Rethinking Assessment
Strategies for holistic adult numeracy assessment
A resource book for practitioners, policy-makers, researchers and assessors

Beth Marr, Sue Helme and Dave Tout
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by

Beth Marr, Sue Helme and Dave Tout

Project funded by the Department of Education, Science & Training and undertaken by Royal Melbourne Institute of Technology (RMIT)

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**Contents**

Acknowledgments v
Introduction vii

**Section 1 – Rethinking Assessment: Listening to the voices of teachers**

1. Building a Model of Holistic Competence 2
2. Assessment in Adult Numeracy: Existing practices and issues 15
3. Keeping Track of Student Progress: Strategies for record keeping 31
4. Bringing Reality to Assessment 43
5. Initial Assessment 57
6. Using Open-Ended Assessment Tasks 71
7. Negotiating Assessment 83
8. Focussing on Student Confidence 91
9. Focussing on Awareness of Learning 97
10. Focussing on Student Autonomy 101

**Section 2 - Sample Assessment Tasks & Materials**

11. Introduction 111
12. 1. Number Card Sorting 117
13. 2. Making Biscuits 133
14. 3. Mystery Location 139
15. 4. Describing & Drawing Shapes 149
16. 5. Anyone for Pizza? 161
17. 6. Australia’s Growing Population 173
18. 7. How Many Drinks? 185
19. 8. Design a Better Box 193
20. 9. The Price of Biscuits 197
21. 10. Orange Juice 205
22. 11. Battery Hen Cages 211
23. 12. Comparing Age Distributions 217
24. 13. Saving Water 221
26. 15. How Long Might this Med® last? 231
27. 16. Square Numbers 235
28. 17. How Far is it to the Horizon? 239
29. 18. Formative Assessment Activities 245
30. 19. Template for Open-Ended Tasks 257
31. Sample Class Observation and Recording Sheet 261
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Introduction

Background to the Publication

Recent developments in Adult Basic Education have resulted in a wide diversity of programs to suit many different client groups. With increasing focus on accreditation and accountability more has been asked of practitioners than ever before in terms of assessment and reporting. However, practitioner support related to assessment methods has been limited to brief advice in curriculum documents. There have to date been few adult numeracy assessment resources to assist teachers who are currently struggling to meet the needs of their students on one hand, and external ‘quality’ measures on the other, whilst at the same time do justice to the Adult Basic Education philosophy of holistic, situated and critical education.

The Holistic Adult Numeracy Assessment (HANA) project was funded by the Australian National Training Authority. The project aimed to:

- Research current assessment practices of experienced teachers and document issues of concern
- Develop and extend existing models and methods of assessment by working with experienced practitioners using a developmental Action Research model
- Produce an assessment resource which discusses key assessment issues, provides a bank of models of good practice in assessment and demonstrates how holistic assessment can be undertaken within the assessment criteria of accredited frameworks.

The first priority was to document current assessment practices and identify issues of concern for teachers across the country. This was done through a national focus group conducted at the annual Australian Council for Adult Literacy (ACAL) Conference, 2000, and a number of individual interviews with teachers in Victoria and New South Wales. These processes allowed teachers from all over Australia to discuss their own assessment procedures and associated dilemmas.

The information obtained from these interviews and discussions enabled us to form a national picture of numeracy assessment practices and issues which became the basis for the remainder of the project. From that beginning a draft discussion paper regarding the nature of holistic competence in adult numeracy was written and used for ongoing discussion and refinement.

We then held a series of meetings, with a group of experienced practitioners, to explore: the nature of competence; how teachers make their judgements about individual student’s levels of competence; and the types of tasks which allow for holistic assessment of students. The results of these discussions have been combined with the original practitioner input to create this publication.
Practitioners informing the Project

The practitioners interviewed for the project worked in a diverse range of programs catering to many different client groups and age levels. Examples include: Adult Literacy and Basic Education students at all levels of the National Reporting System (NRS) and Certificates in General Education for Adults (CGEA), pre-vocational programs such as pre-apprenticeship courses and office administration, return to study courses for women, programs for indigenous students, for example, the Certificate of Koori Education and Training, English as a second language programs and Labour market programs, such as the Language, Literacy and Numeracy Program (LLNP). Settings within which programs were conducted included Technical and Further Education (TAFE) institutes, community providers and prisons. City, metropolitan, country and isolated rural areas were all represented. Practitioners included sessional, contract, part-time and full-time employees.

The teachers who formed the experienced practitioner group (EPG) had all been working in adult numeracy for many years. They worked in TAFE institutions in Melbourne across a range of programs and student levels. This group met regularly over a five month period discussing concepts of competence, sharing, documenting and extending their existing practices and working together to develop new assessment tasks.

Issues and difficulties associated with assessment

One key aim of the project was to identify issues of concern to practitioners, and address those that fell within the scope of the project. The many issues mentioned, highlighted the complexity of adult numeracy teaching and assessment and the demands placed on practitioners in today’s rapidly changing education environment. Practitioners mentioned many tensions in their work as they strove to balance the learning needs of their students with the requirements of large institutions and funding bodies which require proof of student progress in particular formats. Several of these issues, described briefly below, provide some context for the remainder of this publication. Other issues, more within the project’s scope, are discussed more fully in the chapters to follow.

Teacher uncertainty and lack of confidence

Given that we limited our research to experienced practitioners, we were surprised by what seemed to be a high degree of uncertainty and lack of confidence about assessment. For example one very experienced and well-respected teacher commented: “I always feel that I’m incompetent at assessment, and yet I never stop doing it, because you’re always making some judgement about learning.”

Insufficient time

Lack of time was a recurring theme: time to develop good assessment tasks; the pressure of getting through the numeracy course in the time available; time to complete

viii
paperwork and time to focus on the needs of individual students working at different levels within the same group.

**Storage of student assessment**

Practical problems of storage of students' work, particularly where records were required for accountability purposes, were also mentioned. Many teachers expressed the need for better systems of record keeping.

**Irregular student attendance**

Student non-attendance was also mentioned as a source of frustration in attempting to monitor student progress and ensure course completion.

**Balancing students' diverse needs**

Students working at many different numeracy levels in the one classroom, students with a wide range of literacy and English language competence, and students wanting different outcomes from their numeracy course, all add to the huge challenge of adult numeracy teachers. Balancing the needs of those who want a certificate (and therefore need to focus on covering specified learning outcomes) and those who have different personal aims was often mentioned as a problem by the teachers interviewed.

**Heavy burden of external demands**

Many practitioners reported that the accountability requirements made by outside agencies were seen as an interruption, rather than an aid, to their ongoing assessment process. Monitoring agencies often asked for very superficial/artificial tasks, which could be contained easily on paper and neatly stored for inspection, verification or moderation. Several teachers reported that they dealt with these requests as a separate process, but this process did not usually add to their more insightful integrated approach.

For example, one teacher describes conflicts between a system she has grown to trust and some of the quality procedures:

*The negotiation and discussion works well for the students, it means that we can talk about what they want to do next rather than just moving through a course. But it doesn’t work too well for moderation - They want an assessment task - nor for QA - all the record keeping side, and accountability side. I would need a lot of streamlining checklists and things for that to work. That means a lot more work for me.*

As mentioned above, many of these difficulties are systemic and will only be solved at the level of policy and funding. However, through sharing the existing practices of many experienced teachers, this publication will address some of the difficulties described.
Contents of the publications

Meeting the needs of teachers

'What might assist teachers with assessment in the future?' was a question asked of all the practitioners who participated in the project discussions. Their opinions varied considerably. Some wanted to see a bank of prepared assessment tasks. Others were interested in methods of streamlining their record keeping. Some teachers requested models of integrated literacy and numeracy tasks set around real-life issues, such as the environment. There were also those who thought that it was important to create guidelines of what assessment was meant to be, for example, the purposes of an initial interview. Many teachers urged us to provide advice on how to map students’ work to the curriculum outcomes.

Not only exemplary tasks ...

In some cases, disagreements between practitioners uncovered important issues related to assessment practices and resources.

The suggestion of producing “good assessment tasks that people can trial” will be met within this publication. However, it was clear that it could only be a first step towards assisting teachers to work with their own students. In fact, some practitioners disagreed adamantly with the suggestion of publishing pre-made assessment tasks.

One teacher articulated a widespread concern about supplying photocopiable assessment tasks. She thought this would discourage student-centred teaching: the flexibility that allows teaching content to grow from the interests and needs of each unique group of students.

I have a problem with that. I just teach what the guys are interested in so my assessment tasks are just geared to what they have been studying ... it keeps changing ... You’ve got to keep reinventing because it’s not like having a textbook or a set of notes that you can always go back to. I think it’s a total bonus! I love it! That’s the good part.

On the other hand, many practitioners were aware that such flexibility and student-focused teaching and assessment was challenging for new teachers, many of whom were accustomed to defined curriculum content and tests. These practitioners were interested in a resource that would assist others to understand the thinking behind alternative means of assessing students.

We are anxious about showing what we do for assessment because we’re fearful that it’s not good enough ... people have lots of different reasons for doing lots of things but you have to situate it in the context of why its done to make sense of it.
This project and its resulting two resources has attempted to meet this need. This resource presents the thinking behind the assessment strategies and the rationale for their use (Section 1, Rethinking Assessment: Listening to the voices of teachers), as well as example tasks (Section 2, Sample Assessment Tasks & Materials). The second resource contains sample mappings to curriculum documents (Rethinking Assessment: Strategies for holistic adult numeracy assessment. Mapping to Curriculum Outcomes).

Sections 1 and 2 of this publication also provide other suggested content and starting points which might act as springboards for the imagination. We hope that, from these suggestions, learning and assessment tasks related to all students' needs and interests can be developed.

Details of the structure and content of the two publications are provided below.

The text within the publication has been written in the personal voice, where possible, maintaining exact quotes from teachers. It is not set up as a gospel, or book of rules, but a record of practitioners sharing their experiences and thoughts with others.


Section 1 – Rethinking Assessment: Listening to the voices of teachers

This section aims to introduce readers to the findings of the research and the thinking behind the examples of practice presented. Readers are strongly urged to read this section in order to appreciate the thinking underlying the exemplars and models presented in the remainder of the publication.

This section includes:
• A Suggested Model of Holistic Competence
• Assessment in Adult Numeracy: Existing practices and issues
• Keeping Track of Student Progress: Strategies for record keeping
• Bringing Reality to Assessment
• Initial Assessment
• Using Open-Ended Assessment Tasks
• Negotiating Assessment
• Focussing on Student Confidence
• Focussing on Awareness of Learning.
• Focussing on Student Autonomy

Each of these chapters contains: explanation and discussion of the strategies and their rationale; examples of the strategies drawn from existing practice; suggested general procedures with detailed illustrative examples and ideas for further tasks; and finally, a discussion of issues and difficulties associated with using the strategy, with suggested solutions where possible.
Section 2 - Sample Assessment Tasks & Materials

This section presents detailed descriptions of a selection of the assessment tasks developed during the project, and templates and sample materials for use in the classroom.

Each task description provides details of:

- The possible numeracy levels
- Skills and knowledge that can potentially be observed whilst students perform the task
- Preparation and materials needed for the task
- Suggested procedures for using the tasks in a classroom context
- Possible extensions and links to other literacy and numeracy tasks [for purposes of integration]
- Suggested tasks of a similar nature.

Suggested observation and recording sheets have been included with several of the tasks in this section, for example, practical tasks at the lower levels of numeracy, for which written student work may not be an appropriate expectation.

As well, samples of student responses with accompanying discussion have been provided for selected tasks in this section, discussed in terms of general competencies using the Task Process Cycle, which is described on page 5. These comments will relate to use in any numeracy teaching context, no matter what curriculum or reporting system is used.

The tasks from this section are displayed in a grid on the opposite page and also on page 115. This grid indicates the task's potential level in terms of low, medium, and high; their mathematical/numeracy area; and other properties of the task. More details of these characteristics of the tasks are at the start of Section 2 (page 113).

Structure of the second publication - Rethinking Assessment: Strategies for holistic adult numeracy assessment. Mapping to Curriculum Outcomes

The second publication documents examples of how to map student work against Australian assessment and curriculum learning outcomes. It contains samples of students work, again, first discussed in terms of general competencies using the Task Process Cycle, followed by diagrams which indicate how they might be mapped to the outcomes and indicators of competence of particular assessment and curriculum documents, including Australia's 'National Reporting System' and 'The Certificates in General Education for Adults'.

This part has been presented in a separate book for ease of use: it may be used in order to simultaneously view the curriculum mapping of the student response, the task description and/or the curriculum document.

We also hope that, as a separate booklet, this section of the publication can be updated and/or customised to suit different local curriculum documents in Australia and overseas.
# Grid of assessment tasks included in Section 2

<table>
<thead>
<tr>
<th>Task/activity name:</th>
<th>Level1</th>
<th>Maths/numeracy strand</th>
<th>Type of assessment task2</th>
<th>Student responses incl.</th>
<th>Samples of materials incl.</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number Card Sorting</td>
<td>L/M &amp; H</td>
<td>N</td>
<td>F</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. Making Biscuits</td>
<td>L</td>
<td>M</td>
<td>RB</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3. Mystery Location</td>
<td>L &amp; M</td>
<td>S</td>
<td>RB &amp; OE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4. Describing &amp; Drawing Shapes</td>
<td>L &amp; M</td>
<td>S</td>
<td>OE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5. Anyone for Pizza?</td>
<td>L/M &amp; H</td>
<td>N &amp; A</td>
<td>RB &amp; OE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7. How Many Drinks?</td>
<td>L/M</td>
<td>M</td>
<td>RB &amp; F</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8. Design a Better Box</td>
<td>M/H</td>
<td>M</td>
<td>RB &amp; OE</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The Price of Biscuits</td>
<td>M</td>
<td>N &amp; M</td>
<td>RB &amp; OE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10. Orange Juice</td>
<td>L/M</td>
<td>M &amp; N</td>
<td>RB</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11. Battery Hen Cages</td>
<td>H</td>
<td>M &amp; A</td>
<td>OE &amp; RB</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>12. Comparing Age Distributions</td>
<td>M &amp; H</td>
<td>D &amp; M</td>
<td>OE</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Saving Water</td>
<td>M</td>
<td>M &amp; N</td>
<td>OE &amp; RB</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>15. How Long Might this Med*(last?</td>
<td>L/M</td>
<td>M &amp; N</td>
<td>OE &amp; RB</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Square Numbers</td>
<td>H</td>
<td>A</td>
<td>N</td>
<td>✓</td>
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<td></td>
</tr>
<tr>
<td>17. How Far is it to the Horizon?</td>
<td>H</td>
<td>A</td>
<td>N</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Formative Assessment Activities</td>
<td>All</td>
<td>All</td>
<td>F</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Template for Open-Ended Tasks</td>
<td>All</td>
<td>All</td>
<td>OE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 **Levels**: L = Low; M = Medium; H = High (see page # for description)
2 **Maths strand**: M = Measurement; N = Number; D = Data; S = Space & Shape; A = Algebra
3 **Type of assessment task**: OE = Open-ended; RB = Reality-based; N = Negotiated; F = Formative
Section 1

Rethinking Assessment:

Listening to the voices of teachers
Building a Model of Holistic Competence

A fundamental aspect of the Holistic Adult Numeracy Assessment project involved building a picture of the student attitudes and behaviours which teachers focused on when assessing competence. To do this we included in the initial teacher interviews and discussions the question: What do you think it means to be competent in numeracy? The question allowed experienced practitioners to explore the complexity of their notions of ‘competence’. For example, one practitioner drew many threads together:

*It means having an understanding and the ability to do it now, and maybe in 6 months time you still have the ability to do it then, or if not ... the resources to draw on to tackle it again, and the confidence to know that you can ... it’s just a matter of finding out how [Marg].*

In spite of the diversity of teachers interviewed, there was surprising resonance in the characteristics, or ‘criteria’, mentioned in their descriptions of competence. The characteristics appeared to fall into clusters of essential features, which, when combined, created a portrait of a person with a growth in numeracy competence. None of these characteristics was seen as sufficient alone. They emerged from the data as complementary parts of the whole; the jigsaw pieces which fit together to complete the picture.

Central role of ‘identity’

Taken together, the features described a holistic notion of competence that has at its core a change of ‘Identity’ or alteration of ‘self concept’. The majority of teachers interviewed talked of a change from an ‘I can’t ...’ type of person to an ‘I can ...’ kind of person: a shift towards an identity as a more numerate individual.

*There is a belief that they can’t, that is very fixed. In interview they often talk in terms of being that 13 year old. Not that they are now 30 and they can do lots of other things. It’s like ‘I’ve never been able to ...’ A lot of people are very stuck with the vision of who they were when they left school - the vision that they can’t manage or were no good at school. That whole belief system has to be challenged so that people can let in that they will know ... [Barb].*

The components of holistic competence

The components fell loosely into cognitive and affective characteristics. The cognitive components we have called: *Skills and Knowledge*, using a *Task Process Cycle* and *Transfer and Application*. The more elusive, affective components, which we have called *Confidence, Personal connections, Awareness of learning* and *Autonomy* were seen as integral to competence by most of the experienced teachers interviewed.
Our attempts to represent these key features in a diagram have undergone several alterations during the consultation stage. The final metaphor, or model, of a jigsaw was chosen because of the interlocking nature of the pieces, and the essential part each one has in completing the picture.

![Diagram of a jigsaw puzzle with labels: Transfer & Application, Autonomy, Task Process Cycle, Awareness, Confidence, Personal Connections, Skills & Knowledge.]

*Figure 1. Model of Holistic Numeracy Competence.*

The remainder of this chapter describes these complementary aspects, expands on the jigsaw metaphor and discusses the implications of the model for assessment practices.

**Cognitive aspects of competence**

**Using Skills and Knowledge**

Achieving the skills and knowledge components listed in the curriculum documents was clearly a basic requirement for competence. Three aspects of this were highlighted by the teachers' comments: repeated demonstration, understanding, and integration.

**Repeated demonstration**

There was concern that students were able to confidently demonstrate the skills on more than one occasion. For example:

*They can do it yesterday, they can do it today, they can still do it tomorrow....I do say to the guys just doing this once won't be enough for me ... They need to come back next week and do it, be able to do that again ... with relative comfort, with confidence [Lynn].*
Understanding
Teachers wanted students to demonstrate that they had some understanding of concepts that went beyond the demonstration of skills and processes.

*The questions they ask. Like asking ‘how does that work?’ Or if you give them a formula, like for the area of a triangle, why do you have to halve it? Making those connections. ‘Oh yes! I can see that. The triangle’s half of a rectangle’ [Jakki].*

Integration
It was also important that different aspects of numeracy became integrated, or drawn together by the students. They need to be seen as set of related competencies rather than isolated skills. Teachers said that they look for evidence that students are fitting different pieces of knowledge together and connecting new mathematics skills into their existing repertoire of past knowledge.

*The recognition of what it’s about and where it fits, and applying what knowledge they had before into it... when somebody comes back and says, ‘Oh, that’s about so and so’, they’re recalling the earlier time... they’re making the bits fit [Ruth].*

Or as Barb reported “Sometimes they say ‘this is like those other ones that we did’ so they are really looking at that prior experience and making connections.”

Using the *Task Process Cycle*
Teachers stressed the importance of students being able to find a pathway through whole tasks, not just demonstrating isolated, out of context, mathematical skills. Before using the mathematical skills students need to be able to select the information they will need and decide on the appropriate strategy to apply.

*So it’s that process that’s involved. When they actually get down to the maths of it, it’s just such and such divided by so and... but it’s all this other stuff that comes beforehand that will stop them getting to that ... [Di]*

After they have performed the mathematical operations, students need to reflect on the meaning of the result, decide how reasonable this seems for the particular circumstance and consider its likely implications.

We have called this series of steps the ‘Task Process Cycle’. In short, it can be conceived of as four related components as shown in Figure 2.
Many teachers referred to the importance of fostering this approach to numeracy at all levels, and very early in the teaching program.

*I value mathematical thinking more highly than being able to do accurate tasks all the time ... I have students who just do sums ... reams and reams of sums where all the problem solving has been done. All they have to do is provide the answer, and they never start to think about where those numbers have come from. As opposed to students who really get in behind and try to understand the processes.* [Jakki]

Practitioners discussed reflective thinking, or consciousness of the process, as an integral part of the cycle: “Metacognition. Thinking about thinking. *So to solve that problem, what do I have to do?*” [Martin]. In elaborating this aspect of competence, Barb described a person who:

_worked through a problem, and then he would see there was something missing, and he would go back and change what he had done ... so he was actually thinking about the processes he was using._ [Barb]

The evaluative aspect of the cycle was reiterated by most teachers as a sign of competence “When someone comes up with an answer and says *it's not right*. That they know it's not right is great” [Ruth]. Liz agreed that this indicated a difference in competence: “between getting the wrong answer but _knowing_ you’ve got the wrong answer and getting the wrong answer but _not_ knowing.”

Australia's 'National Reporting System' (Coates et al., 1995) also acknowledges the importance of the aspects described in the proposed Task Process Cycle. It utilises four indicators at each of the five levels: one dealing with locating information; one about selecting and applying strategies; another regarding the evaluation of results in context; and finally, an indicator regarding communication of mathematical processes using appropriate language and symbols. These indicators combine the 'choose strategy' and 'apply strategy' aspects of the Task Process Cycle, whilst including communication as a separate reporting indicator. In the proposed Task Process Cycle, oral and/or written communication (dependent on the level) is considered an integral part of each component.
Transfer and application of skills and knowledge

I definitely don’t feel that competence is only being able to perform skills. It has to be applying those skills in a variety of situations ... a real-life problem that may involve skills from a number of numeracy maths areas as well as the problem solving process of getting from A to Z.

Many practitioners highlighted the importance of students being able to apply numeracy in the world outside the classroom. “It’s not a matter of ticking boxes, it’s a matter of really working with that student as long as you can, to see if you can make an assessment that this person has the skills [Maria]. In assessing her students, Maria asks herself: “Would this person, in a shop, be able to deal with the money, would they be able to find their way around the world...and could they recall, if the need is there?” Transferring and applying skills is the culmination of the cognitive domain. It complements the combination of skills and knowledge used within the task process cycle to handle new situations.

I think it’s more knowing the process that’s important and it’s also knowing how to find the process or how to understand it and then it’s being able to apply the skill, or dare I say, transfer the skill and being able to use it or work out how to use it [Jo].

The three cognitive components taken together describe what is the currently understood as numeracy. However, comments such as: “When I feel that they’ve gained the skills, can apply them over a variety of situations and have the self esteem and the confidence ...to do more ” indicate that the affective components of the model are considered essential companions to the cognitive aspects.

Affective aspects of competence

Confidence

This component was the most interwoven of all: the word ‘confidence’ arising constantly in descriptions of all other aspects. The respondents were all aware of the significant effect of mathematics anxiety on students’ learning, “Self esteem is extremely important. That has to be established and built up before a great deal of learning will occur” [Di]. Shifts in students’ confidence were, therefore, seen as vital.

... Confidence is an important part of competence. It can be something that is totally not related to maths, just the way they come and sit in the classroom. You can see confidence in their body language... ….. It’s definitely a big part of assessment even though it is not written down [Jakki].
Experienced teachers explained that they look for more positive self-talk and confident body language as indicators of this kind of change. "How you rate the student has a lot more to do with how they go about the task than what the task is" (Jakki). "They sort of draw it in closer and they sort of 'get into it' like engaging with the piece of paper. Whereas it's a bit like a distance thing when they are not sure. They sort of look at it and it's not theirs" [Barb].

Jan's journal, kept during the project, tracked a particular female student, who had expressed extreme lack of confidence about mathematics during the initial assessment interview. (Interestingly, this student was bringing up two children and working in a highly responsible job at the same time as she was studying).

```
29/5  Formal test - decimals
Showed competency throughout but finished close to last

30/5 Conversation about the test
Expressed feelings that she does not yet 'own the learning'
Wished she could apply logic to it
Eq divide by 0.01 means how many hundredths in ... - but found she couldn't think like that in a test situation

I'd tend to accept that Brenda's conceptions of not 'owning the learning' more than what the test working showed. I felt that she feared that the learning could be extinguished over time, as it is still reliant on processes (rules) rather than a feel for number.
```

The last entry in the journal illustrates the teacher's recognition that she needs to help Brenda (the student) achieve a firmer understanding of decimals before she will feel confident. Merely passing the test was not enough for her.

**Personal Connections**

This aspect seems to touch on students' emotional relationship to their learning. It might be a connection with students' personal lives, interests and goals that motivates students to learn.

*Competence is inextricably tied up with what the student wants to achieve. They're not going to learn anything unless they have a purpose, and their purpose is more than achieving the Learning Outcomes [Ruth].*

Sometimes it is the ability to see their learning as useable afterwards, applicable to their life outside the classroom, that indicates real learning taking place: "making connections between what they do outside and what's happening. Saying 'Oh this is like ...' [Wendy].
For example, after we had done the doll's house (practical measuring in class) one of the students said he had helped his brother build a shed ... the brother didn't know where to put the end of the tape measure. Like where the nought was and they kept getting this little bit wrong. 'I (the student) told him it was because he was measuring from the wrong part' Something that was real knowledge that had happened in the class [Barb].

**Awareness of themselves as learners**

Another component of competence highlighted by practitioners was students' awareness of the skills and knowledge they had gained, and the ways in which they had gained them.

Students need to recognise what they know and understand... For somebody else to be telling them they're competent I'm not quite sure whether that helps ... to be told you're competent enough to ride a bicycle but you keep falling off, you know you're not [Ruth].

Ruth also discussed the strategies that she used to assist students develop this awareness:

*I encourage students to become more aware of their own competence by pointing it out to them when they explain something to another student ... sometimes they make a statement that means they understand something and I highlight it by saying that if they say it, it means they understand it... to be able to put it into words [Ruth].*

Maria suggested student participation in assessment as a strategy for focusing students' awareness of their learning. "There's a lot of discussion ... It's a matter of them telling me how they're feeling and whether they can do it, whether they're happy, and they also get feedback from me".

Barb explained the importance of students having an awareness of their learning style, as well as what they have learned. "Also knowing how you learn. This is my big thing about metacognition." She discussed a visual learner who benefited from realising that she could understand better if she drew diagrams or pictures. She also described some male students who were "very active, touchy, sort of 'doing people' - mechanics and the like ... That's how they've learned things". Their learning style was validated by encouraging the use of concrete aids like blocks and counters. "They know that's how they need to do it, then they can move on from there. Once people know that it is OK to do it any way that you like, then I think that is very important for them to grow" [Barb].
Growth of Autonomy as a learner

This dimension of competence describes a growing independence in the learner. As Marilyn said "Their move from dependence to independence is something I look fairly closely at" she added that "taking some control over their learning" was important to her. This sort of active participation in learning was mentioned often. Wendy described one student's developing independence: taking class investigations home over the break and extending them. "She had the incentive to do more and more".

Similar sentiments were expressed by Jakki:

_I really like to see them taking charge of their own learning. It's really good when they come up to you and say 'I really don't know this well enough. What can I do to be able to do it better?' They have the confidence to ask you questions about their learning. I like them to get involved and see that they can take control of it. They don't need me to tell them everything [Jakki]._

Students' growing autonomy is also evident in their willingness to have opinions and take risks. Getting started on new tasks with less assistance than before was a frequently mentioned sign.

