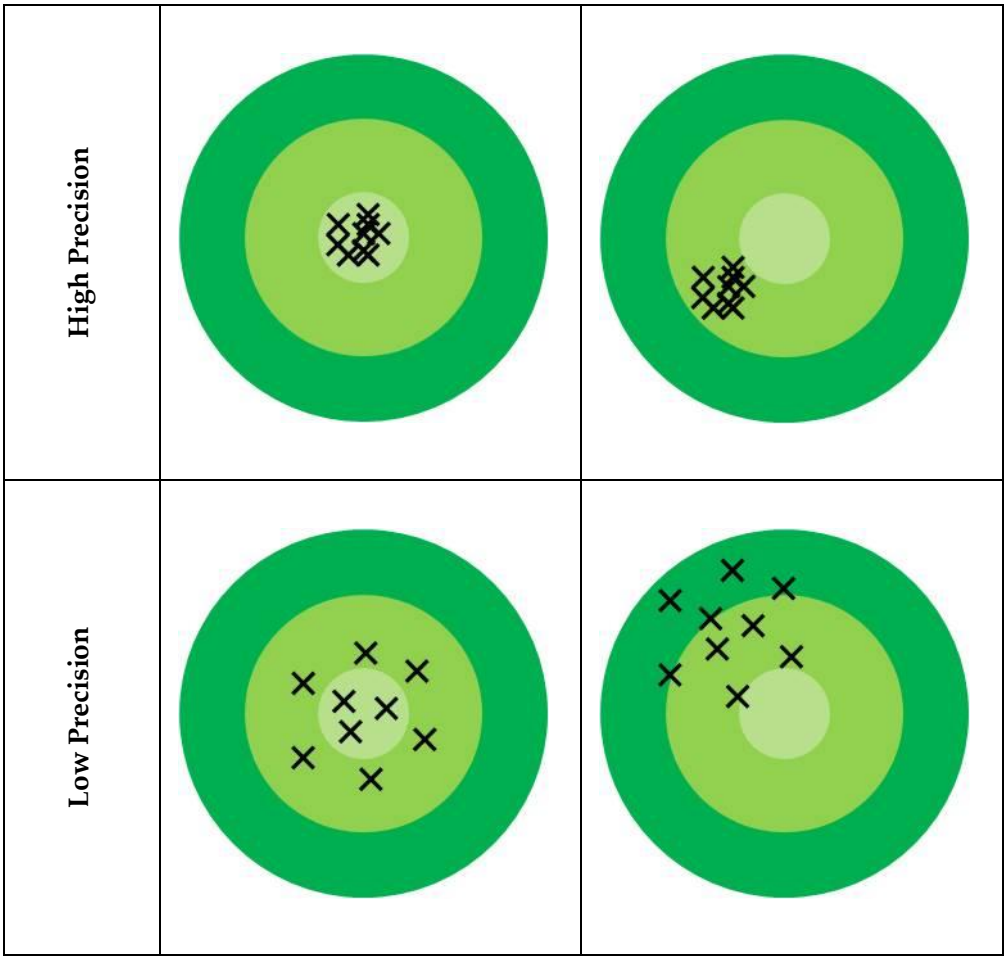
Accuracy is how close the measured value is to the true value. The higher the accuracy, the lower the error. Precision, sometimes referred to as reproducibility, is how close the measured values are to each other.

Consider a weigh scale that has not been calibrated and reads a measured value that is consistently 2 g higher than the true value. Measurement using these scales has high precision, but low accuracy.

Measurements can have high accuracy and low precision, low accuracy and high precision or high accuracy and high precision. A measurement is considered valid if it has both high accuracy and high precision.

This is illustrated in the following diagram using shooting targets. Where there is high precision, the crosses are closely clustered. Where there is high accuracy the crosses are centred. Where there is high precision and high accuracy, the crosses are both closely clustered and centred.