_It's the confidence to think things through without saying I don't know I've got to go to somebody else ... Some of these people have been so wrong for so long, there is a real risk in putting anything down on paper at first ... sort of testing out ideas. ... It's a risk they get better at taking as they go on. It's sort of the confidence to have an opinion and to say what they think [Barb]._

_The ability to come up with strategies, even if those strategies don't work. Looking at it, saying well that didn't work, we'll try it a different way. Students who scribble on their paper, generating ideas, thinking about what they are doing [Jakki]._
The Completed jigsaw or whole picture: change of identity

As mentioned at the beginning of this chapter. These seven components were seen as fitting together to create a complete picture of holistic competence: the shift of a person's numeracy 'identity' or self concept.

Shifts in students' self concept, or identity, were almost universally mentioned as a central feature of change in competence. As Wendy put it: "that whole identity of who you are, and how that changes as you become more competent". The centrality of 'identity', coming from the teachers interviewed, resonates strongly with aspects of James Gee's address at an Australian national literacy conference (Gee, 2000)\(^2\). He likened teaching new literacies, to recruiting someone to take on an identity. From this point of view, literacies (which include numeracy) are seen as social languages. A person 'enacts an identity' whenever they switch social languages, for instance teenagers switching communication styles for parents and for peers. Citing the seemingly miraculous amount of learning displayed by pre-readers who are keen to 'take on the identity' of a Pokemon expert, Gee suggested that if teachers could turn their 'passion for skills' into a 'passion for identity', then learning would be transformed. He contrasted this approach to the approach of school education, which breaks learning up into little bits, suggesting that if Pokemon were taught in school, then the usual children would fail.

There seems to be a link here with the desire, or ability, of numeracy students to see themselves as able to become numerate; the belief that the 'I can .. .' identity is attainable.

Our growing conviction that competence is more than mere completion of assessment tasks was strengthened over the course of the project as this excerpt from an experienced practitioner's journal illustrates:

A student who has been given level 3, does not seem like a level 3 student to me. He himself says he found level 3 really hard. He is a really conscientious and hard-working student but he is anxious, dependent on rules, has no idea of estimating and no ability to transfer skills.

This seems to me to illustrate potential problems associated with using 'assessment tasks' to assess competency. A student can slog away at the work and complete a task associated with the work they have just been doing, but have no confidence, limited retention, and no comfort level. This does not indicate competency to me [Penny].
It would seem that this student had managed to jump the assessment hurdles of his previous course. However he had not yet had sufficient opportunity for the repeated demonstration, understanding and integration, which were identified in this model as essential aspects of obtaining new knowledge and skills. Nor did he seem to have the confidence or sense of autonomy required for him to feel a growth in his numeracy ‘identity’.

Implications of the model for adult numeracy teaching and assessment practices

Discussion of the original version of the model focused on whether teachers agreed with the components, how the affective features influenced assessment and reporting, and how the model might encourage teachers to expand their repertoire of assessment and/or teaching strategies. Debate about the naming, and overlap, of the aspects of the model, and the difficulty of drawing definitive lines between them, reinforced the complementary and interconnected nature of the components, indeed the complexity of competence. However, there was broad agreement that competence embraces both the affective and cognitive domains, and, that teachers draw information from both when making their judgments.

There was also strong agreement that students’ confidence is an important cue for assessment of competence. However, concerns were expressed about whether all of the affective aspects would need to be exhibited before a student could be considered competent. Regardless of the relative emphasis given to the affective components, the group stressed the importance of recognising and highlighting these aspects within the model, rather than allowing them to disappear into the background.

Teachers and the jigsaw metaphor

Reference to some of these aspects exists, in differing degrees, within the various accredited curriculum documents, yet the extent to which they are acknowledged or validated in practice, and how this occurs, is unclear. Teachers all ‘see’ it differently - through the eyes of their experience.

To consider this notion further it is useful to again draw on the jigsaw metaphor. Different people working on a jigsaw give attention to, or ‘see’ different things, depending on their expertise or experience. There is a temptation for new puzzle solvers to focus only on the obvious, the bright, central, features, like the skills and knowledge of curriculum documents.

More experienced solvers take time searching out the straight edges and the subtle colours of the background, realising that such strategies will pay off in the end. We could liken this to a numeracy teacher paying early attention to affective aspects of their students: taking time setting up an environment in which real learning might take place later; encouraging students to think about their learning styles and the like. Teachers might also concentrate on the Task Process Cycle: whole tasks, not bits and pieces of skills.
Just as the efficient puzzle solver remembers to keep their eye on the whole picture they are trying to create, and not get totally engrossed in putting together isolated features, the holistic numeracy teacher needs to alternate between the big picture - the changing numeracy identity - and its many complementary pieces.

Implications of the model for assessment strategies

Having arrived at a model for holistic competence, the next step was to consider how it would influence our recommendations regarding assessment strategies. How could we use the model to inform holistic approaches that value all of the aspects articulated within the model?

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*This seems to me to illustrate potential problems associated with using ‘assessment tasks’ to assess competency. A student can slog away at the work and complete a task associated with the work they have just been doing, but have no confidence, limited retention, and no comfort level. This does not indicate competency to me* [Penny].

The group acknowledged that it was easy to leave many aspects to chance, rather than giving them space in our teaching assessment practices. For example, not all students would spontaneously discuss their feelings about learning without prompting, nor would teachers necessarily hear about the ‘personal connections’ of diffident students without making specific efforts to encourage discussion. Similarly, it would be difficult to assess students’ ability to apply the Task Process Cycle without appropriate assessment tasks. The EPG therefore discussed strategies that would enhance holistic approaches, valuing both the affective and the cognitive aspects of competence described by the model. Sample tasks illustrating holistic strategies were developed and trialled with participants’ students during the project. Feedback has allowed further refinement of the ideas.

In order to draw attention to the affective side of the model, the group experimented with strategies to explore students’ feelings about numeracy learning and encourage greater autonomy or independence. We also discussed and trialled methods that specifically encourage students to articulate their learning, and gain insight into their learning strategies.
Strategies related to the cognitive aspects of the model were also discussed and developed by the group. For example, open-ended tasks have been favoured, because they enable students to demonstrate their own level of competence in multi-level classes and thus provide all students with opportunities for success. Some time was also spent articulating negotiated assessment strategies that encourage independence and allow students to apply numeracy skills to their own areas of interest.

Using real artefacts, such as supermarket items, menus and maps, in learning and assessment tasks, was also a technique given a great deal of attention. Using real-life materials validates students’ informal knowledge and facilitates personal connections with the numeracy. Tasks revolving around everyday materials also strengthen the Task Process Cycle, since the relevant information must be found from the real item, and the results of calculation related back to reality.

The remainder of this publication discusses these strategies (Section 1), and illustrates them by exemplary tasks and sample student responses (Sections 2). We hope that this will assist teachers to expand their notions of holistic numeracy competence and their repertoire of strategies for assessing it. We also hope that teachers use, and develop further, the assessment strategies in this publication.

Footnotes


Assessment in Adult Numeracy: Existing Practices and Issues

I think observation is always the teacher's best tool! [Lynne]

I find that in the initial interview they always ask ‘What about tests?’ or ‘How will you test me?’ or ‘Is there an exam at the end?’ It always comes up. They are terrified! I say to them that there are various ways to assess them, informal assessment, group assessment, or a project or assignment or observation. I say to them ‘You are adults!, You know when you can do it and I know when you can do it, so between us we should be able to make sure you are competent’ [Ros].

During the initial phase of the Holistic Adult Numeracy Assessment project, we interviewed twenty-six experienced practitioners in order to capture the range of assessment methods used and some of the issues which were of concern to them. This was done in order to document current practice and assist us to chart the direction of the project.

Assessment is based on multiple sources of information

Most experienced teachers interviewed stressed that assessment was always ongoing. It didn't ever depend on a single formal assessment task, but was based on multiple sources of information. Their assessment integrated informal aspects such as observation of students as they participated in class activities and discussion with students about their progress, as well as information gained from their written work. Teachers were continually compiling their picture of the students' numeracy competence. This picture was eventually used to make judgements relating to students' completion levels and suitable further study options.

On the whole, the methods reported by experienced teachers came under the banner of 'formative assessment', since all information gathered was used to plan the next step in their teaching process, not just to decide whether or not the student was competent without following up.

Ongoing assessment happens all the time, which is how you plan the next class. What happens in this class and how they respond affects what you do in the next class. So that's ongoing assessment - ‘Do we do more of that particular topic or do we need to go back over it?’ or ‘Do we need to do it in a different way or do we move on?’ [Liz]
So assessment happens in a number of ways. Observation in groups, talking to the student about how they came to get their answers - when their answers are wrong - but they do understand the process - just don’t always have the number skills. That’s important to acknowledge too. Convincing students that answers are not always just right or wrong - they are sometimes ‘almost right’ [Chris].

A mixture of formal and informal assessment methods was the norm for most practitioners interviewed, although the strategies that they described covered a wide range. Teachers affirmed that assessing their students continuously, using different strategies, allowed them to capture the fullest picture possible of students’ skills and understandings. Many of the assessment strategies mentioned by teachers are described more fully on the following pages.

Learning tasks or assessment tasks - are they separable?

Most of the teachers participating in the project, saw assessment and learning as intertwined. Because of teachers’ continuous observations of students’ progress, every task that students attempt is an opportunity for ongoing assessment.

It depends on how the student uses it. For some it may be a learning task, where the students are discussing how to do it, but in my class there were a couple of women who were well in front of the others. They sat down and worked out how to do it and were able to demonstrate that they understood. They did not need assistance … They did it by themselves. That became an assessment task. I recognised that I did not need to do any more on that with them [Chris].

Similarly, referring to her students at a lower numeracy level, Sharon noted that most tasks were different things for different students. “You may give the same task. Some do it fine - as an assessment task, but others are still doing it as a learning task.”

In one of our discussions, the Experienced Practitioner Group tried to decide whether or not there was any essential difference between an assessment task and a learning task. There was agreement that some learning tasks could be quite narrow, for example, they may only involve practising a skill, such as multiplication or estimation. However, numeracy assessment tasks usually have some degree of breadth or application of the skill. As Penny put it: “Any assessment task could be a learning task, but not any learning task could be an assessment task.”

To reiterate, any task that requires students to apply skills in a realistic situation, or demonstrate their conceptual understanding, has the potential to be an assessment task. What might be a new learning task for one student, can be an instrument for another to show their competence by applying skills and knowledge. Alternatively, a task given as an assessment task might perform a formative assessment function. It might show up skill gaps for some students, thus alerting the teacher to areas that
require more learning activities for them. When skill gaps are exposed by an assessment task, then it is useful, not only to diagnose, but also to expand the students’ knowledge through some direct teaching and assistance.

**Informal assessment strategies**

Informal assessment strategies were mentioned by all of the teachers informing the project. The more common methods are described below, using the teachers' direct words where possible.

**Observation**

Observation of students in every class was used to build up a picture of skills and understandings over a period of time:

*Every class has assessment. In every class I'm always checking how people are approaching worksheets, if they're working independently, if they're getting stuck, how they're going about solving problems, whether it's by asking me, the person sitting next to them, or sitting there waiting for something to happen [Liz].*

*I observe in a number of ways. ... I am always moving around the classroom. I have some students who are very very keen and I have to have extra work with me to give them - also homework. Which I mark for them. If I don't have it for them they are not happy [Chris].*

Observing students' interactions in groups is also useful:

*They work in groups and I always note who is doing the talking, who is listening, who is able to explain the process and demonstrate an understanding [Chris].*

Suggestions about keeping track of the observations made when students are working in groups and pairs are discussed further on pp. 31-42.

**Listening to students' oral explanations**

Allowing students' oral responses as an indicator of their understanding can be a useful assessment strategy at all levels. "For lower level students oral responses give a better indication of students' understanding than their written work" [Ruth]. Because low levels of literacy and numeracy often go together, many lower-level numeracy students are unable to record their thinking in writing.

Oral responses and explanations were also mentioned as informative for students working at higher numeracy levels. Informally asking students to explain the processes they are using in their written class-work, or their small group tasks, often opens a window into their understanding.
Discussing students' progress

The need to involve students in the assessment process was mentioned by several of the teachers interviewed. As Ros commented, the students are adults, so they have their own perceptions of what they can and cannot do. Ruth made the important point that students will not be happy unless they can see the improvements in their skills. Someone else telling them that they have achieved is often not enough.

With this in mind, it seems a good strategy to ensure students have some input into their own assessment. Discussing students' progress as they proceed through their course was one way of doing this.

*There are times when I use formal bits and pieces but generally not. I have re-written the assessment criteria to be more student friendly. Periodically I sit individually with students and we discuss what they have done that shows that or sometimes I say ‘there are these gaps’ and they might come up with something they have been doing at home. The we look at what we could do to show that they have done it. So it’s not set assessment tasks, it's just discussion about what is happening.*

Portfolios of student work

*I often don’t use formal assessment ... I used to feel guilty about it, but now I don’t. I think my system is fine. There’s an ongoing record I keep of different bits that I collect as students are working that I think is a really good record of what they are up to.*

Portfolios, or collections of work samples for each student, are often kept as evidence of their achievements. The work samples are usually then mapped to learning outcomes. Portfolios take many forms, such as a manila folder, a compartment of a concertina file or a hanging file in a cabinet. (Further details about portfolios are given on p. 36.)

Formal assessment strategies

Formal strategies were usually used in an ongoing manner throughout the course, either with the entire class or with particular students when they were judged to be ready. Formal tasks were usually seen by practitioners as one piece of evidence in their ongoing picture of the students, rather than stand-alone assessment tasks. These more formal strategies are discussed in the following section.

**Note:**

Final assessment tasks, or summative assessments, were seldom used in this sector. Sometimes a final task or assignment was used to finish off a section of work by the whole class. However, these were usually given when the learners were judged ready for them and acted to provide students with feedback and a sense of completion, as well as reinforcing the teacher's judgement. In other words, they were used to confirm the teacher's feeling that students were able to demonstrate competence on particular learning outcomes.
Written assessment tasks

The category of written tasks includes a variety of possibilities. The following list describes some of those mentioned by the teachers in our interviews and discussions.

Problem-solving tasks: usually involving real-life applications of skills to a particular real-life scenario. Some teachers encourage students to discuss problem-solving tasks in small groups initially. This allows them to decide on the parameters and possible strategies in a non-threatening situation before tackling their individual solutions.

Simulated real-life tasks, such as, completing a time sheet and calculating the total number of hours, or writing instructions for another person to go from one location to another.

Revisiting or revision tasks: tasks done some time after a topic has been done by the class. These tasks can reassure both the teacher and the students that the skills and knowledge have been retained. They can also be very affirming for students, assuring them about their growth in the subject. For example, Penny described giving a task to her students "to see if they still knew something from long time ago - It was writing formulae for a bunch of situations. One person said 'this seemed really hard when we did it before, but now it seems easy!'"

Write your own test. Several teachers mentioned asking students to compose a test, or write their own question and supply an example of what a typical solution might look like. One instance was described by Jan.

After we had done a lot of work on measurement I gave students two headings: 1 - What we have done on measurement? 2 - What I would put in a measurement test? Then they had to work out solutions so we could use it in class - some students were really good, competent and thorough - but it's also very illuminating when they can't piece it together very well. [Jan]
Making a Measurement Test

What we have covered:
- length, area, volume, and liquid capacity
  
  \[
  \begin{align*}
  \text{eg. } & m \quad m^2 \quad m^3 \quad 1L = 1000mL = 1000\text{cm}^3 \\
  \text{area of } & \Delta \frac{1}{2} \text{ area rectangle} \\
  \text{area parallelogram } & \\
  \text{circles } & \pi \times d \quad d=\text{diameter} \\
  \text{area circle } & = \pi r^2 \quad r=\text{radius} \\
  \text{volume of prism: area of base } \times \text{ height} \\
  \text{Pythagoras' theorem } & a^2+b^2=c^2
  \end{align*}
  \]

- Conversions: eg. gms → kg

Only works for right angled triangles. You need 2 lengths to find one. Depends on whether you are looking for the side or not.

What I would ask in a measurement test?

In a test I'd give students area of a circle is

\[
A=\pi r^2 \quad \text{but no other formula}
\]

The questions I'd ask would be straight ones first, then ones that you'd have to work out the diagram for (worded ones)

eg. 1. (a) 650 cm = \( m \) (b) 3.2 kg = \( gms \)

(c) 165000 mm = \( m \) = \( km \)

2. Work out each perimeter:

(a) \( \hline \) \( \hline \)

(c) square, each side 40 cm (d) \( \hline \) \( \hline \) \( \hline \) % Worked
Journal entries: Journals are a method used successfully by some teachers to encourage students to put their thoughts and understandings into writing. Prompts for journals entries can simply ask students to explore their understanding of a particular topic. However, they can also invite responses to more specific questions, such as, 'How would you explain the meaning of ... to a child?' or 'Imagine one of your classmates missed this lesson how would you describe ...'

Projects, assignments and investigations

Longer tasks, usually a combination of class-work and homework, are sometimes given to students at higher levels. These can be pre-set by the teacher, the same for all the group, or they may be negotiated by the teacher and individual students around the students' interests. (For more detailed discussion of negotiated tasks see the section on Negotiating Assessment, p. 83.)

Testing procedures

A range of testing procedures that have been trialled by experienced adult numeracy teachers includes take-home tests, student-composed tests, practice entrance tests, and short tests given in class to confirm for students that they have mastered relevant basic skills. However, tests were seldom used or recommended at lower levels of the numeracy spectrum. Issues of mathematics anxiety and past negative mathematical learning experiences make the use of tests at any level a highly contentious issue in the adult numeracy field. These issues are discussed in detail in the following section on page 25, along with possible strategies for using tests wisely as one component of the ongoing assessment process.

Concerns about written assessment tasks

Ruth described her concern about teachers attempting to create assessment tasks using the learning outcomes as their starting point:

I think it's very hard to start with a group of learning outcomes and say 'I'll write an assessment task for it.' I think you just say 'OK this looks like it might be interesting as an assessment task', and see how everything else hangs off it. I think the people who really get worried are the ones who start with the learning outcomes and go to the task [Ruth].

Many other teachers interviewed agreed with this sentiment, saying that tasks that attempted to cover all of the assessment criteria became contrived because of the number of extra questions required to meet all of the demands.

We can all write tasks that work from the Curriculum criteria (eg CGEA). But often those sort of tasks end up more like a test - instead of working backwards to show how the tasks that are of interest to the students demonstrate the criteria [Barb].
The assessment tasks criticised by these teachers usually comprise a number of questions related to a particular text or household item, for example, a water bill or a shopping catalogue. The questions, which tend to address one assessment criteria each, usually deal in short fragments of knowledge interpretation and show little relationship to one another. Even though worksheets of this type use real-life articles or texts, they seldom engage students in real-life or holistic thinking and problem solving.

Liz, who always tries to suit tasks to students’ interests also said she thought that good tasks integrate several aspects of numeracy. “What you aim for is an integrated assessment task. It might, for example, include area, estimation, problem solving, fractions etc”. However, these should arise naturally within the task. Trying to force more criteria into the task will make it artificial.

Many of the tasks suggested in this publication are ‘open-ended’: they allow students at different levels to demonstrate their own capabilities through the task. This means that the task can be given to a whole class of students at the same time, instead of waiting for individuals to reach a particular standard. (Open-ended assessment is discussed in detail later in this publication. The meaning of the term is given on p. 71 along with fuller discussion on the rationale and strategies for using such tasks.)

**Formal assessment strategies: non-written tasks**

Not all numeracy competence can be judged through written assessment tasks. In fact written tasks alone are definitely not appropriate for many aspects of numeracy, such as choosing appropriate measuring equipment and using it effectively. Neither do written tasks always allow teachers to judge students’ understandings, especially at lower levels, or in situations where language and literacy are barriers to written expression. Several ideas for non-written formal assessment tasks were described during the project.

**Practical demonstrations**

There are many measurement and design tasks in which students can demonstrate their competence directly to the teacher. These include measuring with real-life equipment or constructing objects from written and pictorial instructions. Skills such as in-the-head computations might also be better assessed in practical situations. This could be done in real locations such as shops, public transport, banks and post offices where practicable, or through simulations such as role-plays of purchasing involving handling money and counting change. Observations of the students’ performance can be kept on official checklists along with descriptions of the tasks. More details are given in the sections on Record Keeping Strategies (p. 31) and Using Open-ended Tasks (p. 71).

**Oral presentations**

Semi-formal situations may be set up in which students give an oral presentation to the teacher, a small group or the whole class. For instance, students might be asked to do a
calculation in their heads and explain how they went about it to others in the class. They may be asked to gather data, create a graph and describe the process to the class, or to interpret tables and graphs found in the newspaper or on the web.

Jan described one task that she finds effective:

*I think it's really good to be able to come back later after the students have supposedly taken in the concepts and do show and tell. For instance, you've got something written in symbolic language like $1/2 \times 1/2 = 1/4$ and you ask 'Can you show, with diagrams, fraction circles, or with a situation, what this means?'* [Jan].

It is likely that students' understanding of many types of formal mathematical expressions could be assessed using similar techniques.

**One-to-one interviews**

One program coordinator reported on her successful use of mid-point and end-point interviews with individual students. These serve a double purpose. They are useful in allowing students to reflect on their achievements by showing off their work to someone besides their day-to-day teacher. The interview also allows the coordinator to collate a folio of the student's work for record keeping purposes. As Marilyn explained it:

*With the government funded Literacy and Numeracy Training clients, I leave the classroom teacher to do the ongoing assessment. However, when they get to the mid-point of their funded hours I get them to bring along some examples of their reading, writing and numeracy (usually they bring their whole folder) and the student shows me the work they've done.*

*They find it a really positive experience. They get quite excited about it! I am quite surprised by how organised they are before they come, and they are really happy to show me what they have been doing.*

*Then I select some samples that show me the progress they've made and photocopy them for their official records file (with their permission, of course). At the end-point I do the same thing again* [Marilyn].

Marilyn clarified that she always spoke to the teacher before this assessment process, and also looked up the records of the student's initial interview. In this way, before the interview she had an idea of the student's progress and how it correlated to their plans for the future. These mid-point interviews were not mandated by the authorities. However, as program coordinator, Marilyn found them an effective way of touching base with the students for whom she was responsible and for compiling the portfolio specified under the funding agreement.

At the final interview, the portfolio was used to provide the evidence needed to satisfy the indicators of the reporting system. If there was some gap in the portfolio evidence then she might also ask students to answer some questions orally or to do something during the interview.
Issues and difficulties associated with assessment

In our research, practitioners were asked to articulate issues and needs associated with assessment. The wide range of issues mentioned, highlight the complexity of adult numeracy teaching and assessment in today's rapidly changing education environment. As mentioned in the introduction to this publication, many of these issues are ongoing, and some of them, beyond the scope of the project. However, we hope that this resource will assist practitioners to address them in part and will facilitate sharing of the methods that are proving useful to the teachers participating in our project.

Balancing students’ diverse needs

Catering for the many different levels of competence in one classroom and balancing the needs of those who want to concentrate on the learning outcomes for a certificate and those who are there to focus only on their personal needs are amongst the challenges mentioned by teachers interviewed during this project. Suggestions offered for addressing these difficulties include:

• Using open-ended assessment tasks, which allow students in one class to work at many differing levels on the same task, whilst still being able to participate in group discussions of the related themes and issues (see discussion of using Open-ended Assessment Tasks on p 71)
• Negotiating assessment to cater for the interests and levels of each individual student (see Negotiating Assessment on p83).

Keeping track of student progress/record keeping

Keeping track of students (often working at different levels within a group); the logistics of getting around to them all; the need for systems to streamline record keeping, especially in situations of irregular attendance; and practical problems of storage of large amounts of student work were all mentioned as ongoing problems by participating teachers. Although, not all of these problems can be solved without extra resources, many of the strategies for record keeping, used by experienced practitioners, are discussed in the following chapter.

Getting it right/uncertainty

Fear of making inaccurate judgments about students, was one of the problems discussed by teachers interviewed. For example, they were worried that it was possible to make assumptions about the competence of quiet students: because they don’t ask questions, there is the risk of assuming they have understood when they haven’t. Systems of recording observations about students, such as journals or tick-sheets are one way of ensuring that the teacher is not tending to notice some students more than others. These strategies are discussed in the following chapter.

Another means of avoiding such problems is to encourage students to reflect on their progress, and to communicate to the teacher how they feel they are progressing. Further discussion of these methods is provided in the chapters: Focusing on Awareness of Learning (p. 97) and Focusing on Student Confidence (p. 91).
The issue of ‘Tests’ in adult numeracy assessment

Most of us would never think of using tests with adult basic numeracy learners because we are aware of the anxiety with which many students return to the study of numeracy. We realise that many adult learners carry dreadful memories of failure and inadequacy at mathematics from their previous schooling. These weaknesses were never more exposed than during ‘the test’. Now, even the thought of a mathematics test is likely to provoke negative associations and fear for many members of any class. More progressive school educators are also now moving away from testing situations to assessment alternatives such as those described in this publication. There is a growing distrust in the efficacy of testing situations in mathematics education. Some of their limitations are listed below.

Limitations of tests to effectively assess numeracy

• Tests necessarily assess a limited repertoire of skills and understandings. With their reliance on pencil and paper, they do not give students the best opportunity to demonstrate the full extent of their knowledge and capabilities. (This may also be true for classroom tasks involving time-pressure, such as timed ‘races’, games or activities that depend on speed.)

• Tests can be unfair to students who are unconfident when expected to perform under pressure or scrutiny.

• Low literacy levels can also be a barrier to understanding the requirements of test questions. Many students are unfamiliar with written language, particularly the language associated with numeracy and mathematics, which they may understand if it is presented informally or orally.

• Low literacy levels can be a barrier to students communicating their competence. If answers require a written response, students may not have the literacy skills and confidence to record their answers in an acceptable format.

• Often test questions are presented out of context, so that students cannot capitalise on what they know from their experiences beyond the classroom. This is of course an especially important consideration for numeracy classes, where mathematical skills are not an end in themselves, but tools to use in real situations.

• There is a concern that once tests become the means of assessment, then practitioners tend to ‘teach to the test’ even though they are aware of the limitations expressed above.

What is a test?

It was interesting that we could have a lengthy discussion about tests without ever clarifying what we meant by the term, when all other types of assessment required so much discussion of meaning. Perhaps this was because the invariant vision of ‘the mathematics test’ is so vivid to all of us and probably our adult students also. (For
students have not performed well under these conditions, the picture will also conjure up an array of associated negative feelings.) Then what is it? How might it differ from a formal assessment task, or an assignment?

The Mathematics Tests that we all remember were usually atomistic: consisting of a series of disconnected or unrelated questions. They were usually timed and supervised to prevent cheating (collaboration). Performance came from memory or rote learning (no references allowed). They were marked quantitatively, the results always associated with numbers ‘what did you get?’; ‘how many right or wrong?’. The total mark was the important thing for the students, rather than an interest in why responses were judged correct or what types of misconceptions were exposed. They were impersonal: one test for all, rather than being customised to the individual. They were used for normative purposes, to decide who was better, or best, and who should be failed.

**Note:**
For students who have been unsuccessful in tests, any tasks that resemble them are likely to trigger the same sort of negative associations. For example, negative reactions may be invoked by worksheets with long lists of questions, as opposed to whole-task problem situations. Even lists of questions put in as stepping stones to the final solution may create the appearance of a test, and be approached in much the same way, with students failing to make connections between the questions.

**When might it be appropriate to use tests?**

With our personal reservations about testing in mathematics or numeracy, it was almost by accident that they were mentioned at all during the project, and we were rather hesitant continuing the conversation. However, as our discussion progressed, it became apparent that the issue of whether to use tests was not so cut and dried. We agreed that the decision to use tests, or not use them, depends on the goals and levels of students. However, they were definitely not seen as appropriate for students at lower numeracy levels.

As Penny said, “You don’t want to do it with CGEA students who are there for broad, general reasons, including getting more confidence.” Sharon agreed strongly that she would not use tests at the lower levels of the curriculum, and also pointed out that in assessing the numeracy competence of learners from language backgrounds other than English:

... *to give them a written test, it is to get complete and utter misinformation, because they might be highly numerate in their first language ... There are so many factors that it is such a gamble to put a written test in front of them* [Penny].

Whilst in agreement that tests were inappropriate for many students, we also acknowledged that they can have potential value for some students, especially at the higher levels. Our conversation helped us clarify, not only the limitations, but also the potential value of formal testing in some circumstances, given the realities faced by students undertaking higher levels of mathematics and numeracy. We did agree,
however, that tests were only appropriate only as one approach amongst a range of other assessment tools. "You can't use it to say 'this is the student'."

Some of the positive purposes for using tests with higher-level numeracy students are discussed below.

**Some positive reasons for using tests**

**Tests can be a measurable goal or affirmation for students**

Jan discussed short skills tests on metric conversion and statistical calculations that she had given her students. She pointed out that they were powerful as reinforcement and affirmation for the students. They let them know when they were 'on top' of things and when they needed to do further work. From Jan's point of view, they acted to verify her prior judgement of students' skill levels “they confirm what I hear in the classroom (students explaining to each other). They feel like an adjunct to the assessment process”.

Beth recalled a mature-aged, pre-service teacher who was extremely anxious about mathematics when she began the primary teaching course. She thought that passing the mathematics test was the best thing that she'd ever done.

*She felt so proud of herself, because there was a measurable hurdle there. It was very different to putting a series of things in a folio and having me say, ‘Yes very interesting.’ There was something by which she could measure herself as having achieved something that she’d never been able to do before. I can’t say this is bad, because she worked hard towards knowing that range of mathematics. Whether it is transferable, repeatable six months down the track, I can’t say, but I believe it has changed her image of herself with respect to mathematics ... It’s been a great thing for her to say, ‘Yes, I can do it!’* [Beth]

**Tests give valuable feedback to students**

Penny discussed situations in which tests were valuable to clarify areas of weakness, as well as strength, for students in transition to more formal tertiary courses. “It enables them to see, and be convinced, that they are not really on top as well - sometimes to show up the area they need to look at.”

**Recognition of Current Competence (Prior Learning)**

Tests can be a useful tool for recognising students' current competence through prior learning. They can be given to a student to verify what they already know. This can be useful in the situation where a student simply wants a piece of paper that reports their attainment of a certain level of numeracy for official purposes. (For further discussion of this type of testing see the section on Initial Assessment p57.)

**Practice for students’ future goals**

Some students are likely to face situations involving mandatory testing when they leave your numeracy classes. These might be part of the assessment culture of courses they are preparing to enter. They might also be the necessary hurdle for acceptance into a
career such as the armed services of police force. Whatever we may think of these practices, whilst they exist and are real goals for some of our students, then we owe it to those students to assist them to meet the challenges ahead. This of course does not mean that all students in the class should undergo tests 'just in case' they will need them in the future, it means practising the simulated situation for those who have explicit needs.

Often students can be referred to short courses designed specifically for the purpose of assisting them with entrance tests. However, when these do not exist it is a good idea to acquire samples of past tests so that students can gain confidence with the specific format, and you can ensure that they are confident with the likely content. Unfortunately, content for such tests can often include skills that teachers, and the curriculum, do not considered essential 'numeracy' skills and knowledge, forcing teachers into compromise situations between the curriculum and students' immediate needs.

When students are preparing to enter a further study program which includes testing as the main assessment method, then it might be helpful if the numeracy teacher assists them to overcome 'test anxiety'. This might be done by beginning with short tests designed around skills they are confident about, and gradually working towards longer and more challenging situations.

For both of the above purposes, the tests given do not necessarily need to be considered vital to the students' assessment for the numeracy component of the curriculum. Inability to succeed in test situations does not mean the student is not competent in numeracy.

**Testing - still a problematic issue**

The members of the project team remain ambivalent about testing. Whether the disadvantages are ever outweighed by the advantages is still a question that each individual adult numeracy teacher needs to consider carefully in the context of their own course and their own students.

Our resource is trying to broaden people's idea of assessment. It aims to encourage a wide range of assessment strategies used in conjunction with one another. With this in mind, the team agreed that clarity of purpose about tests, for example, as a medium for student feedback at some point in the course, rather than to differentiate between students achievements, was important. Such clarity might affect the way that tests are designed and make them a useful teaching and learning strategy.
Tips for testing

If using tests for any reason with your students it is probably best to:

• Avoid a timed situations, don’t make it a speed thing
• Create multiple versions of the tests and ensure students are aware that there will be many opportunities to repeat until they have mastered the skills
• Discuss students responses with them so that it is also a learning experience
• Plan together strategies for improving their skills.

Footnotes

1 *Formal assessment*: interrupting the teaching and learning process to administer a test, assignment or special assessment task.

2 *Formative assessment*: that which assists in the learning process by informing the teacher and student about the student’s knowledge and skills. In other words, the kinds of judgements which assist in planning the next steps in their teaching program.

3 *Informal assessment*: collecting information about students’ progress without interrupting the learning process.

4 *Summative assessment*: the more traditional type of assessment which enables final judgements to be made about the students’ attainment of competencies.
Keeping Track of Student Progress: Strategies for Record Keeping

A lot of my assessment is done by observation. We have tick sheets that are only for teacher use - with what the activity was and tick off their names when they have got it [Chris].

All teachers who contributed to this project recognised the importance of keeping ongoing records of students' written work, as well as recording their own observations of students' competence. They reported that their strategies continued to evolve, not only to satisfy their own needs, but also to meet the requirements of their institutions and external funding agencies.

A range of files, folders, checklists and record-keeping forms were described by those interviewed. Many of these involved prepared lists of the curriculum outcomes and assessment criteria with notes about individual students' progress recorded in some way. Others were records of the particular tasks, with a means of recording students' completion of the task. Some teachers used anecdotal notes in journals during and each of their sessions.

The remainder of this chapter describes each of these methods in further detail with illustrative examples provided by the project teachers. It is organized into three sections:

• Anecdotal note-taking
• Portfolios and folders
• Checklists.

Anecdotal note-taking

Some practitioners keep an ongoing record of each lesson: who was there, how they went, and notes on the progress of each student. Making notes and comments on student progress after each session was described by these teachers as a valuable way of planning ahead for the next session, as well as maintaining records about student progress. For some, this ongoing process involves much reflection between teaching sessions. As one teacher expressed it:

A lot of it's in my head. If I am made to put it down it pulls me away from the classroom and from the flow of things. I do make notes in my diary as to who's going to do what next week. ... A lot of my planning is done whilst I am driving home, or at the pool when I am swimming [Di].

Sharon observed that “recording what students say in a lesson tells so much more than what recording assessment task completion does. The following example is one of my favourites!! It speaks yards about the student's conceptual development.”
A simple addition problem about spending money was 'Karin bought a new pen for $5.65 and lunch for $12.45, how much did she spend altogether?'

When I asked a student in the class the explanation was as follows — well $5 and $12 makes $17, then the 50 c and the 45 c makes another $1 and the 5 c and the 10 c makes 15 c, then you just put it all together — you've got $17 and 50 c and 10 c so he spent $18.10.

This informs the teacher to a greater extent than would a written sum and a calculator!!!

As a teacher committed to this approach, Sharon has given it a great deal of thought. The following describes some of her rationale for this approach.

In a low level numeracy class I always use discussion and oral communication as a means of assessing students understanding of numeracy.

In comparing a written assessment task with the spoken dialogue that goes on when a student is trying to explain how they did something (either to me or to another student) I will always favour the spoken exchange for the following reasons:

- It is a more effective way to diagnose students' understanding and conceptual development. By noting students comments in my journal I had a great record of their thoughts and understanding.
- Clarification and further questioning can occur during a spoken exchange, drawing out more information, whereas sometimes during written assessment tasks a more 'closed' approach is taken. The journal gave me a much better picture of my student than a pile of completed assessment tasks and a list of ticked boxes of learning outcomes.
- Students' memory is often much better than their writing at the lower levels, so speaking to explain how they got an answer is more useful than writing their explanations.
- Allowing the students to express and verbalise their understanding is a great way for students to develop confidence in their ability. I will always ask a student (who I know is capable of answering) to explain it to the class - it's amazing how good the student feels doing this - you can see their confidence build, particularly with other students commenting positively, for example 'that's a good way to do it', 'that's an easier way than I do it in', 'Sarah's good at adding money'.

Note: whilst explaining to the class can boost a student's confidence, it is very easy to lose that fragile confidence by pushing a student too hard too early. Be sure only to ask students to explain what they feel capable of.
Systematic observations and recording of student progress

Teachers within the 'Experienced Practitioner Group' decided to experiment with different systematic approaches to recording their observations of the students during class activities. They used separate note-books for the purpose and trialled various formats for structuring them. Some allocated several pages for each student, beginning with observations from the placement interview, and following the student through the classes. The following example from Jan's journal is an example of this approach.

Brenda:

5/2/01 Interview
At interview struck me as very competent, working in responsible job and raising two children. However, very under-confident about maths - held her back from starting Division 1 Nursing course because her 'maths was so poor'.

'Started in grade 6. I had asked the teacher to help me learn long division but she never got round to it. I felt then I was behind in maths starting high school.'

Observation from numeracy questions:
- Items she did not perceive as maths were OK
- Could visualize number of cubes to build something
- Answers to time-distance graph fine

Number skills down - perhaps affected by nerves
- Estimation of cost of 3 items wrong
- No tactics for division by 4 - on paper or in head without prompting
- Could hand back 1/3 of 12 counters
- No attempt to estimate the number of litres for $15 (at 53c litre)
- 20% of 300 OK (10% doubled)

Most obvious indicator of confidence was reluctance to put anything down on paper.

15/2 Looking at number systems - decimals in particular
In conversation I never thought that the columns were related by 10s, even though I suppose that I knew that. It seemed like magic when you add zeros or move the decimal point. Now I'm trusting myself to use logic - trusting where the numbers are moving.'

1/3 Test - Metric conversions
All areas showed competency (except for difficulty with $m$)
Afterwards showed interest in this area

on suggestion happy to re-explore cubic cm in litre to reinforce.
Worksheet on Volume of Prisms

- unusual shapes but possible to use area base x height

Overheard her explanation to another student: "Nowhere can we slice it to get the same cross-section so no good finding that area - need to find the other - no, not the bottom - sliced across." (indicates perfect understanding of the concept behind the procedure)

And later, she continued:

Brenda has been much more prepared to commit her thoughts to paper in last couple of weeks, of her own accord. Such as contrast to the interview and first few weeks - attempting all problem solving in her head - with odd non traceable noting of numbers on paper. Now using diagrams to aid solutions and recording of the steps in her procedure, as well as using units (generally)

Relating back to the model of holistic competence, Jan commented that she saw Brenda's progress at recording her problem solving steps as part of "her development of self as 'a numerate person." As Jan said "for her it is risk-taking, as it records the succession of her thoughts."

Other teachers in the group used their journals to keep a running collection of notes sorted by session and date where they recorded observations about several students, during, and at the end of, each session. This method is illustrated by the following excerpt from Sharon's journal.

Level 1/2 Class.

6/13/01.

Mario  if doing multiple items eq: 3 cans $1.25 ea
didn't know to do $3 x $1.25 using a calculator

Athena  doesn't know division eq: 24 ÷ 2. Showed how to use times tables charts to find the answer.

*Most of the class not aware that ÷ 2 used to find half of something.
Keeping Track of Student Progress: Strategies for Record Keeping

Stephen problem with 'reasonableness' of answers. Too quick to calculate without stopping to think.

7/3/01

Tania did all 10 Quick Quiz Q’s by herself, no help.
- add subtract money
  - 1/2 of $24 = $12
  - 50% off $40 = $20
  - 1/2 km = 500 m
  - 1/2 + 1/2 = 1

Athena left out all the 1/2 Qs on the Quiz, 1/2 + 1/2
- 1/2 of $24
- 50% off
- doesn’t know how to do 50%, or half price

Stephen still not thinking about answers properly - does that look reasonable?

Jason didn’t know to use times tables sheet to do division Qs
e.g. 21 ÷ 7 use 7x, find 21 answer = 3
once shown quick to pick up a concept.

Athena can do addition using carrying on paper, uses calc. only to check answers
- 6.89
- +2.68
- $9.57

Sharon noted that throughout her journal process:

I am looking for signs of confidence (numerate thinker)
- active participant
- risk taker
- talkative
- start and continue with work without waiting for instruction
- self-directed, initiates
- helping others.

Journal keeping - much better awareness of students progress, conceptual development in my class where I am keeping my journal than in my other classes (no journal)
- easier to track student progress.

Some teachers attempted to make a note about every student in each lesson, whilst others concentrated only on episodes that indicated particular knowledge, understandings or other evidence of students’ level of competence, such as Jan’s entries above.
There were advantages to both systems. Sometimes the notes on each student every session become repetitious, especially if there is not a great deal of observable progress made. On the other hand, this system makes it harder to overlook quiet students, since some note of them should be made each session. We recommend that teachers experiment for themselves. It might also be useful to begin one way and switch later in the semester when you have a better feel for each of the students.

One teacher who tried keeping several pages per student in her record book found it difficult because of the ever-changing student population in her class. Eventually she recorded her observations about individual student progress at the end of her session plan for the day. Since the session plans were all kept in a specific folder for that class, she was able to look back for her notes regarding each student.

**Folders and portfolios**

Individual folders of students’ work are commonly used as a record keeping system.

> *Everything that they do gets put into their folders. I just keep it all. I've always got that to refer back to [Liz].*

Jo described a thick file with different coloured dividers for each of the students, where she stored samples of their work - also a record keeping page of competencies which she marks with a coloured highlighter when discussing students' progress, and planning their next steps. She finds this especially useful for a class of students who are all at different levels, many of whom attend sporadically "so if someone comes who I haven't seen in ages, I open up and see what they were doing before ... what I have marked and what is left"

Ros reported on a system that she has trialled in the past where students maintained files of their work in a folder as well as their own record sheets that they were to leave for her at the end of each session. However, after finding that the folders disappeared too often she now maintains them herself, and occasionally gives them to the students so that they can also be involved in checking 'where they are up to'.

Lorraine described her department's "fairly formal" system, which they developed in order to satisfy the requirements of the government Literacy and Numeracy Training contract.

> *There is no formal testing. It's a portfolio. We are continually collecting work from people and putting it in their file. ... We have a lot of movement in our student group. They may go off and get work, come back, drop out, and then they are sent back ... we need to keep a record of what they were up to [Lorraine].*

She also pointed out that, since their funding was dependent on student achievement at mid-point or exit-point in their program, it was necessary for the sake of the program to maintain ongoing records demonstrating movement in students' competence during their time in the class.
In cases where teachers know students might move from state to state, they leave students original work with them, but keep photocopies for the students' files.

_We photocopy work that the students do so that, if they leave and get a job and you don’t do assessment, we can verify that they did move a level. The problem that we are finding is that it is using a huge amount of storage space._

One teacher described the systems established within her program. "The students have a folio that they keep their best work in. And when they leave they take the folio with them. But we are also constrained be a quality assurance system". The QA system of her institution requires tasks on record that act as evidence of students' achievements and attendance in the course. She explained that although most of the assessment energy was concentrated on the holistic tasks in the students' folios, the teachers had also established another system of short task booklets for the QA files. Students would complete these tasks at regular intervals, and the compact booklets were kept on file after students had departed with their own portfolios.

**Checklists**

Checklists are another commonly used devise for tracking student progress. Sometimes they are used in conjunctions with portfolios, sometimes as stand alone records. A variety of formats are currently in use.

Di described a system of maintaining records of students' achievement against the learning outcomes. She uses a sheet with the students' names at the side and the assessment criteria at the top, which she uses to record her assessment of their competence.

![Class Observation and Recording Sheet](image)

*Figure 1: Sample of class observation and recording sheet (see p. 261)*
Di stipulated her need to be assured that the student has a firm grasp of the skill and has transferred it to a number of situations before she will tick off the criteria. She is constantly deciding whether students are able to transfer the skills or whether more work is needed on particular skills.

*I broadly concentrate on one or two learning outcomes at a time. It might be measurement, but decimal number will be connected as well. I'm developing the skills for the various assessment criteria as we go through the activities [Di].*

Other teachers use similar checklists of the curriculum learning outcomes but have one for each student. Barb and Wendy said teachers in their centre put these sheets in the students' folios along with their work samples. The sheets they use leave a large space beside the criteria for comments as well as ticking. "The teachers find the comments about what students found easy and difficult very valuable."

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**Figure 2: Samples of class checklist and recording sheets**.
Lynne described another set of checklist sheets supplied in a Western Australian induction package which were based on a system that was working for her department:

*a double sided sheet with the learning outcomes set out and we just initial and tick off sections as they do them and if there’s a specific task we just write the task on. They are all stored in an alphabetical file that we access as and when we need to [Lynne].*

Liz combines a student portfolio with a checklist of outcomes for each student:

*there’s one of the Learning Outcomes per page and some space for me to write some notes. I just go through it every now and then. ... I think ‘Gosh I haven’t done that for ages!’ or that someone’s feeling like they’re getting close perhaps and I’m thinking ‘OK what else do we need to do in class?’ and then I go through and have a look at where the holes are [Liz].*

![Image of a recording sheet](image-url)

*Figure 3: Example of recording sheet.*
Cath also uses a student portfolio with a checklist of outcomes for each student where there's all of the Learning Outcomes per page and some space to write a description of the task for each, along with an indication of how the assessment was made - via observation, through written documentation, by oral questioning and responses, or through group work or project work. The sheet also allows an indication of how many times the student has attempted each Learning Outcome.

<table>
<thead>
<tr>
<th>Learning outcome</th>
<th>Task Attempted</th>
<th>Assessment</th>
<th>No. of attempts</th>
<th>J/M</th>
<th>NYC*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform mathematical operations required in personal everyday situations involving 3 operations (+, -, x) and whole numbers, with special emphasis on handling money.</td>
<td></td>
<td>Observ</td>
<td>Written</td>
<td>Oral</td>
<td>Group</td>
</tr>
<tr>
<td>Measure height, weight (mass), capacity, length, time using personal and everyday referents (informal units).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use language of shape and position to give and follow directions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Find everyday information from graphic representations of data.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4: Example of recording sheet*.  

*Note: J = 'Just got there' = competent; M = 'missed out' = not competent; NYC = 'not finished assessment task' = not yet competent
Issues and difficulties with record keeping

Keeping records can get in the way of teaching

Even though all adult numeracy teachers agreed that record-keeping was an important part of any ongoing assessment, they acknowledged the dilemma of dividing their attention between teaching and record keeping.

Let’s get real about record keeping ... racing back to your desk to make a note of it ... there might be someone who gets missed out on something along the way but if you cover the same things over they will get picked up.

We are all that sort of people. If you are teaching adults and you are teaching these courses. Where do we put our energies? - into the students! And all this paper work is something you’ve got to do, but it’s not the be all and end all, and its not the most important aspect [Lynne].

Insecurities about record keeping

Expressions such as the following, throughout focus groups and interviews, indicated the ongoing insecurities that teachers feel about the record keeping process.

I still don’t think I’ve got it in a form that’s really easy to sift through and feel confident that the person could do these things ... but teasing it all out - exactly what they do know and what they don’t know ... Sometimes it seems like there’s too much detail and sometimes it seems like there’s not enough [Teacher].

If I was a good record -keeper the system would work beautifully, but I’m not a good record-keeper [Teacher].

Reconciling informal assessment with outside processes

One teacher described her method of assessment that relied on student - teacher discussion and looking for evidence of students' competence within their ongoing classwork. However, she also indicated the difficulties of reconciling this method with the moderation process.

My system falls down when it comes to moderation. They want an assessment task. I tried doing anecdotal stuff for it, but it was too much work for me. So that’s still a problem. The negotiation and discussion works well for the students, it means that we can talk about what they want to do next rather than just moving through a course. But it doesn’t work too well for moderation - nor for QA - all the record keeping side, and accountability side. I would need a lot of streamlining checklists and things for that to work.
This practitioner's experience flags the necessity for developing, and continuing to use, some kind of systematic recording devices. Further ideas for recording student progress during practical assessment tasks which do not involve written responses are discussed in the 'Bringing Reality to Assessment' chapter (see p. 43). Example recording sheets are also provided for appropriate tasks throughout Section 2. (See information in the grids on page xiii and 115.)

Demands on physical space

As indicated in the comments above, the need to retain student portfolios for verification and 'Quality Assurance' after the course demands a large amount of storage space. This problem was mentioned by many of the teachers interviewed.

Employment conditions of adult literacy and numeracy staff

Several coordinators mentioned that their record-keeping problems were exacerbated by the lack of staff continuity in their programs. Reliance on part-time and sessional teachers means that they constantly have to initiate new staff into the working of their system and its underlying philosophy. This unrecognised staff development function adds considerably to their workloads.

A final note

Even though there are many issues and difficulties related to assessment and record keeping, there is a general feeling amongst practitioners that it is worth persevering with this system if it means that assessment decisions remain with the numeracy teachers. The alternatives, such as externalized testing, or mandatory tasks, are definitely seen as a retrograde steps that would severely disadvantage students and compromise the notion of a 'numeracy' which is meaningful for the individual.

Footnotes

1 These samples of class checklists and recording sheets are taken from the CGEA Record Keeping Kit, Eastern Metropolitan Regional Council of Adult, Community and Further Education, Melbourne, 1999 (a new version of this kit for the 2002 CGEA is now available from ARIS - for contact details see page ii).
2 This is an example of a recording sheet used by Liz, and is from a local provider delivering the CGEA in Melbourne.
3 This example of a recording sheet is used by Cath at the Tropical North Queensland Institute of TAFE.
Bringing Reality to Assessment

If an opportunity arises like an excursion then we work together with whichever teacher is doing the excursion and get the maths class to cost it out, look at distances, work out a route. So it is often an integrated task, rather than keeping it separate. Trying to make it as real as possible [Wendy].

What do we mean by ‘bringing reality to assessment’?

Anne McRae’s article in Numeracy in Focus described her placement, assessment methods based around real-life objects or artefacts – a collection of household bills and receipts; calendars, banking slips, local and daily newspapers; catalogues and brochures from supermarket and specialist stores; timetables and street directories. She said that her collection ‘resembled the contents of her hall table’. (See further suggestions on page 43.)

Anne’s method was based on the idea that students bring with them experience and knowledge that are vital to their learning. She valued their experience and state of mind by providing for active participation in the assessment process. This kind of approach does not deal with mathematics first and then seek applications for using it. “Rather, the students knowledge and experience and thus the context in which it was acquired, is a valuable part of the assessment” (McRae, 1994, p. 16).1

Anne stressed that her artefacts were real materials. They were not photocopies, they were not changed in any way and they did not have the assessment questions written on them.

Why use real objects in assessment?

We believe that domestic artefacts act as ‘footholds’ from familiar situations in learners’ lives. The students’ prior knowledge is connected with current numeracy tasks, linking ‘spontaneous’, or everyday, knowledge to ‘formal’ knowledge2. For example, household items such as food containers seem to be instrumental in linking spontaneous knowledge of the products and their packaging with formal (mathematical) knowledge, such as the metric measurement system.

The practice of using real-life objects in the classroom and in assessment situations is now widespread amongst experienced teachers, and advocated in many Australian numeracy curriculum documents. Verifiers3 have recently commented that more people are following the guidelines and using realistic assessment tasks that are related to learners’ life experience.
However, they also noted that many numeracy assessment tasks were still presented a series of unrelated questions with no ‘real life’ support materials, such as:

1. If you bought 2 cans of coke at $1.30 per can and a hamburger at $4.75 how much change would you get from $10?
2. If you wanted to travel to x location to arrive by 1.15 pm what time would you need to catch the bus leaving at y location? ...

Although these are set in everyday, familiar contexts they are several steps removed from the lived experience of the learner.

We know that this tendency is a common temptation in numeracy teaching and assessment situations. Beth’s classroom research has confirmed observations of linguist Robert Veel that well intentioned attempts to connect mathematics to reality through word problems and worksheets - ‘real life’, expressed through language - do not seem to be as effective as real artefacts which create meaningful hooks to reality without the encumbrance of language. Veel asserts that once word problems are re-contextualised in the school setting there has been a shift from real life experience using everyday forms of knowledge, to an experience which is mediated by language and symbols.

**Barriers to real life representations through written words**

It seems that attempts to make real-life connections for mathematics through the medium of words can create two types of barrier. One, the contextual barrier, concerns the unfamiliarity with contextual situations in which the mathematics is embedded. For example, building and decorating scenarios will only help learners display their competence if they are contexts that are reasonably familiar to them. In some cases the explanations necessary to make contextual understanding clear do not enrich the students’ knowledge of numeracy, only their understanding of an unfamiliar or irrelevant situation, which may be of no benefit.

The other obstacle is a ‘language’ barrier created by the text attempting to represent a realistic situation ‘tied up with language’. Even when the context of the mathematical problem is familiar, the language used to describe it presents an added layer of complexity. A student quite familiar with the items described, such as powdered milk, may still find the task ‘text heavy’, in that the amount of reading required makes the task inaccessible.

The two barriers of language and context often seem inextricably linked, since understanding the question is heavily dependent on the contextual clues or ability to picture the situation, which in turn indicates which words within the question are important.

We suggest that when teachers wish to teach and assess numeracy skills in everyday contexts it is more effective to use real products, such as, bottles, packets, recipes, paint tins, tickets and bills, whenever possible, rather than trying to describe them in text or pictorial representations. Tasks would then not only lose most of the confusing language that was necessary to describe the situation, but also become more real.
Other advantages of real-life materials

Enhancing classroom dynamics

Beth's observations have shown that real-life materials can also assist to enhance social dynamics in numeracy classrooms. They can act as a trigger for communication between learners, or between learners and the teacher, which 'position' learners and teachers in equal adult roles outside of the classroom situation. They can share experiences as parents, as shoppers, as people who pay similar household bills, drive cars or catch public transport. These interchanges have also been noted by Mike Baynham, who referred to them as 'identity work', and by Roseanne Benn who talks about establishing 'cultural touchstones', especially between the teacher and learners. Beach has commented that these interchanges provide the opportunity for class members to find out more about each other as people, and that this 'self disclosure about their lives and experiences' creates social bonds which make students more willing to listen to each others' subject related ideas.

Beth has observed that real-life items are also powerful for triggering memories from one session to the other. They make a more lasting impact in learners' minds, strengthening their hold on the mathematical ideas much more than words and diagrams on worksheets ever do.

Spontaneity and new directions

Real-world problems or objects that students and teachers bring along to the class can unexpectedly trigger interest and enthusiasm that a flexible teacher can harness for both teaching and assessment purposes. For example, in their interview Wendy and Barb described a series of activities that arose almost spontaneously and captured the interest of a particular group of students.