High Accuracy	**Low Accuracy**



There are significant costs associated with ensuring high accuracy and high precision measurements. In the workplace context, the level of accuracy and precision required depends on the business need. For example, compare a manufacturer producing automotive engine parts using precision engineering measuring instruments to a baker preparing baked goods using uncalibrated measuring jugs.

Think about the measurements that you see used in the workplace. What levels of accuracy and precision are required? Why?

Discuss with a trusted peer or mentor how this relates to what you do. Record this in your Professional Development Journal.

Review

This section provides a broad overview of workplace numeracy and the VET sector.

Take a few minutes to reflect on this section by answering these questions:

- *What did you learn?*
- *How does what you learnt relate to your practice?*
- *What actions will you take?*

This contributes to the achievement of the following units of competency:

- TAELLN411 Address adult language, literacy and numeracy skills (TAE Training and Education Training Package)
- TAELLN802 Analyse and apply adult numeracy teaching practices (TAE Training and Education Training Package)
- FSKNUM32 Use and calculate with complex measurements for work
- FSKNUM23 Estimate, measure and calculate measurements for work
- FSKNUM15 Estimate, measure and calculate with routine metric measurements for work
- FSKNUM09 Identify, measure and estimate familiar quantities for work
- FSKNUM04 Locate, compare and use highly familiar measurements for work

If you think that you need to further develop your knowledge and skills in this area, add these units of competency to your Professional Development Plan. Record this in your Professional Development Journal.

APPENDICES

ACRONYMS

This resource uses the following acronyms:

ACSF	The Australian Core Skills Framework
ALLS	Adult Literacy and Life Skills
NATA	National Association of Testing Authorities
NCVER	National Centre for Vocational Education and Research
NMI	National Measurement Institute
PD	Professional development
RTO	Registered Training Organisation
SI	International System of Units
VET	Vocational Education and Training

WEBSITES

Important website references relevant to this resource are listed in the table below.

Reference	Key content	Link
AWPN website	Foundation skills resources Foundation skills conferences and events	www.awpn.com.au
Innovation and Business Skills Australia FSK support information	FSK Companion Volumes Support resources Feedback hub	https://www.ibsa.org.au/foundation-skills-fsk
LiteracyNet	Resources Training program information	www.industry.gov.au/skills/AssistanceForTrainersAndPractitioners/LiteracyNet
The National Centre for Vocational Education and Research (NCVER), Australia's principal provider of VET research and statistics	VET research and statistics A comprehensive list of VET terms and acronyms	www.ncver.edu.au www.voced.edu.au
The Department of Industry's National Measurement Institute, Australia's peak measurement body	Measurement system information Legislation links Reference materials	http://www.measurement.gov.au
The official National Register of information on Training Packages, qualifications, courses, units of competency and training providers	Training Packages Qualifications Courses Units of competency Training providers	www.training.gov.au
ComLaw, a comprehensive library of Commonwealth legislation	Measurement acts, regulations and guidelines	National Measurement Act 1960 National Measurement Regulations 1999 National Trade Measurement Regulations 2009 National Measurement Guidelines 1999

FURTHER READING

The resource draws on the following research and resources available to view at http://oggiconsulting.com/projects/numeracy/. These were current at the time the resource was published but things often change. Users are advised to access the most up-to-date information.

Australian Bureau of Statistics (2013). *4228.0 - Programme for the International Assessment of Adult Competencies, Australia, 2011-2012.* Canberra, ABS.

Berghella, T. and J. Molenaar (2013). *Seeking the N in LLN*. Adelaide, NCVER.

Council of Australian Governments Standing Council on Tertiary Education Skills and Employment (2012). *National Foundation Skills Strategy For Adults*. Brisbane, SCOTESE.

DIICCSRTE (2012). *Australian Core Skills Framework*. DIICCSRTE, Canberra.

DIISR(2011). *Australia's standards and conformance infrastructure: an essential foundation*. Canberra, DIISR.

DIISRTE and DEEWR (2013). *Core Skills for Work developmental framework: the framework.* Canberra, DIISRTE and DEEWR.

Hoyles, C., A. Wolf, S. Molyneux-Hodgson and P. Kent (2002). *Mathematical skills in the workplace: final report to the Science, Technology and Mathematics Council*. London, Institute of Education University of London & the Science, Technology and Mathematics Council.

Industry Skills Councils. (2011). *No more excuses: an industry response to the language, literacy and numeracy challenge*. Retrieved 12 December 2012, from http://www.isc.org.au/pdf/NoMoreExcuses_FINAL%20FINAL%20single%20page.pdf.

Innovation and Business Skills Australia (2013). Foundation Skills Training Package Implementation Guide. DIISRTE, Canberra.

TOOLS FOR SELF ASSESSMENT

Use these self assessment tools to test your measurement skills.

Assessment Tool	Measurement Questions	Property
Numeracy in Practice: Numeracy Proficiency Assessment Tool – Process Manufacturing Industry	Question 1	Temperature
	Question 2	Volume, Time
	Question 3	Time
	Question 4	Linear dimensions
	Question 5	Weight, Volume
	Question 6	Time
	Question 7	Strength
	Question 8	Linear dimensions
Precision Consultancy ACSF Assessment Tasks	Complete driver run sheet	Time, linear dimensions
	Complete a log: Security	Time
	Fill out a time sheet	Time
	Forklift safety	Weight, speed, linear dimensions
	Making numbers work 2	Time, linear dimensions, area
	Mixing concrete	Volume, time
	Plan time	Time
	Read a calendar	Time
	Read and interpret a Safety Data Sheet	Various
	Understand feed charts	Weight, time, volume
	Use a floorplan	Linear dimensions, area

Assessment Tool	Measurement Questions	Property
Manufacturing Skills Australia Putting the Jigsaw Together Numeracy Indicator Tool for the Certificate III in Engineering – Fabrication Trade	Question 13	Linear dimensions
	Question 14	Linear dimensions
	Question 15	Time
	Question 16	Time
	Question 17	Time
	Question 19	Linear dimensions
	Question 20	Area, linear dimensions
	Question 21	Volume, linear dimensions
	Question 22	Linear dimensions
Community Services and Health Industry Skills Council WELL Skills Check **Numeracy**	Question 2	Volume
	Question 6	Time
	Question 7	Time
	Question 8	Time
	Question 9	Time
	Question 10	Temperature
	Question 12	Weight
	Question 14	Volume
	Question 15	Time

PROFESSIONAL DEVELOPMENT JOURNAL

This is a Professional Development Journal Template.

Use this Professional Development Journal to record your thoughts and feelings about maths, discussions with your trusted peer or mentor and your professional development progress.

Date	Record

PROFESSIONAL DEVELOPMENT PLAN

This is a Professional Development Plan Template.

Use this planning tool to address numeracy related skills and knowledge gaps.

Thinking about the results of your self assessment, identify professional development goals relevant to your role and develop an action plan to achieve each goal.

Professional development goal	Actions to achieve goals
1.	
2.	
3.	

SNAPSHOT TEMPLATE

This is a Snapshot Template.

Use this template to develop your own Snapshot. Identify an example of measurement in the workplace and work through the questions, using this Guide and the Snapshots to help you.

What is the workplace measurement example? (Describe the workplace activity or text.)
What are the measurement skills demands? (Identify and describe the measurement skills and knowledge embedded in the workplace activity or text.)
What properties are measured? (Identify the types of properties.)
What indicator .09 skills are needed? (Identify and describe the mathematical information that the worker needs to identify and interpret. Consider all the properties.)

What indicator .10 skills are needed?

(Identify and describe the mathematical knowledge and problem solving skills the worker needs to use. Consider all the properties.)

What indicator .11 skills are needed?

(Identify and describe the formal and informal mathematical language the worker needs to use. Consider all the properties.)

What is the ACSF level?

(Identify the ACSF level – using the Performance Variables Grid, the Performance Features and the sample activities from the ACSF – explaining your reasoning. Consider all three indicators.)