I suppose we try to work from the task that is interesting and then fit the maths in with what you can do with it. Rather than work from the document out. For example we renovated a doll's house for a childcare centre that one of the teachers works at. Because when this teacher walked in saying 'Look what I've got' it was an opportunity too good to miss. We just knew that this would be really good. And we've go the mixture of really young people - 15 or so as well as the people of 40ish, men and women - this really unified them for about 5 weeks [Barb].

Discovering unexpected strengths and weaknesses

Barb indicated that during this series of activities the teachers were able to observe which students could operate with the ideas and measurement concepts and who needed further developmental work on the knowledge and processes. For example many students had difficulty in drawing a diagram of the house, which allowed Barb to see how unaccustomed they were to reading or interpreting spatial information.
One thing that was really interesting was sketching the house. The front had two levels, three rooms at the top and two at the bottom, and some of them could not draw that front view. They couldn't see what was there. ... Even when I said to have another look they would go back to their diagram and say it was fine. They'd say that was exactly what the house looked like. Other students would say haven't you got too many rooms, or not enough rooms. But they hadn't seen it.

They also drew these incredibly tall houses, which were nothing like the actual squat shape of the house we had, they drew it like a tower [Barb].

Sample reality-based assessment tasks

1. Making biscuits

Chris' students were given a choice of recipes for home-made biscuits (Chocolate Chip and Anzacs) and the dockets from the supermarket where she had bought the ingredients. Packets of commercially-produced biscuits were also bought so that students could compare the home-made variety with the bought ones.

Students were asked:

How much does it cost to make a biscuit? How does it compare to the cost of a bought biscuit? How does the taste compare?

Anzac Biscuits

INGREDIENTS
1 cup rolled oats
1 cup coconut
1 cup plain flour
1/2 cup sugar
125g (4oz) butter
1 tablespoon golden syrup
1 teaspoon bicarbonate of soda
2 tablespoons water

Preheat oven to 150°C
Mix oats, flour, sugar and coconut together.
Melt syrup and butter together.
Mix soda with boiling water and add to melted butter and syrup.
Add to dry ingredients.
Place 1 tablespoonfuls of mixture on greased tray (allow room for spreading).
Bake for 20 minutes.
Loosen while warm, cool on trays.
(makes about 35)
Students then actually made the biscuits. This involved measuring out the ingredients accurately, cooking the biscuits using the specified time and temperature, and judging the size of the finished product.

They then used the docket and the real packets of ingredients to gain information about the cost of each ingredient and determine the cost of home-made biscuits compared with the bought varieties. They also did taste tests for comparison.

This assessment task used very little language apart from the everyday language of cooking and recipes. There were just the few words of the question, with all other information required for the task embedded in the familiar artifacts: the recipe, the docket, the ingredient labels, the biscuit packaging and in the students' own conversation as they went about the cooking.

Students' abilities to perform practical measurement, numerical estimations and calculations could all be demonstrated as they went about this realistic and engaging task.

This task has been divided into two parts for the purposes of this publication: 'Making Biscuits' (p. 133) and 'The price of biscuits' (p. 197). A detailed outline of each is provided on the pages indicated. Sample student responses to 'The price of biscuits' are also included in Section 2, with sample mappings to curriculum documents in Book 2.

2. How many glasses of Coke in a bottle?

Sue brought to a class of young male students a 1.25 Litre Coke bottle and a polystyrene party cup (one bottle and cup for each group of 3-4 students). First she asked the students to estimate, and write down, how many cups they thought could be filled from the bottle.

Then in small groups the students tested their predictions. Measuring jugs and water were available. Some students simply filled the bottle with water then poured cupfuls until the bottle was empty, counting how many cups they filled. Others filled one cup and measured its volume with the measuring jug. They then used a process of multiplying this volume by several numbers until they reached the closest to 1250 mls. (Division was not generally used by this group of students.)

In this task Sue was able to observe the confidence in measuring and calculating displayed by students at a variety of levels in her class.

This task did not require written language and was closely related to students' everyday experiences.
Issues and difficulties with bringing reality to assessment

Recording observations of student engagement in practical numeracy tasks

When some of the practical ‘reality-based’ tasks were trialled in teacher workshops, some participants indicated concerns related to recording students' work. One participant thought practical tasks, such as ‘How many drinks?’, were a good idea, but felt unable to use them as assessment tasks because the verification system required written records of student work. Since it is unrealistic, and in fact, counterproductive, to expect low-level numeracy students to write reports for practical tasks that involve hands-on measurement or shopping role plays of shopping, this presented a dilemma.

One solution, is to present a written description of the task along with brief notes about individual student's performance, as experienced numeracy teachers like Barb and Wendy, working with small classes, have learned to do:

*I guess it just becomes (part of) the teacher’s thinking. ... just keeping anecdotal record during their classes. Oh they recognise that, I’ll just take a note of that and later transferring it over to their folio.*

*All of the things that we did (in the doll’s house activity) fit within the National Reporting System ‘windows’ and also within the Certificates of General Education for Adults. It was just measurement, but we did lots of estimation ... they wanted to know how many pieces of curtain out of one big bit of material, how much paint it was going to take etc. So although it was all on mini scale we covered all of that area and it fitted really well within the NRS document [Barb].*

However, some practitioners with large class groups, felt that writing individual observations for each student would be far too onerous. With this in mind, we have created possible models of observation sheets for practical tasks. These are described below.

Pre-written reporting sheets

Pre-written reporting sheets have been designed by members of the project team to assist teachers in recording their observations whilst students work on practical assessment tasks, alone or in pairs or small groups. One model (see figure 1) is designed to observe and report on individual students, the other (figure 2) uses a class list, and can be used to record observations for the entire class. A blank form is included on page 261.

These observation sheets describe common predictable methods that students might use, so that the teacher can merely tick or annotate these sheets for each student, making specific notes only when the student adopts an unusual approach. The open-ended elements of the task are acknowledged by providing space to record any less-expected approaches.
# How many drinks?

Sample Recording Sheet for Individual students

<table>
<thead>
<tr>
<th>Student Name: __________________________</th>
<th>Date: __________________________</th>
</tr>
</thead>
</table>

**Task or questions undertaken:**

---

**Observed Stages of the Task Process Cycle:**

- **Select relevant information**
  - [ ] Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
  - [ ] Identified capacity of container & interpreted metric units

- **Choose strategy**
  - [ ] Selected strategy that demonstrates understanding of the task/process required – e.g. chooses appropriate measuring equipment

- **Apply strategy**
  - [ ] Filled one cup repeatedly to practical level, counted whole numbers
  - [ ] Expressed remainder as a fraction
  - [ ] Filled one cup to practical level, accurately measured in some graduated vessel & correctly interpreted metric units;
  - [ ] Interpreted metric quantity on label & correctly converted units for comparison
  - [ ] Correctly performed a calculation using addition,
  - [ ] Correctly performed a calculation using multiplication, or
  - [ ] Correctly performed a calculation using division

- **Reflect on outcomes**
  - [ ] Expressed results sensibly and meaningfully
  - [ ] Judged reasonableness of results by referring to prior experience
  - [ ] Checked results using rough estimations

**Possible annotations**

It is possible that ticks be supplemented with annotations. Some suggestions:

- [p] – indicates prompting from teacher
- [a] – indicates a significant amount of assistance from other student or teacher
- [t] – indicates the student took a leading role in strategy and decision making.

---

*Figure 1: Sample of an Individual Observation Sheet for the 'How many drinks?' task.*

This sheet allows for a range of predictable methods and the skills and knowledge incorporated within them to be recorded using only a tick. The blank entries allow space for any individual approaches, skills and knowledge or insights demonstrated by the student.
**How many drinks? - Sample Class Observation & Recording Sheet**

<table>
<thead>
<tr>
<th>Group:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Responses against the Task Process Cycle**

- **Selects relevant info**
  - a) Demonstrated understanding
  - b) Identified capacity & units
- **Chooses strategy**
  - c) Selected strategy
  - d) Filled one cup accurately
- **Applies strategy**
  - e) Measured one cup accurately
  - f) Interpreted results and units
  - g) Calculated - addition
  - h) Calculated - multiplication
  - i) Evaluated results accurately
- **Reflects on outcomes**
  - j) Judged rationality
  - k) Chose most

<table>
<thead>
<tr>
<th>Student's name</th>
<th>a)</th>
<th>b)</th>
<th>c)</th>
<th>d)</th>
<th>e)</th>
<th>f)</th>
<th>g)</th>
<th>h)</th>
<th>i)</th>
<th>j)</th>
<th>k)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 2: Sample of a Class Observation Sheet for the 'How many drinks?' task.**

This model uses the same range of predictable responses as in figure 1, but provides for teachers who wish to record the whole class on one sheet. The accompanying key sheet (figure 3, opposite) denotes all of the strategies, and the skills incorporated in them, by letters of the alphabet. An abbreviated form appears in the column labels, as shown.
Both models suggest other aspects that teachers might want to record, such as whether the student was taking an active role in the task when working in a pair. The rationale for these aspects is discussed in detail the following section.

### How many drinks?

#### Sample Key for Class Observation & Recording Sheet

<table>
<thead>
<tr>
<th>Group:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>.........</td>
<td>-------</td>
</tr>
</tbody>
</table>

**Task or questions undertaken:**

**Observed Stages of the Task Process Cycle:**

**Select relevant information**

a) Identified/recognition of container interpreting metric units  
b) Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language

**Choose strategy**

c) Selected strategy that demonstrates understanding of the task/process required – e.g. selected appropriate starting point and destination

**Apply strategy**

d) Filled one cup repeatedly to practical level, counted whole numbers  
e) Expressed remainder as a fraction  
f) Filled one cup to practical level, accurately measured in some graduated vessel & correctly interpreted metric units  
g) Interpreted metric quantity on label & correctly converted units for comparison  
h) Correctly performed a calculation using addition,  
i) Correctly performed a calculation using multiplication, or  
j) Correctly performed a calculation using division

**Reflect on outcomes**

k) Expressed results sensibly and meaningfully  
l) Judged reasonableness of results by referring to prior experience  
m) Checked results using rough estimations

**Possible annotations**

It is possible that ticks be supplemented with annotations. Some suggestions:

[p] – indicates prompting from teacher  
[a] – indicates a significant amount of assistance from other student or teacher  
[l] – indicates the student took a leading role in strategy and decision making.

*Figure 3: Sample key for the Class Observation Sheet*
Using pair work in assessment: advantages and difficulties

Why use pairs?

Pair work is recommended in relation to real-world activities for many reasons. Partly because research, and experience, indicates that if students work together they attempt and complete more challenging and realistic tasks than if they are working in isolation, and partly because of the social and language-development advantages of promoting opportunities for student collaboration. These, and other advantages are discussed further below.

Pair work allows more exploratory, open-ended and complex tasks

In an attempt to raise the level of interest and stimulate discussion of real-world issues in numeracy classes, the tasks given to pairs are often more complex than strictly necessary to assess students' skill levels. They often incorporate application and integration of skills and knowledge into problem solving or exploratory tasks. Such tasks have the potential to engage students in several rounds of The Task Process Cycle: selection of relevant information, choice and application of strategy and reflection on outcomes. This can take tasks to a higher level of difficulty than strictly described by the curriculum documents, but also provide for more interest and greater complexity than assessment tasks designed for individuals.

Pair work reduces student anxiety

Working with another person on practical tasks tends to reduce the anxiety students often feel about tackling numeracy tasks alone. With practical tasks, such as those described in this chapter, pair work also creates space for social exchange and fun.

Pair work creates opportunity for student talk in numeracy

Encouraging students to work in pairs on their practical and investigative tasks provides opportunity for more student-student talk than would occur otherwise. Talk between students aids their understanding as they attempt to verbalise their reasoning to another person. Conversation between students also means that teachers can observe and assess students' understanding and use of the language associated with numeracy.

We just found with those things that we'd had .. we tried to have something that was really practical that involved them talking a lot, as well as doing some of the basic mathsy things on their sheets. ... and say 'were they talking the talk? was the language there? ... [Teacher].
As an example, Barb described the language which students were using as they attempted to draw the doll's house:

... say for this group 'uses everyday informal language for representation' that became things like 'Oh it's a triangle!' ‘What shape is that?’

So when you are dealing with something that is real you are not just asking them ‘what shape is this? It's a circle, and it's boring' it was a discovery of the whole thing having two basic shapes, like a rectangle - which some of them didn't know - and a triangle on top [Barb].

**Issues related to the use of pair work for assessment**

Whilst acknowledging the value of students working together, some teachers in the trial workshop expressed doubts about using pair work in the context of assessment. They were concerned that, because students were working in pairs, teachers would not be able to accurately assess their capacity to independently perform the skills within the task.

When considering this aspect, we should keep in mind the intertwining of assessment tasks and learning tasks: that what is assessment for some students is a learning task for others and a chance for the teacher to observe what areas of numeracy need strengthening for individual students. It should be possible to observe who is leading the process, and to ask questions of the other partner to ensure they also feel competent in what they are doing.

**Note:**
This should be a casual process of circulating and asking questions such as ‘Can you explain to me what you are doing now?’; ‘Why did you decide to do it that way?’; ‘Would you show me how you used this to measure what the cup holds?’; ‘Can you think of another way to do this?’ Without the casual approach, the process could be more like interrogation, adding to anxiety and counteracting the benefits of students working together.

With pair work in mind, we have incorporated into the sample recording sheets some possible annotation symbols to indicate the role of individual students: how much assistance and prompting were needed and the amount of leadership shown.

[p] – indicates prompting from teacher  
[a] – indicates a significant amount of assistance from other student or teacher  
[I] – indicates the student took a leading role in strategy and decision making.

These annotations can supplement ticks in the appropriate places on recording sheets and should save the need for extensive writing. With further experience in recording their observations of students, it is likely that teachers will develop their own list of possible annotations.
More about using real-life objects in assessment

A variety of suggestions for bringing reality to assessment are provided in the table below. These ideas are drawn from the 'Experienced Practitioner Group' meetings and the on-to-one interviews with teachers. This list is by no means exhaustive. We hope it will stimulate further ideas.

In addition, many of the tasks in the sections on 'Open-ended assessment tasks', and 'Negotiating Assessment' are also examples of reality-based tasks.

<table>
<thead>
<tr>
<th>Assessment Activity</th>
<th>Materials that could be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooking or preparing food, altering recipes (eg. halving and doubling).</td>
<td>Off-the-shelf packages of ingredients, measuring containers, scales, recipes etc.</td>
</tr>
<tr>
<td>Costing a party, recipe, meal etc.</td>
<td>As above, and also supermarket dockets.</td>
</tr>
<tr>
<td>Planning an excursion or trip, following and giving directions, finding a specific place from written or spoken directions.</td>
<td>Street directories, maps, timetables, etc.</td>
</tr>
<tr>
<td>Costing an outing, excursion or trip.</td>
<td>As above, and also advertisements, brochures, receipts, tickets, etc.</td>
</tr>
<tr>
<td>Collecting and displaying information in tables, graphs and charts.</td>
<td>Packets of jellybeans, smarties etc newspaper and magazine articles.</td>
</tr>
<tr>
<td>Determining cost and change when purchasing goods and services. Working out the best deal, comparing different &quot;specials&quot;.</td>
<td>Catalogues from supermarkets and specialist shops (eg. homewares, camping, computer, hairdresser). Restaurant and take-away food menus. Advertisements.</td>
</tr>
<tr>
<td>Comparing nutritional content of different products.</td>
<td>Cereal packets, biscuit packets, bread wrappers, etc.</td>
</tr>
<tr>
<td>Comparing different telephone options (eg. home phone vs mobile)</td>
<td>Mobile phone brochures, advertisements.</td>
</tr>
<tr>
<td>Estimating and calculating the weight of a bag of shopping.</td>
<td>Bags of shopping from supermarket, including separate items whose labels indicate volumes in millilitres and litres, and others indicating weights in grams and kilograms.</td>
</tr>
<tr>
<td>Simulated banking tasks.</td>
<td>Banking withdrawal and deposit slips, brochures and advertisements advertising interest rates.</td>
</tr>
<tr>
<td>Simulated shopping tasks, shopping role plays. Deciding what to buy within a certain budget.</td>
<td>Household bills, receipts, catalogues, advertisements.</td>
</tr>
<tr>
<td>Interpreting floor plans.</td>
<td>Real-estate flyers, building company advertisements in newspapers.</td>
</tr>
</tbody>
</table>
Connections with the model

Bringing reality to assessment makes many connections with the model of holistic assessment presented in the first chapter. In particular, it focuses on the aspects of transfer and application; but also encourages personal connections and awareness of how and where maths fits into students' daily lives; and invariably supports the building of confidence.

Footnotes


Initial Assessment

When the client comes in I say to them that it is a placement interview, not a test. It's not keeping them out of the course. We want an idea of where they're coming from so that we can place them in the best spot for them, where they will be comfortable [Ros].

What is initial assessment?

By 'initial assessment' we mean the procedures used to gather the information necessary to place potential students in appropriate numeracy and literacy programs. Sometimes the procedures are entirely designed for the purposes of the students and the future teacher, but in some cases they are also for the sake of other interested parties, such as funding bodies, who dictate specific assessment and reporting requirements.

From our research, it appeared that the area of initial assessment practices has been given more attention in the past than the other types of assessment. Good practice models are readily available and experienced practitioners are constantly improving and adapting these to suit local programs and their clients. The majority of teachers interviewed have successfully accommodated the government specifications into their regular procedures.

When we first started the CGEA we used to have quite a formal assessment program. Luckily I don't have to do that now because I found it was very stressful. The first thing they do when they came in was have a test - they felt. So we do it all now by interview [Ros].

We do an integrated numeracy and literacy assessment. It's a combination of us asking the students questions and getting them to demonstrate some of their competencies. Because of the government employment agency contract we try to tease out the areas they actually need to be working on to improve their employability. So it could be just a basic task based on their interview, or it could be something a bit more complex depending on the student's confidence [Lorraine].

Most teachers described initial assessment methods that revolved around individual face-to-face interviews with the potential students. Sometimes the interviews incorporated a series of oral questions or written tasks, used to establish the appropriate commencement level of the student. In cases where such questions were not considered appropriate, self-assessment or informal conversation techniques were established. Often the procedures included a combination of all the above strategies, or were varied according to initial perceptions of each student's confidence.
We spend about an hour with each client, finding out their preferred mode of learning, and working out their attitudes to going back into the classroom. We would assess them against the certificate competencies, they would do a written task. I would integrate some numeracy into the assessment, pick up on their oral skills. I guess it then becomes partly a subjective judgement. I discuss it with them [Program coordinator].

In some cases, numeracy teachers receive little information about students' numeracy levels prior to starting their classes, and therefore use non-threatening activities which allow them to observe students' skills and knowledge during the first few classes. All of these strategies are discussed in greater detail below.

Why use interviews for initial assessments?

I say to my students 'It's important that you are successful ... we could easily put you through to the higher stages but it's important for you to be successful wherever you start' [Lynne].

Experienced basic education teachers are mindful that students' experience of success should begin with the initial assessment procedure. This means careful planning to avoid reinforcing students' sense of failure.

Students don't like sums, I would say. They come to us because they weren't successful at school and they still carry that with them. They come in to the class and the first thing that they say to me is 'I was never any good at maths' And I say 'well this isn't maths it's numeracy' That's why we do it via an interview process, rather than formal assessment. Because I can say to them 'well tell me the sorts of things that you do and don't think you can do' that tends to draw them out and they say 'Oh I can do that!' [Chris].

The assessment procedure is especially important to practitioners if there are a number of classes available. Inaccurate assessment could lead to inappropriate placement, and often it is difficult to relocate students after they have become accustomed to a particular teacher or group of students. It can also be difficult to relocate students when their timetable has already been arranged.

If there is only one numeracy class, with a mixture of levels, then accurate placement information is not such an issue and only a broad assessment is needed. The actual level of the students can then be determined during the first few weeks of classes.

Suggested initial interview procedures

The interview procedures described were of varying duration. Those combining literacy and numeracy tended to be the about an hour to an hour and a half.

Teachers conducting these interviews usually have a range of authentic assessment
materials for students to choose from (as described in the ‘Bringing Reality to Assessment chapter, p. 43). Authentic materials might include real-world documents, such as supermarket fliers, shopping catalogues, maps, clocks and calendars. Having a range available makes it more likely that there will be something each student is personally familiar with, in order to gain an accurate picture of their ability.

*I want to ask the students different things, be it shopping, or a weather map or whatever. I want to draw from more contexts. What happens if you rely only on an electricity account and they never read the electricity? [Marilyn]*

Interviewers usually have a range of questions of increasing difficulty to go with the real-world artefacts. These might range from straightforward questions, such as picking out the cheapest item on a catalogue page, through calculating totals and change, to working out a percentage discount on one or two items.

**The initial interview process**

The procedure usually encompasses these steps:

1. **Put students at ease and try to reduce anxiety** - e.g. describe the course or chat about the student's life, interests and goals.

2. **Encourage the student to discuss their past mathematics learning experiences and their current feelings about the subject.**

3. **Discuss the numeracy the student currently uses and feels comfortable with** - e.g. ask them about their use of clocks, timetables, measuring equipment; ask whether they read and interpret newspaper graphs or workplace charts; or whether they perform money calculations, such as rough estimates of change, GST (service taxes) or tips.

4. **Select appropriate levels of questions to ask each student, based on their earlier responses.** [It is important that potential students can show what they can do in such an interview, without offending them by asking questions that they find too trivial.]
Self-assessment in interviews

Two different techniques were described for self-assessment in interviews. In one technique, students were asked to look at a series of sample tasks or questions on cards and decide how confident they felt about tackling them:

*I also ask them how they feel about it ... I ask them ‘Can you do this?’ and ‘Can you do that?’ and if you say things like that and you’ve got a comfort zone for them, more often than not they will tell you pretty well straight off where they think they’re at, and what they need to learn. ... because they are adults they know what they can do [Ros].*

Sometimes the students’ self-assessments are validated by asking them to perform the task.

Other teachers discuss the outcomes statements in the curriculum document with the students.

*We actually have a self assessment. We get them to react to what it (the curriculum document) says, like ‘can read the time on the clock with hands’. Then I tick the box. They usually come clean about what they can do [Teacher].*

Creating private ‘space’ for students in initial assessment - written assessment tasks

Some experienced teachers and coordinators feel that it is quite threatening for some students to attempt numeracy calculations whilst someone is watching them, as in the one-to-one interview situation. They opt for a combination of interview questions and some written numeracy tasks. Marilyn described her process using prepared written assessment sheets built around real-life documents (see pages 61 to 63 for examples of types of these materials).

*I have a series of sheets that reflect authentic material, for example a supermarket specials list, or part of it, stuck on a piece of paper with questions underneath. The most basic questions will be like, tick the cheapest, circle the most expensive, how much will two items cost? If you bought something would you have change? and a bit of estimating.

There are several sheets. The simple one, and some with more complex text - more specials and more difficult questions. I give them both and say ‘Have a look at these. What do you think about them? Do you feel comfortable with doing that? Oh, is that a bit easy? Have a look at this one. Would you like to try some of the example in there?’ - trying to give them a bit of choice before they start.*
When they have chosen I ask them to have a go at the sheets. I say 'I'll just sit here and do some work. We can talk through any of it if you want to or you can have a go at it on your own. Here's some scrap paper. See how you go.' I try to give them as much space by writing on my own stuff, because I don't like anyone looking over me when I am doing something. They ask me if they have any difficulties and we talk it through [Marilyn].

Other teachers with a lot of experience in initial assessment also reiterated the need to give students space whilst they are performing calculations. Some will leave the room for a short while, on 'errands', others will busy themselves at another desk, or make cups of tea or coffee for themselves and the student.

Some examples of initial assessment materials

Below, and on the following pages, are some examples of the types of materials that can be used in initial assessment, for students to attempt themselves or in some instances, as a self assessment for students to decide whether these are tasks they are confident of attempting or not.

What is the total amount due on this account?

When was the account due?

Can you tell me what the graph here is telling us about water use over the last year?
Shopping

a) Mark the cheapest item. ____________________________________________

b) Circle the most expensive. __________________________________________

c) How much would 2 loaves of bread cost? _____________________________

d) If you only had $5.00, could you buy the eggs and the sugar? ______

e) How much change would you get from $5.00 if you bought the juice? __________
House plan

a) The numbers on the house plan (eg 3.2 x 2.7) refer to the sizes of the room. What kind of measurements do you think they are?

b) Which bedroom do you think is the biggest? The main bedroom or Bedroom 2?

Blue Hills Community Centre Class Timetable

<table>
<thead>
<tr>
<th>Day</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>English Tutor: Kaye</td>
<td>Computers Tutor: Roger</td>
<td>Maths Tutor: Suzy</td>
<td>Spelling Tutor: Barb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tutor: Kaye Room B 9.30-12.00</td>
<td>Computer Tutor: Roger Room B</td>
<td>Tutor: Suzy Room B 1.00-3.00</td>
<td>Tutor: Barb Room B 1.00-3.00</td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVENING</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

a) Circle the day that Ali does NOT come to school. Which day is it?

b) What time do classes start in the morning? _______________________

c) How long does he get for lunch on Thursday? _______________________

d) How many hours of English does he do? _______________________

Student: Ali G.
The importance of a range of items

Marilyn described other initial assessment forms that had used only one task, such as interpreting an electricity bill to attempt to assess all aspects of numeracy.

*I'm not comfortable with that. I want to ask the students different things, be it shopping or a weather map or whatever. I want to draw from more contexts. What happens if they never read the electricity bill? ... I try to have two sets of questions (set around different realistic documents) to give them some choice. And often we will do a bit of this one and a bit of that one [Marilyn].*

She felt that having the questions on a printed sheet made it easy to keep records.

*People underestimate assessment. They say it's easy, anyone can do it. But you can't, not without putting a lot of energy into it. I'm continually revising our assessment sheets [Marilyn].*
Shortened numeracy interview processes - 'critical' questions

After years of initial assessment experience and continual changes to their assessments procedures, some practitioners have managed to streamline their assessment to fit rather stringent time constraints. Usually they have become aware of the 'critical', or decisive, questions: those questions which differentiate between the levels suitable for the various programs they offer. For example:

The numeracy is integrated in the interview. They do a written task, they do a reading task, and we just have some sales brochures they look at. If they can, they work out which is the most expensive, the least expensive and they do some calculations in their head. If they can't we rate them against the National Reporting System and from there we assign them to their classes. A very simple system, but years in the design [Cathy].

Barb, talking about the National Reporting System (NRS) described how she used the 'windows' – the description of the content included at each level – together with the sample tasks, as mini indicators to find the decisive differences between levels. For example, she uses the two initial interview questions below, along with the level one, two and three indicators describing the use of fractions, decimals and percentages.

| Level one: Recognises in everyday use familiar fractions eg. 1/2, 1/4; |
|------------------|---------------------------------------------------------------|
| Level two: Recognises and interprets simple fractions, decimals and percentages, eg. 1/3, 1/10, 50%, 25%, 0.25, 0.05, in everyday use; |
| Level three: Calculates with fractions, decimal fractions and percentages, linking equivalent forms and using appropriate to context. |

Blue Hills Community Centre is giving a discount on their computer course.

1. How much would the course cost if you were given a 1/3 discount?
2. How much would the course cost if you were given a 15% discount?

As Barb said when discussing this:

The differences here are like the 'using halves and quarters'. It's like a different level of operations. You begin to pick up what the levels are. ... When you look at the types of activities on the right hand side (the sample assessment tasks of the NRS), over the three levels, they are quite different in their nature. The process that you need to go through and the type of knowledge that you're using. The fractions one and the percentages question really labels people quite strongly whether they are at that level or not, even just that one factor. Then, when you start asking them the other ones that go with this they will not be happy doing quite a number of them. For example estimating times and distances is much more complex that plotting out a little map [Barb].
Penny also described how, over the years, she and her colleagues had streamlined the number of questions needed during the interview process in order to differentiate which of their three class level programs would suit the students. At her Institute the three levels are taught at the same time to allow for appropriate placement. The numeracy team perform specific numeracy interviews which are separate from the literacy placement procedures.

The questions are placed on cards like those below and shown one by one to the students. Notes regarding their responses are recorded on an interview record sheet beside a copy of the questions.

**THE PARTY**
I invited 16 friends to a party. Only 3/4 of them came.
How many friends came to my party?

**PLANT SALE**
A shop is selling 3 pot plants for $15.
How much would 4 plants cost?

**SALE PRICE**
A portable CD player was priced at $200. At a sale, 20% is taken off.
What is the sale price?
Informal conversations

Jo talked about her experience with aboriginal students, and a growing cultural sensitivity which led her to change her initial assessment procedures.

When I started I inherited pages of sums. ... We would tell people to do them and stop when they started freaking out. Now, it's more that we get talking, and they say 'I really want to use maths for my kids' then I say 'Oh, so it might be this type of stuff', making it up there on the spot rather than having something prepared.

I have spent lots of time changing different things about our placement interview. The biggest motivation for change was spending time with some linguists talking about cross-cultural communication with Aboriginal people. They said how inappropriate it is to get in and start asking questions without spending time and meeting people. So I had to think how to deal with that problem when you have the pressure of a lot of people coming in, especially at the beginning of the year.

The way I have tackled it is by going in and talking a lot about the course. Telling them what it is about and painting a picture about what different people in the course are doing. So when I talk about the maths I'll say 'The sort of things we are doing in the class are ...'

Then the first question comes out. 'Does that sound like the sort of thing you might fit into?' That's the first question, not a direct 'Why do you want to do maths?' or 'What are your needs?' Then gradually move into 'So it could be to do with shopping... and we might look at if there's a sale on how you work out the prices.' 'So, if we were doing something like this, (and I just write a bit of a mathematical sum) would that freak you out?' And then starting from there gradually working out what is comfortable.

I want them, if they want to, to have a go at doing some. Some are really keen. Some ask can they take some home. If they are really not so keen to have a go the first time that tells me something too, so I know where to start from [Jo].

Issues and difficulties with initial assessment

Factors influencing over and under assessment

Practitioners noted that many adult students are likely to underestimate what they can do, and this can contribute to an assessment that is lower than it should be. Teachers should be aware of this and encourage students to 'have a go' and not to worry about making mistakes.
Many teachers have observed that people performed at a higher level on money related tasks than they could with other numeracy applications. It was therefore considered important that a variety of tasks be used to judge knowledge such as number skills and understandings of the decimal system.

**Numeracy given insufficient attention in the interview**

Commonly, the numeracy aspects of initial interviews are left until last. This means, that when time is short, numeracy is relatively neglected and numeracy teachers are given very little information about their potential students.

In this situation the numeracy teacher may decide to use the first few sessions to gain an appreciation of students' knowledge and skill levels, before finalising classes or enrolment details.

*I found estimation useful the first day. We used an activity from Mathematics: A new beginning, where they had to select the nearest answer for calculations like 63 x 48. Some didn’t have the notion of rounding or what to do with the zeros. I found it quite revealing [Chris].*

Di explained how she uses games, such as 'Multidigit', to determine whether students can use the conventions and language of large numbers. We all do it at the start, and then some have the option to do something else while I work on this concept with those who need it.

**Assessment by non-numeracy teachers**

Program coordinators who are less sensitive to the nature of numeracy, and students’ likely attitudes to mathematics, sometimes resort to pages of sums as a quick numeracy assessment. Numeracy teachers felt that, as well as being a very unsuitable introduction to the nature of the future numeracy classes, this was not a realistic assessment of students' numeracy abilities.

In such cases, it is advisable for the numeracy teacher to ask to be involved in the initial placement processes, and in the development of the interview proformas.

**English language difficulties - a barrier to numeracy assessment**

Sometimes the English language level of the students make it difficult to assess their levels of numeracy in an ideal manner. For example:

*One student was put in level 1 literacy and numeracy even though he had a university degree in mathematics. He was clearly mathematical. What he had trouble with, was contextualising the problems [Chris].*

If there is reason to believe that the students will not feel threatened, this is one case where decontextualised mathematical 'sums' might be convenient, for example, if a
potential student has an Engineering or mathematically related qualification in their home country. However, it should not be assumed that these students do not need numeracy assistance. Rosemary described one student who had “a degree in business from her own country, so her maths was very good, but the English prevented her using it in the job”. At the very least these students will need to learn the aspects of English associated with mathematics and numeracy. This is unlikely to happen in a regular literacy or English language class.

Pressure from Administration Systems

A common problem mentioned by teachers in certificate programs was the pressure they are under to enrol students in the exact level of the program before their level of competence can be accurately established

*I had a big struggle with data administration about not having to tick which box the first time. At first I played the game and did the ticks and they had to keep changing because I got it wrong. Now I’ve convinced them that I won’t keep changing if they give me a few weeks. Now they hang on and ask me ‘Do you know if they’ve decided yet?’* [Jo].

As indicated, there are many issues and difficulties involved in the initial assessment process. In spite of these, experienced numeracy teachers and numeracy-sensitive coordinators, continue to negotiate the multiple administrative demands, whilst at the same time keeping the students’ sensibilities and placement needs uppermost in their minds.

Footnotes:


**Note:** These three resources are available from ARIS, Language Australia - see page ii for contact details.
Using Open-Ended Assessment Tasks

Our discussion of open-ended assessment began with a comparative exercise. The Experienced Practitioner Group negotiated the placement of a number of tasks on a continuum, according to how open-ended we judged them to be. Our initial reasoning was based on experience with the tasks and instinctive judgements about open-endedness. In teasing out our placement decisions, we reached agreement on several issues related to open-ended tasks and their role in assessment, as discussed below.

What is an open-ended task?

Two key characteristics seemed to be essential for a task to have the potential to be open-ended:

**Divergence of method**
The task can be approached in many different ways, each of which may draw on different amounts, types and combinations of skills and knowledge.

**Divergence of outcome**
The task can be taken in a number of different directions and/or to different levels of complexity and/or difficulty.

Why use open-ended tasks?

Open-ended tasks have many strengths. In terms of assessment, they have the potential to provide valuable and accurate assessment information because they allow students to work to the limit of their potential and demonstrate what they can really achieve.

Besides being a valuable assessment resource, open-ended tasks can enhance student engagement and learning in a number of ways, which we list below.

Open-ended tasks have the potential to:
- Cater for individual differences. Students can approach an open-ended task at their own level of skills, knowledge and understanding.
- Stimulate discussion amongst students of different approaches and outcomes as they become aware of different ways of approaching tasks.
- Extend students' skills and understanding as they explore different approaches or attempt, perhaps with the teacher input, to move into unfamiliar territory.
- Give students more control of the learning cycle. Because methods and outcomes are not predetermined, students have the freedom to experiment and test their ideas.
- Enhance student involvement, and thus engagement with learning. Students who explore their own ideas and interests may also think more deeply and carefully about what they are doing.
Assessment tasks have an important influence on learning.

Authentic learning is always open-ended. All tasks in the real world can be approached in different ways, to different degrees of depth. This is true for numeracy too, despite the image of mathematics that most people hold as neat, tidy and “closed”. Given that assessment often directs teaching and learning, we believe it is important that assessment tasks attempt to model the open-endedness of real-world learning.

Connections with the model

Using open-ended assessment tasks strengthens connections by allowing personalisation of the question and task; encourages autonomy because the student needs to take control of the question and problem; and the Task Process Cycle becomes a core aspect because to solve the problem/task requires the application of all the four steps of the cycle.

Some Issues related to Open-ended assessment tasks

Is the difference in the task?

Several of the teachers described tasks which they initially thought were quite open becoming fairly closed because of the amount of teacher prompting required with a particular group of students. Alternatively, there were tasks which were apparently closed which became unexpectedly open-ended. For example, one teacher reported:

*I had lots of different types of numbers: decimals, fractions, measurements - on small pieces of paper and asked students to put them into pairs. Later in the day I gave the same materials to another class. As I went around the room distributing them, students had already started to sort them. So I let them go. They got amazing combinations I never even considered - they looked at the person next to them and had a long discussion because different people did it so differently. It told me a lot about their understanding [Sharon].*

As a result of our discussions, the group came to realise that there is no written task that can be guaranteed to be open-ended. Instead, the degree to which a numeracy task is open-ended depends on how it is used in the classroom, and how students respond to it. Open-endedness is the product of the interaction between the task itself, the teacher, and the students. “Unexpected things can happen a lot, even within what seem to be fairly closed activities because people make unexpected jumps and leaps".
The degree of open endedness is an interaction between the activity, how students react to it, and how the teacher reacts to how they're reacting. You can get really different degrees of open-ness according to the response of the student. You may get someone who will just take off and be wonderful and make a lot of it and you can get someone else who wants specific directions, can't think what to do, and you've got to constantly prompt them, give them examples. Also, students are more likely to make something of it later in the year when they know each other better and are talking to each other more [Di].

What is the role of the teacher?

As described above, the extent to which a given task is open-ended depends on what the teacher does with it in the classroom, and how students respond. To allow a task to become open-ended the teacher needs to let go of control, and become a facilitator who encourages, prompts and questions students where appropriate. This involves carefully watching what students do, listening to what they say, and responding to their questions without giving them too much direction.

Managing students' responses to open-ended tasks is the most challenging aspect of a teacher's role, as these teacher comments illustrate:

Sometimes a task that you plan as open turns into a closed task because students aren't ready for it and need lots of direction. ... If students don't respond, then you need to have more input, but sometimes the teacher's input tends to put boundaries and restraints in more, because students often don't think the same way as you do, so it becomes more closed [Chris].

Students find it difficult, especially choosing what graph they think is appropriate (in an open-ended graphing task). Because it's open you can see whether they are thinking about what the graph is telling them, not just doing a graph, but also interpreting it. What they write in the report is very revealing. They might do a histogram and describe it in a step by step manner, rather than give an overall interpretation ... If you want the task to be open, the critical thing is that they choose their own [Penny].

Is it worth the effort?

Teachers from this project really thought that the trouble taken to set up open-ended assessment situations was worthwhile because the rewards were many. In addition to engaging students at their own level and catering for their individual differences, students' responses to open-ended tasks are good indicators of their ability to handle the numeracy Task Process Cycle, and their levels of independence as learners. Open-ended tasks are also a useful means of gauging students' potential to cope with the next level of numeracy.
Sample open-ended assessment tasks

The following examples should assist to clarify the meaning of open-ended assessment and hopefully provide some ideas that will act as springboards for ideas that will interest your own students.

Example 1 - Anyone for Pizza?

Using Pizza menus from local restaurants, Chris provided stimulus for students to show their various levels of competence with money calculations. Open-ended questions such as "Which restaurant would you prefer to go to and why?" Or "Are the specials worthwhile?" allowed students to incorporate their own personal criteria as well as their monetary calculations into their responses.

Higher level students asked "Which Pizza is the Best Value?" were able to display their problem solving ability in making comparisons. Some students focussed on size, using area of circle calculations, others concentrated on exploring value between pizza varieties (in terms of relative costs of topping) using data collection and display techniques.

Students working at the lower numeracy levels might work out Best Value by deciding on the cost of an individual meal serve from different sized pizzas, and comparing these.

A more detailed description of how this open-ended task might be used with a group of students is provided on p. 79, where it is used to illustrate a general procedure for encouraging students to personalise tasks to their own lives and circumstances.

Students' responses for the Pizza tasks are supplied and analysed on p. 166.

Example 2 – Number card Sorting

At one of our project meetings Sharon described a number matching exercise that turned into an open-ended sorting and categorising task. Inspired by her account, two other teachers in the group experimented with this idea. The task has evolved along the way to allow creative student input in addition to sorting and matching. [See p. 121 for the number set used in this activity.]

Number card sorting – low level group

Sue gave her lower level group, numbers equivalent to 0, ¼, ½, ¾, 1 and 1.5 expressed in a mix of percentages, decimals, fractions and diagrams. Students, working in pairs were given a question card on which was written the instruction "Arrange these cards in a way that makes sense to you."

Their conversations as they completed the tasks and their level of confidence/uncertainty gave a good indication of students' competence with these ideas. For example, in one pair the task was clearly an assessment task for one student, who
sorted the cards easily, whilst it became a learning task for the other, who was less clear on the meanings of the decimal and fraction symbols.

When the first task was completed the students were given blank cards to add more ideas to their arrangements. They were encouraged to use different pictures, words or numbers. This gave them an opportunity to further demonstrate their understanding of these number concepts.

See pp. 117 - 132 for details of the task and some sample student responses.

**Number card sorting – medium/high level group**

Jan gave her higher-level maths/numeracy students a collection of numbers that included percentages, ratios, decimals, fractions, negative numbers and irrational numbers such as \( \sqrt{2} \). The students, working in twos and threes, responded in many different ways. Some sorted them into equivalent pairs and some arranged them from smallest to largest on a number line. One group created a ‘Number Family’ which involved classifying the numbers into subsets of number types such as rational and irrational numbers.

Students commented afterwards that they thought it was really good for learning. Remarks included: “It made me have to stop and think!”; “We thought this was a really good way to think about all the fractions and things we’ve done so far” and “It showed me that I’m not really confident with percentages yet.”

Jan felt that the task was a helpful way for the students to draw their learning of number together and to handle number understanding at their own level. She thought that in future she would also include blank cards for students to add further examples.

See p. 126 for examples of the numbers used in these sorting activities.

**Example 3 – Open-ended task using maps and street directories**

Maps of students’ local areas, towns and suburbs have tremendous potential for open-ended tasks that allow for students' individual differences. Tasks such as “**Work out a route from the college to the Museum, Cinema, Zoo or other popular destination**” allow for students' personal knowledge and preferences to be included. Preferences may relate to roads to be avoided or short-cuts, if travelling by car. They may relate to forms of public transport, optimal connections and times for travelling, if public transport is a more likely option.

Another open-ended task using a map or directory may be “**Describe a route from your home to ....**” – insert a venue as described above, or ask students to choose their own venue.

One group of students were given a task called “**Mystery Location**” which involved them writing out instructions for others to follow on the map. They were told that the instructions should help someone to go from the College to a secret location they chose
themselves. This task involved a built-in evaluation, since it was obvious if the partner reached the unknown destination successfully by following the instructions. Students were able to review and amend their instructions from their partner's feedback. Extensions for higher level groups may include calculating distances using the scale on the map or deducing travel times using estimated average speeds. (The task ‘Mystery Location’ task is included in Section 2, Sample Assessment Tasks, along with sample student responses - see page 139.)

Example 4 – What’s the best phone deal for you?

Advertising brochures for mobile phone schemes and home phone providers, actual phone bills brought by you and the students, and price schemes from the various companies, should provide fertile ground for students to investigate the best phone options to suit their personal needs.

Beginning with discussions of which students already use mobiles and why, students could then calculate their own likely usage for a typical week, considering:

- Number of calls
- length of calls
- whether calls are made during peak or off-peak periods.

Suggested procedure for using open-ended tasks with a class

When considering how to present the tasks to readers of this publication, we decided that it would be helpful to attempt to describe a general procedure that can be followed for most open-ended questions. This was motivated by our hope that teachers would invent their own tasks rather than merely use the examples provided in this publication. Beginning from one or two task descriptions, it was possible to generate a series of steps that appeared to be a reasonable approach for most open-ended tasks. They are steps that we hope will encourage students to engage with the topic and develop their own personal perspectives and interests before they are presented with the actual task. We hope that they also include some opportunity to exchange ideas and student input as well as teacher guidance, without limiting students’ individual approaches to the task.

The procedure also guides teachers through the stages of the Task Process Cycle and may act as a reminder to emphasise the evaluation/reflection stage at the end of each task. It is a step that often is neglected at the end of a task, sometimes through lack of time. However, it is an important step for assisting students to make meaningful connections between their tasks and the world outside of the learning situation. Hopefully, using a guided procedure like this will act as a reminder for all of us.

A flowchart describing the procedure is shown in figure 1, opposite, with “Anyone for Pizza?” - a specific example based on the flowchart - included on the following pages to clarify the meaning. A blank, photocopiable, template of the steps is included in Section 2 on page 257 for teachers who might like to try it as a basis for designing and documenting their own tasks. (The ‘Anyone for Pizza?’ task is also included in Section 2, Sample Assessment Tasks, along with sample student responses - see page 161.)
Preparation

Materials required
Where possible collect authentic, up to date, real-world items or articles from newspapers or the web, as a basis for the task.

Formulating the task or question(s)
Prepare well worded question(s) that allow for a range of responses. Preferably questions which might be answered across a range of levels.

Suggested procedure

Tuning in to the topic
Provide a brief opportunity to discuss the topic or examine the realistic materials in a general way before looking at the specific questions.

Introducing the task
Hand out or display the questions. Either the same to the whole class, or different levels for different students.

Reflecting on the task
Allow students time to consider their initial responses in a non-threatening situation, either individually, or in pairs, before sharing their ideas with the whole class.

Focussing students’ ideas and strategies
Provide space for students to share their initial thoughts about the question, and how it might be personalised, or different for each of them. At the same time, use students’ starting points to steer the conversation towards aspects that may need to be considered to perform the task.

Working on the task
Allow students time to work on their personal, or pair, responses to the question, recording their results as clearly as possible so that they can share it later with you or other students. Encourage some students to widen their enquiry, depending on individual progress and ability to respond to different challenges.

Encouraging evaluation and reflection - Is it reasonable?
Facilitate the ‘evaluation’ aspect of the Task Process Cycle by asking questions appropriate to their level. At lower levels encourage judging by personal experience. For example ‘Does that seem reasonable to you?’ At higher levels suggest rough estimates alongside calculations, and consideration of real-world implications of solutions.

Figure 1: Flowchart for using open-ended tasks
Issues and difficulties using open-ended assessment tasks

There are many teachers who are required to submit written documentation to external verifiers or moderation sessions. With low-level numeracy classes, many of the suggested open-ended tasks involve physical activity or oral responses, but little written response. Some teachers have suggested that with larger group sizes this makes recording the individual methods used by each student too onerous.

Rather than avoid open-ended tasks altogether, we suggest that the problem can be avoided if a prepared observation sheet is used by the teacher. The sheet would briefly describe a range of predictable strategies that students might use, with the associated skills and knowledge involved teased out in advance. Of course, space would be left for any unforeseen strategies also to be described. Recording would then be a matter of ticking against these descriptions, with the odd annotation regarding other particular observations of the student. Examples of recording sheets are shown on pages 49 - 51: one for recording a whole class, another that might be used one per student. Other samples are included in Section 2 - refer to the grid on page 115 for a listing of which tasks include recording sheets.
Sample - Anyone for Pizza?

This set of tasks grew from an idea that Chris tried out with her students. She used local Pizza menus with her class, and found that because the menus were real and local they were usually of personal interest to the students. Chris found that beginning with an open-ended question allowed her students to engage at different levels according to their interest and their ability.

Potential levels, skills and knowledge

**Low/medium:** Number skills in the context of money calculations.

**High:** Number skills in the context of money calculations and use of measurement formula - area of a circle.

Preparation

**Materials required**

Where possible collect authentic, up to date, real-world items or articles from newspapers or the web, as a basis for the task.

Collect copies of local Pizza menus – at least one (or one set) per pair of students, or one each depending on how you wish students to operate.

Formulating the task or question(s)

Prepare well worded question(s) that allow for a range of responses. Preferably questions which might be answered across a range of levels.

Some suggestions for questions:

**Questions with potential for lower levels**

- If you won a $50 gift voucher for a night at the Pizza restaurant, how would you use it?
- If you won a $50 gift voucher, would it be enough to feed your family or a group of your close friends? What would you buy?
- Are the specials at this restaurant worthwhile?
- Which restaurant would you prefer to go to, and why? Compare costs of the meals you would buy in each.

**Questions with potential for higher levels**

- Which sizes give the best value?

[For this one you will need the diameters of the pizza sizes – they may be on the menu or you may have to find out in advance.]
Suggested procedure

Tuning in to the topic

*Provide a brief opportunity to discuss the topic or examine the realistic materials in a general way before looking at the specific questions.*

Ask students to pair up for the start of the activity and give out one copy of the local menus per pair.

Tell them you are going to think about value for money with Pizzas this session, and you have collected some of the local menus to use.

Encourage students to examine the menus you have given out until they become oriented to their contents and layout.

Free flowing discussion will probably follow as a warm-up to the topic. If not, a few leading questions such the following might encourage student discussion.

- Who eats Pizzas?
- Which are your favourite restaurants?
- Why do you choose them?
- What do you normally eat?
- Do like sharing or just have one type?
- What do you think about tipping? .. etc.

Introducing the task

*Hand out or display the questions. Either the same to the whole class, or different levels for different students.*

Give the question cards out to individuals or pairs — one between two if you want them to work together or share ideas at the beginning.

Students at potentially different levels could be given slightly different questions at this point.

Reflecting on the task

*Allow students time to consider their initial responses in a non-threatening situation, either individually, or in pairs, before sharing their ideas with the whole class.*

Tell students you will give them a minute or two to think about the question and the aspects that come to mind before discussing it together as a whole class.

Encourage them to ask clarifying questions or discuss the question with nearby students or their working partners, as they think it through.
Focussing students' ideas and strategies

Ask who would like to share what they started thinking about.

Encourage a few suggestions. Examples could be:

- "We looked at the prices and sizes"
- "It usually costs me more than that to take my family out."

Encourage conversation around students' starting points. Make links with the previous discussions, whilst gradually steering students towards the useful aspects by asking questions which might expand their thinking. For instance one or two of these might help:

- Do you prefer a few big pizzas or lots of tastes with smaller ones?
- Are any of your group vegetarians?
- Does anyone ever buy the garlic bread?
- Do you take drinks or buy them there?

The conversation should allow students to personalise the task, and go with their own interests, whilst encouraging them to think about aspects such as:

- Numbers of people
- Amount they eat
- Extras they usually have
- Getting their money's worth from the voucher by going as close to $50 as possible.

Working on the task

Allow students time to work on their personal, or pair, responses to the question, recording their results as clearly as possible so that they can share it later with you or other students. Encourage some students to widen their enquiry, depending on individual progress and ability to respond to different challenges.

After this warm-up discussion suggest that students work on their own personal responses, and record them as clearly as they can, to allow for sharing with others. As you walk around and discuss their progress on a one-to-one basis you can judge their capacity to extend their investigation.

Some students could be encouraged to explore a variety of responses and select the best. Others might be encouraged to widen the scope of their task.
Encouraging evaluation and reflection - Is it reasonable?

Facilitate the 'evaluation' aspect of the Task Process Cycle by asking questions appropriate to their level. At lower levels encourage judging by personal experience. For example 'Does that seem reasonable to you?' At higher levels suggest rough estimates alongside calculations, and consideration of real-world implications of solutions.

When students are finalising responses, you may need to facilitate the 'evaluation' aspect by asking questions appropriate to their level.

For lower levels
- Does that seem like a suitable meal for the number of people?
- How much is that for each person? Does it seem a reasonable amount?

For higher levels
The suggestions above also apply, but in addition, encourage estimation of calculations throughout the calculation stages. And as mentioned earlier, students could investigate which size pizza give the best value by considering the different sizes of the pizzas (through the use of the formula for the area of a circle) and their respective prices.

Also facilitate some discussion of the real-world implications of their solutions by exploring other considerations as well as the mathematical or monetary aspects. For example:
- Does that mean people are always foolish to buy small sized Pizzas?
  [Students might say 'No! Because you would rather pay more and get the variety' or 'smaller pizzas are easier to handle - no plates needed']

Recording student outcomes

For lower level students a recording sheet is provided - see page 169.

For medium level students written records can be mapped against the assessment criteria. (The same recording sheet used above on page 169 might also be useful for this purpose.)
Negotiating Assessment

I try to individualise assessment. If I can sit down with a student and work out something together that they can do in a real life situation that meets the Learning Outcomes, that’s the ideal [Di].

In our project discussions on assessment strategies, we discussed some of the ways in which we try to make assessment more closely aligned with individual learners’ needs and interests. We agreed that negotiated assessment is a powerful method of strengthening the links between classroom activities and real-life experience. It can also make a significant contribution to students’ feelings of achievement and sense of ‘ownership’ of their learning.

What is Negotiated Assessment?

Negotiated assessment tasks are negotiated between the teacher and an individual student, with input from both. The student and teacher work together to devise an appropriate assessment task that interests the student whilst also meeting relevant assessment criteria. In our discussions, three approaches to negotiating assessment emerged. These are briefly described below, and are followed with four examples of negotiated assessment tasks.

1. Choice of context
For lower level students, teachers can negotiate assessment by giving students choice within a given framework, such as by choosing their own context for an activity or process that they have previously worked through with the class. An example might be, for a costing task, the student and teacher negotiate what it is the student will ‘cost’.

2. Student-initiated question
In this situation, a student may ask a question or raise an issue that lends itself to investigation. The teacher and student formulate a task together that captures this interest. Although the teacher is mindful of the assessment criteria that could be met by the task, the interests of the student primarily determine its direction.

3. Student-initiated task
In this situation students devise their own task in response to particular learning outcomes and assessment criteria. The teacher gives students a copy of the learning outcomes and assessment criteria from the curriculum document, perhaps in a simpler format, and the student develops their own task. This approach would suit mid to high level students.

Why negotiate assessment?

Negotiated assessment meets many of the key aspects of the holistic model of competence – both cognitive and affective – outlined in the first chapter.
For example, negotiated tasks have the potential to:

- Encourage greater student autonomy, because the student is following a line of enquiry that they are at least partly responsible for.
- Enhance student engagement with the Task Process Cycle. Students who explore their own ideas or interests may think more carefully about the data and information they need (because it is real and personal) and are more likely to attend to the reflective phase of the cycle because the outcomes of the task are personally meaningful.
- Extend student's skills and understanding. A negotiated task may require knowledge that the student does not yet possess. This is an excellent opportunity for the teacher to introduce new content that has immediate and relevant application.
- Strengthen the connections between students' classroom and real-life experience, because negotiated tasks are personally meaningful.
- Build student confidence. Completing a task that has meaning and relevance in one's life can be a strong catalyst for growth.

Sample negotiated assessment tasks

This section is based on discussions with Di, who has used negotiated assessment extensively in her teaching practice. She describes four negotiated assessment tasks. These tasks range from fairly straightforward tasks in which students decide on their own context for a skill that is taught in class (for example, costing), through to a high-level task based on students' query (such as, "What is the distance you can see to the horizon?"). Details of these tasks are provided below.

These examples give an indication of the possibilities for negotiated assessment. Negotiated tasks, being based on individual students' needs and interests, often have a strong element of open-endedness. Thus the procedure we have developed for open-ended tasks generally works with these tasks too. However, there are a few slight differences in approach, which we point out later in this section.

Example 1. Negotiated costing task

This assessment task is based on costing tasks done in class and for homework. The class activity involves students working out the cost of one cheese sandwich, using real ingredients. This is followed by costing a similar item at home, such as another sandwich with more ingredients.

Then the assessment task is introduced. Di does this about half an hour before the end of the session:
I would like you to do a costing on anything you like. Make it related to your own life, or something you are interested in. It doesn’t necessarily need to be costing food. It could be something else you’re using in your everyday life, if you’ve got a small hobby going or something like that.

Students are given a few minutes to discuss it, to bounce ideas off other people.

I find that if you give a really open task like that without the opportunity to discuss it, some people close up and don’t have any ideas.

Then the group comes back together, and students share their ideas with others.

The next step for them is to write down a description of their task and how they are going to go about it. Di checks that the task is going to be appropriate to satisfy what she is looking for.

I frequently find that there needs to be a reasonable amount of discussion with them. I also need to make sure that the task is deep enough to cover a significant number of assessment criteria. By asking questions, I can direct their thinking to a deeper level.

The students then gather the data they will need to go about that task, and bring that along to the next session, where they continue to work on the task.

Di reflects on the tasks undertaken by her students:

Students come up with a wide range of ideas, including a main course meal such as spaghetti bolognaise, or snacks such as tacos, cakes and slices. I remember a student who did floral arrangements, but had never gone through the process of actually costing them. This involved working out the cost of small numbers of flowers taken from several different bunches, such as two roses out of a bunch of twelve. But she did not relate this to work on fractions she had already done in class. With some assistance from me she was able to integrate her informal and formal knowledge and write it up using fractions terminology.

I had a student who did ceramic pottery, and so she had to cost in her materials and equipment such as paints and the paint brushes. Provided it satisfied the learning outcomes that I was looking for, the skill demonstration that I was looking for, that was fine.

One student costed spraying blackberries. He had to dilute the spray mixture so it brought in quite a few other concepts. If they need to bring in a concept we haven’t covered in class, I ask them how they are going to do it. I hear what they’re saying and, because it comes from their own life, and they’ve been doing it, they’ve actually got the numeracy to do it. It’s now putting it down in a formal way, which they may never have done before. And also making connections between what they have always done in real life and what we’ve done in the classroom [Di].
Example 2. Student-developed task: Buying Petrol

This task was negotiated with an individual student to address some of the Assessment Criteria of a medium level data-related learning outcome (CGEA 2.5: Numeracy for Interpreting Society-Data).

I believe that Data lends itself well to negotiation. Because the assessment criteria can be phrased in pretty student-friendly terms, I give this out to the students. And I say to the students, what I'm looking for is for you to use these skills in something that is of interest to you. And I give some examples to get them started [Di].

Di described negotiating a suitable assessment task with a student around buying petrol:

A student came up to me and really didn't have any idea what to do. In chatting to her I found out that she had never put petrol in her car. So we devised a task where she was going to put petrol in her car every week. We talked about how she could use that idea to satisfy the requirements of this Learning Outcome but also to extend her, for her to do something that she's never done before, that would be of benefit to her.

So we talked about what sort of information she could gather when she went to the bowser pump, for example the price of the petrol, how many litres would go in, and the number of kilometres she travelled.

Then she worked out how she would record it, what sort of table she would set up, and then later on did the graphing. She devised a table and decided on the columns and the headings. The next thing was doing the graph. She made two graphs: the amount of petrol against the cost, and total cost of petrol against date over a four-week period. But it was also a real challenge for her to go down to the service station and find out how to put the petrol in the car ... because her husband had always done it! [Di]

This task could be varied or extended to satisfy some higher level outcomes. Variations may include graphing daily fluctuations in petrol prices, or verifying the cost of petrol by checking the amount charged against the product of price and quantity as shown on the petrol pump. If students were keen to meet some measurement-related assessment criteria they could calculate petrol consumption (in litres per 100 km).

Example 3. Student-initiated question: Square Numbers

This task is an example of building an assessment task from a question posed by a student that lends itself to investigation. Di's higher level numeracy students had been learning about square numbers and square roots using a diagram of a square. A student then came up with the question:

"If 15 equals 10 plus 5, why doesn't 15^2 equal 10^2 plus 5^2?"
Di saw the opportunity to capitalise on the students’ curiosity, and encouraged the student to explore the question for herself. The student subsequently demonstrated diagrammatically why $10^2 + 5^2 = (10 + 5)^2$. She also went on to devise a general rule for squaring the sum of two numbers. The student wrote up the task and it was used as part of her assessment portfolio. (See Section 2, ‘Sample Assessment Tasks’ for the student’s response to this task)

**Example 4. Student-initiated question: How far is it to the horizon?**

This task was also based on a question initiated by a student. The question was: “How far is it to the horizon?” Di recognised the potential for exploring this question, and building it into an assessment task. Her response to this question was, “I don’t know Ken. That’s a great question”. She recalled how the assessment task was developed:

> So we talked about what the horizon is. And I asked questions such as, ‘what do you understand by the horizon, what things can you think would affect the horizon?’

> Then we had to figure out a method to work it out. This was pretty much my idea and then he used the method I suggested, which was basically Pythagoras using the radius of the Earth. Fortunately he had already learnt about Pythagoras, so it was a great opportunity to build on and apply this knowledge. We talked about what factors affected the distance of the horizon and I related a story about a time we came up from a dive and, because our heads were low in the water, and the water was choppy, we lost sight of our boat. We also talked about sailors in the old days climbing up the mast to sight land. I asked him if he thought that distance to the horizon is going to be constant and he said, ‘no it’s going to vary according to the height of the person above the earth.’

> He had to go and gather information such as the radius of the earth, and to come up with what heights he was going to use. And then he did the calculations and drew a graph relating height above the surface of the earth to the distance to the horizon [Di].

The student response is shown in Section 2, Sample Assessment Tasks & Materials (see pages 239 - 243).
Strategies for negotiating assessment

The process of negotiating an assessment task is basically the same process that we outlined for open-ended assessment except for some deviations which are set out in Figure 1 below.

Formulating the task or question(s)

Tuning in to the topic

Introducing the task

Reflecting on the task

Focussing students’ ideas and strategies

Working on the task

Encouraging evaluation and reflection - Is it reasonable?

Figure 1: Flowchart for using negotiated assessment tasks
Some issues and difficulties with negotiated assessment

Negotiating assessment has its challenges, as our discussions highlighted. There is always the possibility that the context chosen may not lend itself to the learning outcomes the teacher expects to be demonstrated.

Another potential pitfall of negotiated assessment is that students may head off unexpectedly into an area other than the one being assessed. This can be problematic if it is something that has been assessed previously or if it is a topic they have not met before.

Our discussions stressed that, to manage these issues, we need to maintain constant communication with students, from the initial time of negotiating the task, right through to its conclusion.

It’s a constant discussion. What are you doing now, can you show this in a different format? They don’t go away and do it all by themselves, they get feedback along the way, to see how they’re going ... Sometimes particular assessment criteria can’t be naturally brought in. If that happens, I’ll leave it. I won’t push them into the task just for the sake of it. I’d rather assess those criteria in some other way, either informally or in another task [Di].

However, teachers who have tried negotiating assessment tasks believe that the final outcome is worth it. This is illustrated powerfully by the comments of this student:

I didn’t know you could get so much information out of a graph. After I did all the calculations I finished up with a lot of figures which didn’t mean much to me. But when you put these figures into a graph it makes the figures mean something. It was amazing how easy it was to work out the distance you see to the horizon. I thought it would be a lot more complicated than it was. The hardest thing was knowing how to go about solving the problem, the maths was easy ... I was very lucky I had someone I could ask to show me the way to work it out. It was a good task for me to do.
Focussing on Student Confidence

Why focus on student confidence?

The teachers interviewed during the project were aware that many students in adult numeracy classes had experienced failure in the school system. Consequently they had lost confidence in their ability to learn. Familiar indicators were comments such as, 'I've never been able to do this' or 'I haven't got a mathematical mind.' As discussed in the first chapter, teachers saw growth in confidence is the most 'interwoven' component of Holistic Competence, touching on every other aspect of students' learning. They felt that confidence was a key aspect of competence; that the way a student went about a task told them just as much about their competence as their performance on the task itself.

It's about confidence. It's got a lot to do with attitude and affective things as much as the skills. They can have the skills but not the confidence to do something ... and feel good about it ... There has been a lot of talk about tasks that are equivalent to particular levels. But how you rate the student has a lot more to do with how they go about the task than what the task is [Barb].

A few of my students don't have the confidence, the panic sets in and they think that they can't do it. That to me means no, you're not level 3 ... if you have the confidence to tackle it ... then yes you would be competent [Liz].

During this holistic assessment project Jan maintained a series of detailed journal entries for several of her students. Changes in one student's confidence are described on pages 33 - 34.

Several teachers mentioned that body language was a key indicator of confidence:

It's like there's a body language that goes with it too. They sort of draw it in closer and they sort of 'get into it' like engaging with the piece of paper. Whereas it's a bit like a distance thing when they are not sure. They sort of look at it and it's not theirs [Barb].

Students' more confident approach was also associated with a growing belief in themselves:

The belief that they can do it ... Feeling free to question things and not feel stupid about it. .... Students will say it as well, 'I feel a lot more confident about that, my confidence has grown'. It's definitely a big part of assessment even though it is not written down [Liz].
Experienced adult numeracy practitioners know that it can take time and effort for students to overcome negative feelings and anxiety. Assisting students to build self-esteem and belief in their ability to learn successfully is an important part of numeracy teaching.

*Self esteem is extremely important. That has to be established and built up before a great deal of learning will occur. Sometimes it can take 3 or 4 months before any learning has occurred, because their brick walls are there. The challenge is to break those down and then the learning will occur. You can see it in their body language. That's the challenge, to read their body language and to build up their self esteem and confidence [Di].*

It became clear from our discussions that many teachers find it helpful to discuss some of these issues with students, either individually or as a class, to assist them to identify as numerate, 'can do' individuals.

**What does it mean to focus on student confidence?**

Focusing on student confidence means consciously structuring time and activities into the program as part of the formative assessment and teaching routine. Time for reflection, and time to encourage students to focus on their progress or changes in attitude to numeracy.

If we believe confidence is a key aspect of competence then it seems important that it becomes a more transparent part of the teaching and assessment process, rather than being left to chance. It is all too easy for students to focus on what they still cannot do, rather than on the progress they have made. Sometimes it is only after a particular incident or moment of reflection that we can 'see' how far we have come, and 'own' our skills. Therefore, an important teaching role is to facilitate the discussions that recognise positive achievements and changes in attitude. Such recognition might contribute to the ways in which students use their numeracy skills outside the classroom or how they approach further learning.

At the beginning of the program, students sharing their feelings about numeracy with one another can overcome feelings of isolation and help to build a supportive learning environment. During the program, this dialogue can be continued by setting aside time to help students 'see' some of the positive progress or change of attitude that might have taken place. Time might be allocated at regular intervals, or scheduled into the middle and end of the subject, to ensure that the aspect of change and growth in confidence is given attention.

The following section includes a number of discussion prompts and questions that were developed during the project. They were planned to assist students and teachers focus their attention on students' feelings about numeracy, their confidence levels, how their confidence has changed and how these changes came about.
One or two of the focus questions or prompts can be presented verbally, on cards, written on the board, or given on a sheet of paper. They can act as discussion starters or as writing prompts, depending on students' language and literacy levels. They might be used with individuals or the whole class.

**Sample strategies for focussing on student confidence**

The teachers involved in the project trialled a range of prompts and presentation formats with their students. Some prompts focus on general feelings about numeracy, and might be suitable for scheduling at particular points in the course. Others focus on progress in particular topics, and might be used regularly for a short time at the end of sessions. The modifications resulting from those trial runs are presented here, with advice on how they might be used. The collection is not meant to be comprehensive, but we hope it will trigger other ideas that would suit your particular student groups.

**Possible uses of the focus questions and prompts:**
- As a discussion starter in small groups or the whole class
- To facilitate individual teacher-student discussion
- As writing prompts for end-of-class reflection
- As prompts for ongoing journals.

**Note:**
It is most effective to use only one or two of these questions at a time. We found on our first trial that using many questions at once made the process rather daunting for the students, whereas one or two stimulated useful thought and discussion.

**Example formats and wording**

**Tick the box**

The tick the box format provides a set of words to help students name their feelings more easily.

```
How I feel about numeracy at the moment ...
(tick the words that best describe you)

<table>
<thead>
<tr>
<th>OK</th>
<th>Worried</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertain</td>
<td>Confident</td>
<td>Excited</td>
</tr>
<tr>
<td>Interested</td>
<td>Embarrassed</td>
<td>Relaxed</td>
</tr>
</tbody>
</table>

Any other words? ____________________________________________
```
Once these feelings are named, students can elaborate further if they wish in pairs (by sharing with another student), small groups or the whole class. Their responses can be collected by the teacher for use as a point of comparison later in the program or as part of a final self-assessment statement from the student.

The same exercise may be repeated later to look for changes in attitude. Alternatively, a range of formats or strategies may be used later in the program for a similar purpose.

When I think about doing maths I feel ...
(tick the words that best describe you)

<table>
<thead>
<tr>
<th>OK</th>
<th>Nervous</th>
<th>Blank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertain</td>
<td>Confident</td>
<td>Excited</td>
</tr>
<tr>
<td>Interested</td>
<td>Embarrassed</td>
<td>Relaxed</td>
</tr>
</tbody>
</table>

Any other words? ____________________________

Short prompts or sentence beginnings

These can be presented on a half sheet of paper to encourage students to express their immediate feelings after a session. Some ideas include:

- After the class today I feel ...
  Because ...

- I am good at ...
- I feel good at numeracy when ...
- I like numeracy most when ...
- I feel confident when ...
- To help myself feel good about numeracy, I ...
- When I feel “stuck” with a numeracy task I ...
- In Numeracy classes I enjoy ...
- The best thing about numeracy is ...
Focussing on Student Confidence

Brief questions

Similar to the prompts, these are designed to be used singly at various times during the course. Some ideas include:

- How do you feel about numeracy at the moment?
- How do you feel about .......... at the moment? [the teacher can insert any current topic in the space]
- What do you enjoy most in numeracy at the moment?
- What can you say to reward yourself when you complete a task?
- What can you say to encourage yourself to keep going in numeracy?

As mentioned above, any written student responses can be collected as a point of comparison later in the program, put in portfolios for future discussion, or used as part of a final self-assessment statement from the student. Oral responses can be noted by the teacher and used in a similar manner.

Photocopiable versions of all of the questions and prompts above are supplied in Section 2, Sample Assessment Tasks and Materials, p. 245.

More about confidence

The way in which numeracy is taught and assessed is also important if students are to become more confident. Teaching methods once considered innovative have now become widely used in the field. These include using enjoyable classroom activities such as games; hands-on and real-life materials; learning in pairs and small groups; and using familiar and relevant contexts. For a comprehensive discussion of principles for teaching adult numeracy, see Breaking the Maths Barrier (Marr & Helme, 1991)¹.

Specific strategies for overcoming maths anxiety and building positive attitudes can be found in Breaking the Maths Barrier, Strength in Numbers (Goddard, Marr, & Martin, 1991)² and Mathematics: A New Beginning (Marr & Helme, 1987)³. These publications also include many numeracy activities that promote student interaction, enjoyment, success, and, consequently, their self-confidence.

Footnotes:


Note: These three resources are available from ARIS, Language Australia - see page ii for contact details.
Focussing on Awareness of Learning

Students need to recognise what they know and understand ... For somebody else to be telling them they're competent I'm not quite sure whether that helps [Ruth].

Why focus on student awareness?

The teachers interviewed during the project felt that, besides making progress in their learning and understanding, students need also to be aware of the progress they have made. That is, students need to be able to articulate the concepts, skills, knowledge and understanding they have gained as a result of their involvement in numeracy classes. We believe that students who know what skills and knowledge they possess are more likely to make use of them.

Furthermore, teachers felt that students should also have some awareness of how they made these gains in understanding, that is, the learning strategies that they find most helpful, or approaches to learning that suit them as individuals. Having an awareness of how they learn best gives students the resources for further learning.

The what and how of learning

The teachers we interviewed look for evidence of awareness of learning achieved. This may involve putting their thoughts into words, perhaps by giving an explanation to the teacher or another student:

Sometimes they make a statement that means they understand something - if they say it, it means they understand it - to be able to put it into words.

Teachers also discussed the importance of students having an awareness of how they learn. Some expressed it in terms of learning style, or preferred way of learning. Barb mentioned a student who realised that she could understand better if she drew diagrams or pictures. In other words, she came to see herself as a visual learner.

Barb provides resources that accommodate different learning styles. She discussed some of her students who found hands-on materials helpful:

These guys know that the concrete stuff is there, the blocks and the counters and things are there. Because they are very active, touchy, sort of 'doing people' - mechanics and the like, that's been their life. That's how they've learned things - so we just say to them, 'use what's there, don't try and do it in your head.' They know that's how they need to do it, then they can move on
from there. Once people know that it is OK to do it any way that you like, then I think that is very important for them to grow [Barb].

What does it mean to focus on student awareness?

Focussing on student awareness means consciously structuring time and activities into the program as part of the formative teaching and assessment routine. This means ensuring that students have the time and opportunity to:

- Articulate their reasoning and strategies to other students
- Reflect on their progress and achievements
- Think about the strategies that helped them learn.

Sometimes it is only after a particular incident or moment of reflection that we can 'see' how far we have come, and 'own' our own skills. Therefore, an important teaching role is to facilitate the discussions that recognise positive achievements and how they have come about.

Reflecting on achievements at regular intervals throughout the program builds an awareness in students of their progress, as illustrated by the following comments:

Lately we have been reflecting on 'what you know and what you don't know' before the end of the class e.g. new words, concept map, reflecting on how the bits fit - 'let's try and gather your thoughts'.

I have helped one of my students reflect on the positive change - 'Remember when you started how you didn't know what all those words mean?' Helping him see the changes, ... how he has progressed [Sharon].

Instruction that incorporates a range of teaching and learning strategies gives students an opportunity to discover preferred ways of learning and also to broaden their repertoire of learning strategies. Teaching methods once considered innovative now have become widely used in the field. These include enjoyable classroom activities such as games; hands-on and real-life materials; learning in pairs or small groups; and using familiar and relevant contexts.

These approaches validate the use of strategies (such as blocks and other hands-on materials) that students might have previously thought to be inappropriate for adult learners. Discussing the relative strengths of different approaches gives students an opportunity to focus on what works for them, and why.

The following section includes a number of discussion prompts and questions that were developed during the project. They were planned to assist students and teachers focus their attention on learning; what progress students have made and how this progress came about. The focus questions can be presented verbally, on cards, written on the board, or given on a sheet of paper. One or two of the questions can act as discussion starters or writing prompts, depending on students' language and literacy levels. They might be used with individuals, small groups or the whole class.
Sample strategies for focussing on student awareness

The teachers involved in the project trialled a range of prompts and presentation formats with their students. The modifications resulting from those trial runs are presented here, with suggestions on how they might be used. The collection is not meant to be comprehensive, but we hope it will trigger other suggestions that would suit your particular student group.

Possible uses of the focus questions and prompts:
• As a discussion starter in small groups or the whole class
• To facilitate individual teacher-student discussion
• As writing prompts for end-of-class discussion
• As prompts for ongoing journals.

Note:
It is most effective to use only one or two of these questions at a time. We found on our first trial that using many questions at once made the process rather daunting for the students, whereas one or two stimulated useful thought and discussion.

Example formats and wording

Short prompts or sentence beginnings
These can be presented on a half sheet of paper to encourage students to articulate their learning:
• An activity I enjoyed recently was ...
• During this activity I learned ...
• Two or three important things I learned in numeracy recently are ...
• Something important I have learned in numeracy is ...
• I still want to learn about ...
• Something that helped me learn recently was ...
• Something from numeracy class that I have used in other places (eg. Home, work, shopping) is ...

Photocopyable versions of these prompts are reproduced in Section 2: *Sample Assessment Tasks and Materials*, p. 245.

Brief questions
Similar to the prompts, these are designed to be used singly at various times during the course. They can be presented verbally or in writing:
• What did you learn today?
• What helped you learn about (insert topic)?
• What do you know now that you didn't know at the beginning of today's class?
• Is there anything you feel uncertain about at the moment?
**Tick the box**
The tick the box format provides a set of words that help students articulate their thoughts.

The following activity asks students to tick the words that describe the way they learn best. Another way to use this activity is to cut up the phrases and ask students to sort them into “yes” and “no” categories. They could then give examples of situations where a particular strategy helped them learn something.

<table>
<thead>
<tr>
<th>Tick the words that describe what helps you learn best:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking someone else</td>
</tr>
<tr>
<td>Working with others</td>
</tr>
<tr>
<td>Writing things down</td>
</tr>
<tr>
<td>Working on my own</td>
</tr>
<tr>
<td>Using materials and equipment</td>
</tr>
</tbody>
</table>

Any more thoughts on what helps you learn?

______________________________

______________________________

Photocopiable versions of all the questions and prompts are supplied in Section 2: *Sample Assessment Tasks and Materials*, p.245.
Focussing on Student Autonomy

I really like to see them taking charge of their own learning. It's really good when they come up to you and say 'I really don't know this well enough. What can I do to be able to do it better?' [Jakki]

Why focus on Student autonomy?

Many students in adult numeracy classes have had little formal schooling, or have experienced failure in the school system for one reason or another, such as interrupted schooling, and lives disrupted by family upheavals. This means that many students enter adult classes having never had the opportunity to develop effective learning strategies. Prior experiences of education may also have contributed to the belief that learning results from being told what to do rather than actively constructing understanding for oneself.

As discussed in the first chapter, teachers saw the development of student autonomy as a key aspect of competence. Autonomy means students taking initiative, having less need for assistance and a greater sense of control over the direction of their learning:

*Their move from dependence to independence is something I look fairly closely at ... taking control over their own learning* [Liz].

*They have the confidence to ask you questions about their learning. I like them to get involved and see that they can take control of it. They don’t need me to tell them everything ... The ability to come up with strategies, even if those strategies don’t work. Looking at it, saying ‘well that didn’t work, we’ll try it a different way’* [Jakki].

When the experienced practitioner group addressed the issue of student autonomy, they identified a number of valued student behaviours that indicated growth in autonomy. These included:

- Getting started on new tasks with less assistance than before
- Expressing opinions more readily
- Trying out new ideas without excessive dependence on the teacher or other students
- Explaining ideas and method to other students
- Asking for homework and completing it
- Asking questions that indicate prior reflective thinking
- Selective note taking
- Organising notes and worksheets logically into a folder.
Experienced adult numeracy practitioners know that it can take time and effort for students to be able to take these initiatives with their learning. Assisting students to develop their independent learning skills is therefore an important part of numeracy teaching.

What does it mean to focus on student autonomy?

Focussing on students' autonomy means devoting some time in the program to developing active and independent learning skills, rather than leaving it to chance. Therefore an important teaching role is to encourage student independence. This includes using teaching strategies that encourage students to take more control of their learning, and encouraging students' awareness of the skills and strategies they will find helpful for learning.

Teachers involved in the project discussed a number of strategies that encourage independent learning. These included teaching strategies, classroom activities, assessment strategies and homework. These strategies are discussed in detail below.

Teaching strategies for focussing on students autonomy

Teaching strategies that experienced numeracy teachers use to promote student autonomy include: giving students freedom of choice in activities they do; strategies for responding to student questions; questioning strategies, and promoting Task Process Cycle skills.

Giving students choices

Giving students choices in classroom activities encourages students to take greater responsibility for the content and direction of their learning.

*I give students a choice: a choice of warm-up activities at the beginning of the class, a choice of difficulty of the worksheets that they do, and choice in assessment tasks [Di].*

For further discussion of how students can exercise choice in assessment see the Negotiating Assessment chapter, p. 83.

Responding to student questions

We discussed the value of not immediately giving answers to students, but encouraging them to think things through for themselves:

*When doing volume one of the students was arguing about whether it made a difference which order they put height, width and length in when calculating volume. She asked me but I said, 'why don't you try it and see?' which forces them to take more responsibility [Chris].*
Sharon described in detail how she responds to student questions:

_Not giving answers is really a focus in my class. I always elicit, draw out knowledge that students have themselves. This affirms for me where students are at, their conceptual knowledge and level of understanding. It also gives a sense of ownership of their knowledge, which is all-important for self-confidence. The idea that they know something and can explain how they know it is ownership and gives a real sense of control of the learning process [Sharon]._

In her journal Sharon gave an example from a low level class where students were having problems with how to halve something:

> When questioned or prompted they still haven't grasped the concept of splitting it in two. We've used pictures, cut oranges, used divide by on the calculator etc. One student however has 'got it' and whenever the problem of half arises, he will be called on by the other members of the group, to remind them of how to do it.

**Student 1: Jason, how do you half something again?**

**Jason:** Divide it.

**Student 1:** Yeh, OK. What do you divide it with?

**Jason:** You divide by two, remember it's like the apples, it's cut with the knife down the middle, split right down, two pieces - that's why its divide by two, two pieces, two bits.

**Teacher:** What do you always do to have something Jason?

**Jason:** You divide by two.

From the content of this dialogue and the matter of fact tone of Jason's voice Sharon concluded that he showed understanding and ownership: as she put it 'he is displaying the characteristics of a numerate learner.'

**Building on student questions**

Making use of students' questions, curiosity, experience and input encourages them to make active contributions to their learning. It validates their interest and positions them as a person who asks questions and raises issues rather than someone who only answers the teacher's questions. Many student questions can provide a starting point for further exploration.
They can also be used as the basis for a class activity or a negotiated assessment task.

One of the students said ‘what is the area of China?’ and I said ‘you find out.’ She did it at home. I suggested she come back the next week. A couple of the other women helped her get the information [Chris].

This information was subsequently used by the class to compare the population density of China with that of Australia. Alternatively, it could have formed the basis of a negotiated assessment task with the individual student.

Questioning strategies

There are a number of questioning strategies that encourage self reliance and are helpful for reducing students’ dependence on the teacher-as-expert.

Di values the process of questioning students to draw out the knowledge they already have:

I always draw out knowledge that students have themselves. This affirms for me where the students are at. It gives me an idea of what they know, their level of understanding and conceptual knowledge. It also gives students a sense of ownership of their knowledge, which is also all-important for self-confidence. The idea that they know something and can explain how they know it is ownership. It gives a sense of control over the learning process [Di].

Experienced numeracy teachers are experts at dealing with student questions such as ‘Is this right?’ or ‘How do I do this?’ There are many responses one could make, but ‘What do you think?’ is a useful all-purpose starting point.

Another valued questioning strategy is to increase ‘wait time’. When we ask students a question, we need to give them enough time to think about an idea before expecting them to respond. This means resisting the temptation to 'jump in' and give an answer ourselves before they have really had enough time to think it through.

Promoting the Task Process Cycle

Focussing on all aspects of the Task Process Cycle is important for building students’ independence and developing their ability to find a pathway through tasks, rather than just demonstrating skills. As discussed in the first chapter, the Task Process Cycle skills include selecting relevant information, choosing a strategy, applying the strategy and reflecting on outcomes. It is especially important to encourage students to reflect on the reasonableness of their methods and answers for themselves, rather than depending on the teacher (or the answers in the back of the book).
Classroom activities that focus on student autonomy

It may be useful from time to time to address the issue of autonomy more specifically. This can be done by giving students feedback and encouragement when they demonstrate greater self-reliance or reflective thinking. It may be appropriate to discuss organisational issues with students, such as finding time (and a place) to do homework, or ways of storing and organising their work.

We have included below a number of discussion starters that focus on the skills and strategies that we consider important for developing students’ independence. These could be presented to the whole class, or given to small groups to discuss among themselves. They could be presented verbally or written down, and require either a verbal or written response. This collection is not meant to be comprehensive, but we hope it will trigger other suggestions that would suit your particular student groups.

Possible uses of the focus questions and prompts include:
- As a discussion starter in small groups or the whole class
- To facilitate individual teacher-student discussion
- As writing prompts for end-of-class discussion
- As prompts for ongoing student journals.

Note:
It is most effective to use only one or two of these questions or prompts at a time. As mentioned already, using too many questions at once can make the process rather daunting for students, whereas one or two can stimulate useful thought and discussion.

Example formats and wording

Short prompts or sentence beginnings:
- Before asking the teacher ‘Is it right?’ I could …
- When I don’t know how to get started I could …
- To help me feel more confident with (insert topic) I could …
- Something I can do at home to help my numeracy learning is …

Brief questions:
- Do you think homework is important? Why?
- What could you do at home to help you with numeracy?
- How can you make sure you do some homework?
- You have a spare 20 minutes. What could you do to help you with (insert topic)?
- What could you do with your child(ren) to help everyone learn some numeracy?
- What could you do outside class with other students to help each other with numeracy? (e.g. meet before class to discuss homework.)

Photocopiable versions of these prompts are reproduced in Section 2: Sample Assessment Tasks and Materials, p. 257.
Assessment strategies that promote student autonomy

Assessment strategies that require students to make choices about the content and direction of assessment tasks are a powerful means of encouraging and rewarding student autonomy. Open-ended assessment gives students the freedom to experiment and test their ideas, and therefore more control of the learning cycle. See the Using Open-Ended Assessment Tasks chapter for a full discussion of this approach to assessment.

Negotiated assessment, whereby assessment tasks are negotiated between the teacher and an individual student, has built into it an even greater opportunity for students to demonstrate their independent learning skills, because students are involved in devising their own assessment tasks. For a full discussion of this approach to assessment see the Negotiating Assessment Chapter.

Homework assignments are also widely used as a form of assessment. They allow students to work independently in their own time and take responsibility for meeting assessment requirements.

Homework

Homework and practising numeracy outside the classroom was discussed in great detail by the experienced practitioners, and all agreed that it was a valuable means for developing student autonomy.

Why give homework?

When discussing the strengths of homework as a means of promoting independent learning we discovered there were variations in the way that teachers used homework. These were related to differences in students' confidence, independence and numeracy levels. For example, some teachers use homework to reinforce basic skills and concepts whilst others use it for students to explore a topic more deeply, in their own time.

Our discussions also recognised the possibility of homework becoming a series of tasks that students merely respond to, rather than an activity that promotes independent learning. However, we agreed that the potential advantages of homework outweigh this disadvantage, and concluded that homework is an important tool for developing students' numeracy competence.

Practising numeracy at home

Homework does not necessarily mean undertaking specific tasks set or suggested by the teacher. There are many practical things students can do outside of the class, including at home, in their spare time:

• Practice estimation and mental calculation when shopping
• Estimate then measure ingredients when cooking
• Put up visual aids around the home (e.g. metric charts, multiplication and addition facts on mirrors or doors)
• Use small amounts of spare time to learn number facts (eg reciting multiplication tables when doing the dishes or reading number facts from cards while waiting for a bus)
• Play dice and card games with other members of the family
• Students with school-age children can make homework a shared activity.

**Homework consolidates basic skills**

Sharon has found homework useful for consolidating basic skills:

*I started a while ago with one group. I just gave them a homework sheet with basic skills. I also gave them a record sheet with the name of the sheet, the date I gave it to them, when they did it, and I sign it at the end. I gave it to them wondering how it would go, and it’s just become infamous. I told them to bring it every week because I had to sign it. I do it with my ESL class, hearing impaired students, the ALBE class and mildly intellectually disabled students. I’ve never had anyone lose the record sheet. And every group of students, even those who lose everything else turn up every week with these homework sheets. And if I forget to sign it they tell me - and if they are away they ask for the homework for that week.*

*I don’t know why but it’s become this real routine, that has worked with all of these groups. They love it! Maybe it works so well because it’s something that they can do. If I attempted to give them anything else that required the skills they don’t have yet, then they probably wouldn’t do it. It’s very concrete and straight-forward. They can do it by themselves, at their own level. It builds their confidence - they see that they can do it [Sharon].*

**Homework builds confidence**

Homework can contribute to students’ comfort with new learning and sense of ownership of their learning. Jan described a process in which she offers extra reinforcement by giving homework sheets to students who need more practice.

*Homework is usually reinforcement when students are not yet comfortable with concepts. One of the problems is that everyone wants to take the sheets whether or not they need them. But lately we have been reflecting on ‘what you know and what you don’t know’ before the end of the class, so that they can be a bit more intuitive about what they need. So homework is not given to a class as such - but there is that sense of obligation to own your own learning [Jan].*
Homework gives students time for thinking and reflection

Homework gives students the opportunity to explore ideas more deeply without the pressure of time.

I give things that will benefit from more time and reflection. A week gives them the opportunity to work thorough worded problems at their own pace.

Sometimes I ask them to investigate little questions between classes, for example, ‘what does a litre of milk weigh?’ You have to start with a little and gradually build up to the stage where they are used to doing homework, rather than giving them a whole lot.

I sometimes start a problem off about half an hour before the end of the class - like the handshake problem so they get the hang of it in class - then pose some more questions for them to take way and think about and puzzle over during the gap between classes. They may try it out with their family. They draw on problem solving strategies until they get it, without the pressure of time. I just say ‘have a go. It doesn’t matter if you can’t do it’ - then we come together in the next session and share strategies [Di].

Homework promotes ‘learning to learn’

The migrant youth I work with, their whole experience education is very different. The homework concept is way down the track. They just have to get used to education and learning and some of the learning to learn stuff - it’s all new to them. They are so much in the process of learning to be students. I don’t have a lot of independent learners - some of the boys don’t even bring paper with them [Sharon].

Homework initiates students into formal learning. It helps foster ‘learning to learn’ skills, including finding a place to do homework, and organising time and materials.

It’s a matter of encouraging students with low confidence, building them up gradually. A matter of ‘enculturation’ into being a student. Expecting them to do some work at home and finding a place to do it, somewhere they can sit down and work. Actually buying yourself a folder and some paper and pens. There’s another adult literacy student who came in to the group with very few skills but now has himself organised with folder and pens and goes to lots of classes and is really getting somewhere. So it just takes time to build it up. I think that if there are students in the group doing this they are wonderful role models for the others [Sue].
Homework meets individual needs

Different homework can be given to different students, depending on their needs:

*I guess in my small class I am trying to meet individual needs. But I don’t give them all the same thing. For example, ESL students will ask for more stuff on language so I will give that. Some say ‘I am not going to do it’ and that’s it. Others say they are but they are really disorganised, they lose things. But I always make sure I write down what task they have taken so I can ask for it the following week, check that the homework doesn’t disappear. [Sue].

Homework meets social and family needs

Some members of the group commented that students benefit from the social contact involved in doing homework together as much as from the work itself:

*Peer pressure. They work together in groups so if one person takes homework than the others say ‘me too’ and so then everyone wants some ... Many of them go to the library for an hour before their next class. They use it partially as a social thing [Chris].

For adult students with children at school it can be a shared family activity, and an opportunity for students to model learning behaviour to their children:

*I think the reason why my students do homework is because they all have school-aged children who do homework. They talk to me about how their children react to their parents sitting down doing homework. It is an absolute delight to their children so the parents gain from it as well. In some cases where they have secondary aged children they talk about what they are doing. So they see it as more than just a homework sheet. They see it as an opportunity to model behaviour to their kids – ‘I’ve got my homework, you come and sit down and do yours’ [Chris].
Section 2:
Sample Assessment Tasks & Materials
Introduction

This section presents detailed descriptions of a selection of the assessment tasks developed during the project, along with a range of templates and stimulus materials for developing these types of assessment tasks and related classroom activities.

Each task description provides details of:
- The possible numeracy levels
- Skills and knowledge that can potentially be observed whilst students perform the task
- Preparation and materials needed for the task
- Suggested procedures for using the tasks in a classroom context
- Possible extensions and links to other literacy and numeracy tasks
- Suggested tasks of a similar nature.

Suggested observation and recording sheets have been included with several of the tasks in this section, for example, practical tasks at the lower levels of numeracy, for which written student work may not be an appropriate expectation. As well, samples of student responses with accompanying discussion are provided for selected tasks in this section. These are discussed in terms of general competencies using the Task Process Cycle.

The tasks from this section are displayed in a grid on the following page. This grid indicates the task's potential levels in terms of low, medium, and high; its mathematical/numeracy area; and its assessment type. These categories are explained in more detail below. The grid also indicates which tasks have accompanying record sheets, sample student responses or resource materials.

Task's potential levels

The levels for each task are described against three levels: Low, Medium and High.

Low
Low level activities and tasks are suitable for students needing to develop their confidence in performing simple and familiar numeracy tasks and to develop the ability to make sense of mathematics in their daily lives. At this level students are only expected to perform mathematical tasks involving a single mathematical step or process. Their communication about mathematical ideas would mainly be spoken rather than written. The mathematics involved could include measurement, shape, numbers, and graphs that are part of the student's normal routines to do with shopping, travelling, cooking, interpreting public information, telling the time, and similar daily tasks.

Medium
At the medium level students will be more capable of exploring mathematics beyond its familiar and everyday use, to its application in wider, less personal contexts. Such contexts include newspapers and other media reports, workplace documents and procedures, and specific projects at home or in the community. Students would be able
to attempt a series of operations or tasks with some confidence, be able to select the appropriate method or approach required, and to communicate their ideas in a combination of spoken and written form. They would be at ease with straightforward calculations either manually and/or using a calculator. The mathematics covered is extended beyond that introduced at the lower level and would include measurement, graphs and simple statistics, and the use of maps and directions.

**High**
This level of task or activity is focussed more on learning mathematics for further study, including the early stages of knowledge and skills belonging to formal areas of mathematics such as the use and application of algebra. Students would be able to confidently perform calculations using a variety of methods. They would be able to interpret and use some formal symbols and conventions of mathematics in order to solve simple problems, and to communicate their problem solving processes in writing using a variety of informal and formal language. The mathematics involved includes: numerical calculations and analysis of graphical data required for interpreting information; the use of formulae and graphs, and algebraic techniques and problem solving strategies.

**Australian equivalents**
The three levels approximate to the following levels of the National Reporting System (NRS) and Certificates in General Education for Adults (CGEA):

- **Low:** National Reporting System (NRS) levels 1 and 2; Certificates in General Education for Adults (CGEA): Certificate I – Introductory and Certificate I.
- **Medium:** National Reporting System (NRS) levels 3 and 4; Certificates in General Education for Adults (CGEA) – Certificate II.
- **High:** National Reporting System (NRS) level 5; Certificates in General Education for Adults (CGEA) – Certificate III.

**Mathematical/numeracy area**
Each task is also described in terms of its mathematical area, according to accepted curriculum strands of measurement; number; data and statistics; space & shape; and algebra.

**Assessment type**
Each task is also described in terms of the types of assessment tasks described and elaborated in Section 1:
- Open-ended
- Reality-based
- Negotiated
- Formative.
# Grid of assessment tasks

<table>
<thead>
<tr>
<th>Task/activity name:</th>
<th>Level</th>
<th>Math/num. strand</th>
<th>Type of assessment task</th>
<th>Recording sheet included</th>
<th>Student responses included</th>
<th>Samples of materials incl.</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number Card Sorting</td>
<td>L/M &amp; H</td>
<td>N</td>
<td>F</td>
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<tr>
<td>2. Making Biscuits</td>
<td>L</td>
<td>M</td>
<td>RB</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>3. Mystery Location</td>
<td>L &amp; M</td>
<td>S</td>
<td>RB &amp; OE</td>
<td>✓</td>
<td>✓</td>
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<td>4. Describing &amp; Drawing Shapes</td>
<td>L &amp; M</td>
<td>S</td>
<td>OE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>5. Anyone for Pizza?</td>
<td>L/M &amp; H</td>
<td>N &amp; A</td>
<td>RB &amp; OE</td>
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<td>7. How Many Drinks?</td>
<td>L/M</td>
<td>M</td>
<td>RB &amp; F</td>
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<td>8. Design a Better Box</td>
<td>M/H</td>
<td>M</td>
<td>RB &amp; OE</td>
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<td>9. The Price of Biscuits</td>
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<td>11. Battery Hen Cages</td>
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<td>M &amp; A</td>
<td>OE &amp; RB</td>
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<td>12. Comparing Age Distributions</td>
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<td>D &amp; M</td>
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<td>16. Square Numbers</td>
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<td>N</td>
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<td>17. How Far is it to the Horizon?</td>
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<td>19. Template for Open-Ended Tasks</td>
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1 **Levels**: L = Low; M = Medium; H = High (see page # for description)
2 **Maths strand**: M = Measurement; N = Number; D = Data; S = Space & Shape; A = Algebra
3 **Type of assessment task**: OE = Open-ended; RB = Reality-based; N = Negotiated; F = Formative
Number Card Sorting

This formative assessment task grew out of a task that Sharon gave her students, in which they grouped numbers on cards according to their own criteria (Set 1). The task was then adapted by Jan and Sue, who developed two further sets of numbers (Sets 2 and 3).

This task has two parts. In Part 1 students arrange the cards in a way that makes sense to them. It is open ended to the extent that students choose their own categories, or logical groupings. If students produce some meaningful groupings in Part 1, then they can attempt Part 2, in which students are given blank cards to add further ideas to their groupings. Part 2 asks students to express their ideas in the form of numbers, words or pictures. This allows students to demonstrate their understanding of different ways of expressing numerical quantities. It is also an opportunity for teachers to uncover student misconceptions.

This task is a valuable formative assessment of student knowledge and understanding of numbers and their links to real world usage.

Potential levels, skills and knowledge

Low/Medium: Sets 1 and 2: Meaning of familiar decimals, fractions, money, time and metric quantities.

High: Set 3: Meaning of number system representations and symbols such as $-5$, $\pi$, $\sqrt{2}$.

Preparation

Materials required

- Sets of number cards (see Sets 1, 2 and 3 for examples). If using set 1, select a subset of a manageable size (e.g. about 20). Place each set of cards in an envelope, with one set of cards per pair of students
- A second envelope containing a number of blank cards (for Part 2)
- Copies of the observation sheet (p. 132) – either one observation ticksheet for the whole class, or one copy per student of the individual student observation sheet.

Formulating the task or question(s)

Part 1
Question for Part 1: Arrange the cards in a way that makes sense to you.

This wording encourages students to decide for themselves how they might arrange the cards.
Part 2
Question for Part 2: Use the blank cards to add more ideas to your arrangement. Your ideas can be pictures, words or numbers.

This wording encourages a range of forms of representation.

Note:
These questions are reproduced in photocopiable format at the end of the task.

Suggested procedure

Introducing the task

Part 1
Hand out the question for Part 1 and the envelope of cards to pairs of students. Give them time to look at the cards, read the question, and think about what they might do with the cards. Advise students to:
- Read the question aloud
- Take it in turns to pick up each card
- Read their cards aloud to each other as they pick them up
- Agree with each other before they arrange the cards
- Feel free to change their arrangement at any time.

Working on the task

Part 1
As students work on Part 1, circulate and ask questions to encourage explanation and deeper thinking, such as:
- Tell me about your ideas so far.
- Why did you decide to put that one there?
- How do those ones belong together?

When students report that they have completed Part 1 ask them to explain the basis of their groupings.

Part 2
Go on to Part 2 if students have demonstrated some logical reasoning or groupings in their response to Part 1.*

*Logical groupings may include, for example, all numbers of a particular type grouped together (e.g. fractions, negative numbers), numbers arranged in order of size, equivalent quantities grouped together, or some other grouping. Do not be concerned if students put some cards in the ‘too hard’ basket. Just take note of these and move on to Part 2.
Hand out Question 2 and about four blank cards. As students work on Part 2 you may need to encourage them to broaden their responses, by asking questions such as:

- Can you think of another way of showing that number?

More blank cards could be given later to groups who seem to be engaged in creative discussion, but do not overwhelm students by presenting too many blanks at once.

**Encouraging evaluation and reflection - Is it reasonable?**

When students are finalising responses, facilitate reflection and evaluation by asking questions appropriate to their level, such as:

- Does that seem reasonable to you?
- Is there anything you would like to change?
- Can you think of another way to draw or describe that number?

**Recording outcomes**

There are several approaches you could use to record student outcomes:

- Photocopy students’ arrangements (and their additional written responses if they attempted Part 2)
- Students glue or tape their arrangements on to a sheet of paper (you may prefer to use paper rather than cards if recording responses in this way since the cards will not be reusable)
- Use a recording sheet, such as the sample shown on p.# that has been designed to record responses to Set 2
- Use a teacher journal to record observations and reflections made during the activity (see examples on page 131).

**Links, extensions, follow-up tasks**

This task format can be used at all levels and wherever it is valuable for students to explore the meaning of mathematical symbols and forms of representation. Further examples are: language of operations, space, shape, design, location, data, algebra. The possibilities are endless.
Number Card Sorting - Question Cards

Card Sorting task 1

Arrange the cards in a way that makes sense to you.

Card Sorting task 2

Use the blank cards to add more ideas to your arrangement.

(Your ideas can be pictures, words or numbers.)
<table>
<thead>
<tr>
<th>Number Card Sorting - Set 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{2} ) hour</td>
</tr>
<tr>
<td>30 mins</td>
</tr>
<tr>
<td>1 ( \frac{1}{2} ) hour</td>
</tr>
<tr>
<td>0.75 hour</td>
</tr>
<tr>
<td>quarter an hour</td>
</tr>
</tbody>
</table>
Number Card Sorting - Set 1 cont’d.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>1/4</td>
<td>3/4</td>
</tr>
<tr>
<td>0.5</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>half</td>
<td>quarter</td>
<td>three quarters</td>
</tr>
<tr>
<td>50c</td>
<td>25c</td>
<td>75c</td>
</tr>
<tr>
<td>1 1/2 kg</td>
<td>1500g</td>
<td>1.5 kg</td>
</tr>
</tbody>
</table>
### Number Card Sorting - Set 1 cont’d.

<table>
<thead>
<tr>
<th>1 1/2</th>
<th>1.5</th>
<th>250 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000 g</td>
<td>750 g</td>
</tr>
<tr>
<td>500 g</td>
<td>3 1/2</td>
<td>3.5</td>
</tr>
</tbody>
</table>
### Number Card Sorting - Set 2

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Percentage</th>
<th>Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{2}$</td>
<td>50%</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>.25</td>
<td>$\frac{3}{4}$</td>
<td>75%</td>
</tr>
<tr>
<td>Three quarters</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>A whole</td>
<td>1.50</td>
<td><strong>HALF PRICE SALE!</strong></td>
</tr>
<tr>
<td>A quarter of an hour</td>
<td>Cheese slices: 25% fat</td>
<td>Video Movie&lt;br&gt;Running time: 90 mins</td>
</tr>
</tbody>
</table>
Number Card Sorting - Set 2 cont’d.

<table>
<thead>
<tr>
<th>100% Pure Cotton</th>
<th>Petrol</th>
<th>Apple</th>
<th>Apple</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>Number Card Sorting - Set 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \pi ) 0.3 33.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-5 0 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-\frac{1}{4}) 2.5 0.05%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 12.5% (\frac{1}{10})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\frac{1}{2000}) 1 (\frac{1}{5}) (\frac{1}{8})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Number Card Sorting - Set 3 cont’d.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>√9</td>
<td>√2</td>
<td>1:9</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

Sample student responses

Analysis of student responses

Group A

This group organised the cards together correctly to show an understanding of common fractions, percentage and decimal notation.

They have also indicated their understanding of real-world use and meaning by interpreting the time of 90 minutes as 1½ hours and linking quarter of an hour with pictures and other representations of a quarter; and also interpreting the marker on the petrol gauge.

Their confidence with the visual representation of fractions of a whole is clear from what they have chosen to put on the blank cards, taking the diagrams supplied as a cue for further drawings.

It is possible to infer that they are less confident about symbols and the teacher could explore this further with the group.

Group B

This group shows a broader understanding of different representations than Group A. They have included not only visual representations on their blank cards, but also an ability to use symbols (decimals, fractions and percentages) and a process (for example, “$\frac{100}{100}$” and “50% + 25%”) to represent values.

The “up to 25% off” card lends itself to a discussions of advertising strategies - a common real world application where percentages are used in TV and Newspaper advertising. The “full and half” stick people drawing also indicates an understanding of the relationship between a whole and a half and possibly the relationship of this to past notions of full and half-prices, for example, on public transport. This could be used to open up a discussions and investigations into children’s and concession fare prices operating today.

This activity revealed one student’s misunderstanding about 1.50 and 1.5 representing the same quantities. Because he expressed his doubts during the task, the teacher was able to spend time exploring this with him until it became clear.
Group A:

- 0.25
- 1/4 A quarter of an hour
- Cheese slices: 25% fat

- 50%
- 1/2 HALF PRICE SALE!

- 3/4 Petrol
- 75% Three quarters

- 1
- 1.00 A whole
- 100% Pure Cotton

- 1.50 Video Movie
  Running time: 90 mins

Note: The shaded cards indicate the cards that have been drawn by students in Part 2.
Group B:

- 1/4 .25
- A quarter of an hour

- Cheese slices: 25% fat
- 25%
- Up to 25% off

- 50% 1/2
- HALF PRICE SALE!
- 0.50
- 50¢

- 3/4
- Petrol 50% + 25%
- 0.75

- 1
- Three quarters
- 100% Pure Cotton
- A whole

- 150%
- 1/2
- 1.5

- 1.50
- Video Movie Running time: 90 mins
Sample Model of Teacher Record

Below is a sample of a teacher's notes about students' work on the Card activity. They were recorded in Sharon's journal. The group was a low level numeracy group, and they were using a selection of the cards from Set 1.

Maria - could add/match up all the $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ with 0.25, 0.5, 0.75 etc.
- knew 45 mins = $\frac{3}{4}$ hr etc.

Athena - still stuck with $\frac{1}{4}$, can identify $\frac{1}{2}$ with 50c = 0.5

Robyn - can't identify $\frac{1}{4}$ as 0.25, or $\frac{3}{4}$ as 0.75
- can't do yet 45 mins = $\frac{3}{4}$ hr

Mario - much the same as Robyn

Athena - knows $\frac{1}{2}$ hour = 30 mins (assoc. with TV show she watches).
Number Card Sorting

Sample Recording Sheet for Individual Students

Student Name: ___________________________ Date: ________________

Observed skills:

☐ Groups cards according to form of representation (e.g. all fractions grouped together)

☐ Partially completes grouping of equivalent values

☐ Completes grouping of equivalent values

☐ Produces at least one further representation of each value

☐ Other ____________________________

Further observations and comments
(e.g. teacher prompting, assistance received, leadership in task, other knowledge demonstrated):

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:

[p] – indicates prompting from teacher

[a] – indicates a significant amount of assistance from other student or teacher

[l] – indicates the student took a leading role in strategy and decision making.
Making Biscuits

Chris originally used this practical task with her students, asking them to follow a recipe and make either Chocolate chip or Anzac biscuits. She followed it with a task in which they calculated the cost of the biscuits and compared it to the cost of buying the equivalent commercial variety (see p. 197). The task allows for observation of students competence in following instructions, selecting measuring equipment and measuring ingredients in metric units.

Potential levels, skills and knowledge

Low: Practical measurement of volumes and mass using domestic measuring equipment. Following procedural instructions.

Preparation

Arrange access to a kitchen.

If a kitchen is not available, non-cook recipes (eg truffles, hedgehog) can be made instead in the classroom. If a microwave oven is available, this gives greater scope for preparing non-cook slices that require melted ingredients.

Materials required

- Recipes for making at least two types of biscuits (eg. Anzacs and Chocolate chip)
- Ingredients required for the recipes. (These could be bought in advance by you – or by the students as a related practical task – keep the docket for later use)
- Domestic scales and measuring jugs, spoons, cups, as required by the recipe.

Suggested procedure

Tuning in to the topic

Ask students about the sort of biscuits they like to eat.
Discuss favourite recipes for home-made biscuits.
Ask students if they have tasted Anzac biscuits or chocolate-chip biscuits.
Discuss the term Anzac, and its probable origin.
Introducing the task

Ask students to work in pairs, or individually if they prefer, and you have enough equipment. Each pair should select which biscuits they would prefer to make and negotiate to ensure both varieties are created amongst the class.

Working on the task

Students make their choice of biscuits, carefully measuring out ingredients, cooking for the specified time and temperature.

If you intend doing the follow-up costing task, ask them at the end to measure the size and/or weight of the finished product.

This task provides lots of opportunity to observe students' practical measurement skills.

Encouraging evaluation and reflection - Is it reasonable?

Students could be encouraged to consider the taste and texture of the biscuits and judge whether they have followed the recipe successfully.

• Would they make any changes next time?
• Do they think they will try the recipe at home? - Why or why not?

They could also compare their home-made variety to the commercial equivalents, judge which they prefer and why?

Recording student outcomes

Students practical measuring skills can be observed whilst they are performing this task. A description of the task and record of your observations can be added to each student's portfolio, or submitted for moderation /verification.

There are sample recording sheets provided for this task - see page #. These recording sheets may also be suitable for use with other measurement type questions where the stages of the Task Process Cycle may be very similar.

Links, extensions, follow-up tasks

A recommended follow up task compares the cost of these biscuits to their commercial equivalents (see p. 197).

Similar tasks

Any simple cooking task is recommended as a means of teaching and assessing students' practical measuring skills.
Making Biscuits - Sample stimuli

**Anzac Biscuits**

**INGREDIENTS**
- 1 cup rolled oats
- 1 cup coconut
- 1 cup plain flour
- 1/2 cup sugar
- 125g (4oz) butter
- 1 tablespoon golden syrup
- 1 teaspoon bicarbonate of soda
- 2 tablespoons water

Preheat oven to 150°C
Mix oats, flour, sugar and coconut together.
Melt syrup and butter together.
Mix soda with boiling water and add to melted butter and syrup.
Add to dry ingredients.
Place 1 tablespoonfuls of mixture on greased tray
(allow room for spreading).
Bake for 20 minutes.
Loosen while warm, cool on trays.
(makes about 35)
Making Biscuits

Sample Recording Sheet for Individual Students

Student Name: ____________________ Date: ____________________

Task or questions undertaken: _______________________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
☐ Demonstrated understanding of task – translated task into words, communicated meaning of
  task, understands conventions and purpose of recipe, rephrased task in own language
☐ Identified and interpreted relevant information in the recipe and on ingredient packets

Choose strategy
☐ Selected strategy that demonstrates understanding of the task/process required – e.g.
  follows recipe in purposeful manner

Apply strategy
☐ Correctly used appropriate measuring equipment
☐ Read calibrations on measuring equipment with reasonable accuracy
☐ Followed instructions in necessary order
☐ Set oven temperature as directed
☐ Demonstrated understanding of size and space when items arranged for cooking
☐ Counted biscuits accurately

Reflect on outcomes
☐ Judged from past experience whether the cooking was successful
☐ Discussed cooking process - eg difficulties or achievements

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
Making Biscuits

Sample Key for Class Observation & Recording Sheet

Group: ___________________________  Date: ________________

Task or questions undertaken: ____________________________

Observed Stages of the Task Process Cycle:

Select relevant information
a) Demonstrated understanding of task – translated task into words, communicated meaning of task, understands conventions and purpose of recipe, rephrased task in own language
b) Identified and interpreted relevant information in the recipe and on ingredient packets

Choose strategy
c) Selected strategy that demonstrates understanding of the task/process required – e.g. follows recipe in purposeful manner

Apply strategy
d) Correctly used appropriate measuring equipment
e) Read calibrations on measuring equipment with reasonable accuracy
f) Followed instructions in necessary order
g) Set oven temperature as directed
h) Demonstrated understanding of size and space when items arranged for cooking
i) Counted biscuits accurately

Reflect on outcomes
j) Judged from past experience whether the cooking was successful
k) Discussed cooking process - eg difficulties or achievements

Other
l) ____________________________
m) ____________________________

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[l] – indicates the student took a leading role in strategy and decision making.
### Making Biscuits - Sample Class Observation & Recording Sheet

**Group:** ___________________________  **Date:** ___________________________

**Responses against the Task Process Cycle**

<table>
<thead>
<tr>
<th>Selects relevant info</th>
<th>Chooses strategy</th>
<th>Applies strategy</th>
<th>Reflects on outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Demonstrated understanding</td>
<td>b) Identified &amp; interpreted info</td>
<td>c) Selected strategy</td>
<td>d) Used measuring instruments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Student's name</th>
<th></th>
<th></th>
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</tbody>
</table>

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138
Mystery Location

In this task, students select a place they enjoy going to, or like to visit, and prepare instructions for someone else to follow to get there. This task was given to Sue’s lower level numeracy students after they had done other location tasks involving reading street directories and maps. The task is open-ended because students select a location of their choice and devise their own instructions.

Potential levels, skills and knowledge

Low: Interpreting and using maps or directories to describe and follow routes.

Medium: As above, but for longer or more complex journeys and instructions that incorporate the language and concepts of scale, compass directions and rates (e.g. speed).

Preparation

Materials required

Street directories (for city and suburban students) or local maps (for country towns). Try to have at least one map or directory between two students.

Formulating the task or question(s)

Prepare in advance one or more stand-alone questions, such as:

- Choose a place you enjoy going to, or would like to visit, and write instructions to get there for someone else to follow.

Low literacy students could be given a version that asks them to give instructions verbally, rather than in writing.

Advance planning would involve decisions about some of the parameters, or task requirements, since students will always seek more information about the specifications of the task, such as whether to move to another map in the directory or to stay on the same page. See pages 140-141, Reflecting on the task.
Suggested procedure

Tuning in to the topic

You may have used local maps or directories for other tasks before this, so students would be familiar with the symbols and conventions of maps and street directories and need less ‘tuning in’.

Otherwise, ask students to pair up for the start of the activity and give out one copy of the local maps or directories you want them to use.

Encourage students to examine the particular form of the map until they become oriented to the layout and symbols.

You could encourage discussion with questions like:
• Do any of you use maps/street directories?
• When do you use them?
• What kind do you use? Have you seen this version before?
• What did you last use one for?
• Can you find the College on the map?
• Can you find your street? Can you give the grid reference?

Perhaps you could orient students by encouraging them to look up some places that they know about locally. Or ask them to show each other interesting places they have been to lately, and give directions on how to get there.

Introducing the task

Give the question cards out to individuals or pairs – one between two if you want them to work together or share ideas at the beginning.

Explain verbally that another student will follow these instructions on the map or directory, and that this will enable students to check if their instructions work.

Reflecting on the task

Tell students you will give them a minute or two to think about where they might choose as a destination.

Give students the choice of working in pairs to formulate their instructions, or working as individuals.
Students may seek clarification about the task. Typical student concerns are:

- How far away does it have to be?
- Does it have to be on a different page of the street directory?
- Does it have to be somewhere I have been?
- Does it need to be famous?

You might decide that you and the students should set some guidelines for the task together. For example, students may choose a place they have been to, so they can describe something they know about it, or tell an interesting story about it. You might want them to choose a well-known landmark, a public building or some place that would be useful or interesting for everyone to know about.

**Focussing students’ ideas and strategies**

You could ask students to read out some of the first directions they have thought of. This gives you an opportunity to discuss different ways of giving directions without giving too much away.

This discussion should help students clarify the task and encourage them to think of different ways of giving instructions (eg. to include grid references, or map symbols such as traffic lights).

Guide higher-level students towards using scale to estimate or calculate distances, and more precise language of direction such as compass directions (N, S, E, W or NE, etc.).

**Working on the task**

After this warm up discussion, suggest that students work on their personal responses. Students working in pairs can prepare a joint response, or assist each other prepare an individual response. Remind students to write their instructions clearly so someone else can follow them.

As you walk around and discuss their progress on a one-to-one basis you can encourage them to extend the task sufficiently to demonstrate their competence. Questions you can ask:

- Can you write this instruction in a different way?
- What other type of information could you give here?

When students have completed their instructions, ask them to swap them with another student (or pair of students). This is the important phase of testing the instructions.

**Encouraging evaluation and reflection - Is it reasonable?**

Ask students about the effectiveness of their directions, and encourage them to consider making necessary changes.
Ask questions like:
- Did she get to the right place?
- Were any wrong turns made?
- Were any of his directions a bit tricky to understand?
- Which was the easiest to follow?
- Which the most difficult?

Encourage students to finalise changes to their directions, and then test them on another student.

**Recording student outcomes**

Medium level literacy students should provide written responses and some statement about whether the instructions enable the follower to arrive at the correct destination.

It may be helpful to record student outcomes according to the observation sheet on page #. This sheet could also be used to assess verbal responses of low literacy students.

**Extensions**

- Calculate the distance using the scale on the map.
- Calculate cost of using public transport for the trip.
- Work out how long it might take using different means of transport, such as walking, riding a bicycle, using public transport or driving, depending on the distance.

**Similar tasks**

Choose two places on a map of the state. Describe the first using grid references and a clue about the town. (eg. "A large gold mining town"). Give directions to find the second location. This would include approximate distances and direction of travel along main roads, or compass bearings for cross-country travel.
Sample student responses

Summary of student responses

In their responses to this task the students have successfully undertaken the task of providing written directions using a street directory. The students have used appropriate language, understood many of the conventions of map reading and of giving written instructions. They range in the level of sophistication of their instructions and of any analysis of costs, times or comparisons between different forms of transport. One student used her knowledge of formulae (speed-distance-time relationship) to calculate travelling time. In terms of the Task Process Cycle all the students were involved in three of the four processes - selecting relevant information, and choosing and applying correct strategies at the level they were operating at – and for two of the students at the higher level, there was evidence that they thought about the tasks and reflected on the outcomes.

See the Mapping to Curriculum Outcomes booklet for more details.

Analysis of student responses

Student A

Select relevant information
There is indication that this student has located her street on the correct street directory map, and has interpreted symbols for a bus route and roundabout, and has read the correct street names from the map.

Choose strategy
Student A has shown understanding of the process required for the task by selecting a starting point and destination, identifying a route and deciding on written instructions.

Apply strategy
The student has correctly used the language of directions in the descriptions, the instructions are in sequential order (except for indicating the starting point clearly) - she seems to have made the assumption that the reader knows where she lives, including the suburb.
**Student A continued**

**Reflect on outcomes**

There is no written indication that the directions were checked by another person following them. This should be encouraged as the next step in the process.

**Students B and C**

*Note* - student C's response is on the opposite page.

**Select relevant information**

Both students have indicated use of the street directory to locate departure and destination points, map references, street names, lights, train tracks, etc.

**Choose strategy**

They have both shown understanding of the process required for the task by selecting a starting point and destination, identifying a route and deciding on written instructions. As well they have used the map scale for distance calculations. In addition student C has used the relationship between distance, and speed to calculate time, whilst student B has done a comparison between train and car travel.

**Apply strategy**

Student C has given detailed directions, and described her mathematical calculations (with a minor error of units - seconds instead of hours - but has used her prior knowledge to self correct to get the correct and sensible result in minutes).

Student B has been less explicit in her descriptions of mathematical processes, she appears to have used prior knowledge to estimate travel time. (Teacher prompting or observation would be needed to elicit the strategy used by the student.)

---

**Travelling from TAFE to the Museum**

**Car**

Directions - Turn left at Dimboola rd
  - turn right at Pascoe vale rd
  - turn left onto Tulla Fwy & exit at Bell St
  - Go along Bell st
  - turn right at Nicholson st (where tram begins)
  - Nicholson St becomes Holmes st (Don't panic)
  - changes back to Nicholson & the Museum is on the right hand side at the end of Nicholson St

Time - allow about 30 - 45 minutes (consider traffic)
Distance - about 18 kms
Petrol cost - * also allow for parking

**Train**

Cost - ¥4.05 Fare (All day concession Zone 1 & 2)
Directions - get off train at Melbourne Central Station
  - walk east along Latrobe St
  - turn right at Victoria St
  - & then left to Nicholson St
Distance - about 900 m walk (from Melb central to Museum)

Time - 15 - 20 min walk + 30 min train ride
  - all up about 50 mins.

Conclusion - I would rather travel by train because it is cheaper & less of a hassle. If I chose to take my car, I would also have the added costs of parking.

**Student B’s instructions.**
Reflect on outcomes
Student B has reflected upon the difference between travelling by car and train using prior knowledge and experience.

Student C has used a more mathematical approach to her final conclusions but shows no clear indication of final reflection. (Teacher observation or prompting would again be needed to find out, for example, if her selected average speed of 45 kmh was in fact chosen through prior experience or not.)

Starting point: Wallace Street (between Albion and Hope Streets)
West Brunswick to Malvern Police Station
- Go South down Wallace Street (Maps 29 to 30)
- turn left at Hope Street (heading east)
- turn right into Sydney Road till first set of lights.

....
....

- turn left at Malvern Road (travelling east) joins map 59
- turn right into Glenferrie Road.
Police Station on left, close to Town Hall (Malvern) and High Street.

- Estimated time of travel: 25 minutes.
Estimated speed travelled 45 kilometers per hour (taking into account traffic lights).
- Approximately 18 1/2 kms
- Distance 18.5 km divided by Speed 45 kilometers per hour equals 0.41 seconds.
Multiplied by sixty (to turn it into minutes) equals 24.6 minutes.
Time estimated - approximately 25 minutes.

Excerpts from student C’s instructions.
Mystery Location

Sample Recording Sheet for Individual Students

Student Name: ______________________ Date: __________________

Task or questions undertaken: ______________________________________
_________________________________________________________________
_________________________________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
☐ Demonstrated understanding of task – translated task into words, communicated meaning of task, understood conventions and purpose of street directory, rephrased task in own language
☐ Identified & interpreted relevant information on the map

Choose strategy
☐ Selected strategy that demonstrates understanding of the task/process required – e.g. selected appropriate starting point and destination

Apply strategy
☐ Used directions such as left and right, straight ahead, etc correctly
☐ Used grid references
☐ Used logical sequence of instructions
☐ Referred to features on map: traffic lights, bus stops, tram stops, railway stations

Reflect on outcomes
☐ Tested instructions - checked that instructions lead to correct destination
☐ Amended instructions to produce successful outcome
☐ Judged reasonableness of results by referring to prior experience

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
Mystery Location

Sample Key for Class Observation & Recording Sheet

Group: ___________________________ Date: ____________

Task or questions undertaken: ____________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
a) Demonstrated understanding of task – translated task into words, communicated meaning of task, understood conventions and purpose of street directory, rephrased task in own language
b) Identified & interpreted relevant information on the map

Choose strategy
c) Selected strategy that demonstrates understanding of the task/process required – e.g. selected appropriate starting point and destination

Apply strategy
d) Used directions such as left and right, straight ahead, etc correctly
e) Used grid references
f) Used logical sequence of instructions
g) Referred to features on map: traffic lights, bus stops, tram stops, railway stations

Reflect on outcomes
h) Tested instructions - checked that instructions lead to correct destination
i) Amended instructions to produce successful outcome
j) Judged reasonableness of results by referring to prior experience

Other
k) _____________________________________________
l) _____________________________________________
m) _____________________________________________

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
Mystery Location - Sample Class Observation & Recording Sheet

Group: ___________________________  Date: ________________

Responses against the Task Process Cycle

<table>
<thead>
<tr>
<th>Student's name</th>
<th>Selects relevant info</th>
<th>Chooses strategy</th>
<th>Applies strategy</th>
<th>Reflects on outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>c)</td>
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<td></td>
<td>d)</td>
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<td></td>
<td>e)</td>
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<td>k)</td>
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<td>l)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>m)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Describing and Drawing Geometric Shapes

In this task students develop and follow instructions for drawing geometric shapes. It has two parts. Part 1 involves students selecting a shape from a set of given shapes and then devising a set of instructions that another student could follow to draw that shape. Part 1 is partially open-ended in that students choose their own language for their descriptions.

Part 2 of this task is the more open-ended component, since students create their own shape then develop instructions for drawing it. There is a lot of potential in part 2 for variations in shapes produced (from simple to complex) and in the instructions students devise. It may be a good idea to do Parts 1 and 2 at different times, perhaps in two consecutive sessions.

Potential levels, skills and knowledge

Low: Using the language and concepts of shape and space, and drawing simple familiar shapes.

Medium: As above, but using shapes with greater complexity and/or instructions that include lengths and angles.

Preparation

Materials required

Part 1
Prepare on cards a selection of geometric shapes appropriate to the level of your students, at least one per pair of students. Some shapes are provided on pages 153 to 156 at the end of this activity, but you could also design your own.

Part 2
- Plain white paper
- Compasses
- Rulers
- Protractors (if you want students to measure angles).
**Formulating the task or question(s)**

Task wording you might use for Part 1 is:

- Make up instructions to draw this shape and find out if your instructions really work?

The evaluative aspect of the task is incorporated in the question, and provides students with the opportunity to decide how they might test their instructions.

**Suggested procedure**

**Tuning in to the topic**

To get students thinking about the language and concepts of shape, you may like to start off with one or more of the following:

- Examine a sign or logo (e.g. traffic sign, no smoking sign) and discuss different ways of describing it
- Brainstorm together the words for different shapes
- Produce some different shaped objects and focus on the language that might describe them.

**Introducing the task**

Explain to students that the task involves describing shapes.

Make a selection of shapes available and ask pairs of students to select one of them.

**Reflecting on the task**

Give pairs students a few minutes to examine their shape and talk about how they could go about describing the shape, and how they can find out if their instructions really work.

**Focussing students' ideas and strategies**

You may need to support students to focus on the different features of the shapes, such as the names; the number of sides; the angles within or between the shapes; or the relative positions where there are two or more shapes involved. You could introduce more language at this stage if you feel the need.

Ask questions that encourage students to consider the evaluative aspect of this task, for example by asking:

- How would you know if your instructions worked or not?

Steer the discussion towards the strategy of testing their instructions out on another student.
Working on the task

Ask students to work in pairs to devise their instructions. Working in pairs encourages students to express their thoughts and practice using appropriate language and terminology.

Circulate amongst students and encourage use of appropriate language. When pairs are ready to test their instructions, students select another pair to work with. Pairs can devise how they want to do this.

Depending on the time available, encourage students to repeat the activity with further shapes, so that everyone has had the opportunity to both describe and draw shapes.

Encouraging evaluation and reflection - Is it reasonable?

The evaluative phase is very much part of the task, because the testing phase is part of the task. Students therefore should be able to say if their instructions worked or not. They should also be able to suggest and make improvements, and test their reworded instructions.

Some questions you could ask to facilitate evaluation:
• Did the other students draw what you expected them to?
• Could your instructions be improved?
• How could the instructions be improved to make the shape easier to draw?

Part 2
This time students in pairs, or individually, create their own shapes. They then prepare instructions and give them to another student to follow. As mentioned previously, this may be done in a subsequent session.

Recording student outcomes

Student outcomes can be recorded by students' written responses (i.e. instructions and shapes drawn).

Low literacy students who do this task verbally could be assessed by sharing the drawings that were done in response to their instructions and via a short discussion of the process they used for testing and improving their instructions.
As well, by recording the students' spoken instructions the teacher can keep records of their oral language. See pages 157 to 159 for samples of both teacher's records and students' written responses. These indicate the range found in the one class, especially in terms of their levels of English.

**Links, extensions and follow up tasks**

- You can adapt the activity to start with written instructions, rather than with the already drawn shapes. Some sample cards for this are included on page 156.

- Incorporate three dimensional (3D) shapes. For example, students could prepare instructions for paper folding constructions, or for drawing 3D shapes. They could find some common 3D packages, and describe them, and also pull them apart to learn about how they have been constructed.

- See *Design a better box* (p. 193).
Shapes Cards

- Grid
- Circle with diagonal line
- Series of diagonal lines
- Rectangular shape with diagonal line
- Horizontal line
- Triangle with circle at the top
Shapes Cards

[Diagram with six shapes: triangle, circle, square, envelope, and a combination of shapes]
Shapes Cards

Shapes

Cards
<table>
<thead>
<tr>
<th>Shapes Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Draw a triangle with a circle around it.</strong></td>
</tr>
<tr>
<td><strong>Draw a triangle and place a circle in the middle of it.</strong></td>
</tr>
<tr>
<td><strong>Draw a rectangle and on top of it draw a triangle.</strong></td>
</tr>
<tr>
<td><strong>Draw a rectangle and use the top of it as the base for a triangle.</strong></td>
</tr>
<tr>
<td><strong>Draw a circle and place a triangle inside the circle.</strong></td>
</tr>
<tr>
<td><strong>Draw a square. Draw a line from the top right to the bottom left.</strong></td>
</tr>
</tbody>
</table>
Sample student responses

Summary of student responses

In their responses to this task, pairs of students successfully gave and followed directions for drawing simple geometric shapes.

Both students used everyday informal language of shape to describe and reproduce common shapes. In terms of the task process cycle, both students were involved in all of the four process: selecting relevant information, choosing and applying correct strategies (e.g. deciding how to describe the components of the shape), and reflecting on outcomes (by comparing their shape with the original, and amending instructions where necessary).

Teacher intervention also occurred at this stage, when students were encouraged to use more precise language of shape to convey their instructions.

See the Mapping with Curriculum Outcomes booklet for more details.

Analysis of student responses

Student A has these shape cards:

- Drawing 1
- Drawing 2
- Drawing 3

Student A’s instructions:

**Drawing 1**

“Draw a house.”

Teacher asks student A to try to give instructions again, without using the word house.

A then says: “Draw a triangle with a box underneath it”

Student B’s drawings:
**Student A’s instructions:**

**Drawing 2**
"Draw a cross."

Teacher asks student A if he could give instructions again, without using the word cross.

A then says: "Draw a line across and then another line down and put the second line in the middle of the first line."

**Drawing 3**
"Draw a pyramid shape, a three sided pyramid - and put a circle inside."

---

**Student B’s drawings:**

---

**Student A’s drawings:**

---

**Student B has these shape cards:**

![Drawing 1](Image)

![Drawing 2](Image)

![Drawing 3](Image)

**Student B’s instructions:**

**Drawing 1**
"Do a square. Draw a line from top right to left down."

**Drawing 2**
"Draw a rectangle. Draw a line in the centre of it."
Student B's instructions:

Drawing 3
"Do a round circle and draw a triangle inside the round."

Student A's drawings:
Anyone for Pizza?

This set of tasks grew from an idea that Chris tried out with her students. She used local Pizza menus with her class, and found that because the menus were real and local they were usually of personal interest to the students. Chris found that beginning with an open-ended question allowed her students to engage at different levels according to their interest and their ability.

Potential levels, skills and knowledge

Low/medium: Number skills in the context of money calculations.
High: Number skills in the context of money calculations and use of measurement formula - area of a circle.

Preparation

Materials required

Collect copies of local Pizza menus – at least one (or one set) per pair of students, or one each depending on how you wish students to operate.

Formulating the task or question(s)

Some suggestions for questions

Questions with potential for lower levels

• If you won a $50 gift voucher for a night at the Pizza restaurant, how would you use it?
• If you won a $50 gift voucher, would it be enough to feed your family or a group of your close friends? What would you buy?
• Are the specials at this restaurant worthwhile?
• Which restaurant would you prefer to go to, and why? Compare costs of the meals you would buy in each.

Questions with potential for higher levels

• Which sizes give the best value?
  [For this one you will need the diameters of the pizza sizes – they may be on the menu or you may have to find out in advance.]
Suggested procedure

Tuning in to the topic

Ask students to pair up for the start of the activity and give out one copy of the local menus per pair.

Tell them you are going to think about value for money with Pizzas this session, and you have collected some of the local menus to use.

Encourage students to examine the menus you have given out until they become oriented to their contents and layout.

Free flowing discussion will probably follow as a warm-up to the topic. If not, a few leading questions such the following might encourage student discussion.

- Who eats Pizzas?
- Which are your favourite restaurants?
- Why do you choose them?
- What do you normally eat?
- Do like sharing or just have one type?
- What do you think about tipping? etc.

These questions encourage students to bring related personal experiences into the conversation - to share some opinions and cultural background about tipping or being on the other side of the counter.

Introducing the task

Give the question cards out to individuals or pairs – one between two if you want them to work together or share ideas at the beginning.

Students at potentially different levels could be given slightly different questions at this point.

Reflecting on the task

Tell students you will give them a minute or two to think about the question and the aspects that come to mind before discussing it together as a whole class.

Encourage them to ask clarifying questions or discuss it with nearby students or their working partners, as they think it through.

Focussing students’ ideas and strategies

Ask who would like to share what they started thinking about.
Encourage a few suggestions. Examples could be:
- "We looked at the prices and sizes"
- "It usually costs me more than that to take my family out."

Encourage conversation around students' starting points. Make links with the previous discussions, whilst gradually steering students towards the useful aspects by asking questions which might expand their thinking.

For instance one or two of these might help:
- Do you prefer a few big pizzas or lots of tastes with smaller ones?
- Are any of your group vegetarians?
- Does anyone ever buy the garlic bread?
- Do you take drinks or buy them there?

The conversation should allow students to personalise the task, and go with their own interests, whilst encouraging them to think about aspects such as:
- Numbers of people
- Amount they eat
- Extras they usually have
- Getting their money's worth from the voucher by going as close to $50 as possible.

**Working on the task**

After this warm up discussion suggest that students work on their own personal responses, and record them as clearly as they can to allow for sharing with others. As you walk around and discuss their progress on a one-to-one basis you can judge their capacity to extend their investigation.

Some students could be encouraged to explore a variety of responses and select the best. Others might be encouraged to widen the scope of their task.

**Encouraging evaluation and reflection - Is it reasonable?**

When students are finalising responses, you may need to facilitate the 'evaluation' aspect by asking questions appropriate to their level.

**For lower levels**
- Does that seem like a suitable meal for the number of people?
- How much is that for each person? Does it seem a reasonable amount?

**For higher levels**

The suggestions above also apply, but in addition, encourage estimation of calculations throughout the calculation stages. And as mentioned earlier, students could investigate which size pizzas give the best value, by using the formula for the area of a circle to consider the different sizes of the pizzas and their respective prices.
Also facilitate some discussion of the real-world implications of their solutions by exploring other considerations as well as the mathematical or monetary aspects. For example:

- Does that mean people are always foolish to buy small sized Pizzas?
  
  [Students might say ‘No! Because you would rather pay more and get the variety’ or ‘smaller pizzas are easier to handle - no plates needed’]

### Recording student outcomes

For lower level students a recording sheet is provided - see page 82.

For medium level students written records can be mapped against the assessment criteria. (The same recording sheet used above on page 82 might be useful.)
## Anyone for Pizza? Sample stimuli

### Don’s Pizzas

**The tasty one**

**SPECIAL NO. 1**

**ANY 2 FAMILY PIZZAS**

$25.00

**SPECIAL NO. 2**

**ANY ORDER OVER $25.00 receive a 1.25ltr drink FREE**

### Pizzas

<table>
<thead>
<tr>
<th>Pizz’s</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DON CICCO SPECIAL</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>2. BASS STRAIT (Marinara)</td>
<td>$7.50</td>
<td>$10.00</td>
<td>$13.80</td>
<td>$16.00</td>
</tr>
<tr>
<td>3. CAPRICCIOSA</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>4. NEW ORLEANS</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>5. AMERICANA</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>6. HOT SICILIAN</td>
<td>$7.50</td>
<td>$10.00</td>
<td>$13.80</td>
<td>$16.00</td>
</tr>
<tr>
<td>7. THORNBURY</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>8. PRO HART (Aussie)</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>9. JOH SJELKE (Hawaiian)</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>10. BUNKY BILL (Mushroom)</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>11. GREENPEACE (Vegetarian)</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>12. CHICKEN</td>
<td>$7.50</td>
<td>$10.00</td>
<td>$13.80</td>
<td>$16.00</td>
</tr>
<tr>
<td>13. MARGHERITA</td>
<td>$8.00</td>
<td>$8.00</td>
<td>$11.00</td>
<td>$13.00</td>
</tr>
<tr>
<td>14. NAPOLETANA</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>15. FULL HOUSE</td>
<td>$7.50</td>
<td>$10.00</td>
<td>$13.80</td>
<td>$16.00</td>
</tr>
<tr>
<td>16. MEXICANA</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>17. HALF &amp; HALF</td>
<td>$10.00</td>
<td>$13.80</td>
<td>$16.00</td>
<td></td>
</tr>
<tr>
<td>18. GARLIC PIZZA</td>
<td>$4.50</td>
<td>$6.00</td>
<td>$8.00</td>
<td>$10.00</td>
</tr>
<tr>
<td>19. FOCACCIA PIZZA</td>
<td>$5.50</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.00</td>
</tr>
<tr>
<td>20. PLAIN PIZZA</td>
<td>$6.00</td>
<td>$8.00</td>
<td>$11.00</td>
<td>$13.50</td>
</tr>
<tr>
<td>21. NELLO SPECIAL</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
<tr>
<td>22. TONY SPECIAL</td>
<td>$7.00</td>
<td>$9.00</td>
<td>$12.70</td>
<td>$14.90</td>
</tr>
</tbody>
</table>

**EXTRA TOPPINGS**

<table>
<thead>
<tr>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.50</td>
</tr>
</tbody>
</table>

**Prices include GST**
Sample student responses

Summary of student responses

In their responses to this task the two students have shown a very different range of skills, with one undertaking a very simple process whilst the other used a range of skills and strategies to do a comprehensive analysis of the “best value” pizza on the menu. In terms of the Task Process Cycle one of the students demonstrated understanding and application of all the four stages. The other student, from a non-English speaking background, may have not understood the task or the teacher’s instructions, and obviously found it difficult to give written responses. As such her written response only indicates she covered the first stage of the cycle. This highlights the need to take into account the difficulties presented by both giving written tasks and instructions and requiring written responses from students.

Analysis of student responses

Student A

Select relevant information
There is indication that this student has understood the requirements of the task, and has identified and interpreted the information given on the pizza menu - the prices, the sizes of the pizzas, etc. As well she has seen the need to compare different options, although this depends on what instructions have been given by the teacher.

Choose strategy
Student A has shown understanding of the process required for the task by selecting a number of aspects involved in solving the problem, including a comparison with what she pays elsewhere and deciding that to do a comparison of the costings of the different sized pizzas she needs to take into account their area.

Apply Strategy
Here a range of strategies has been utilised, including calculating with decimals and money, doing comparisons, using and applying the formula for the area of a circle, and using rates to compare the value of pizzas in terms of area per dollar.

Reflect on outcomes
Here student A indicates that she has expressed her analysis sensibly and meaningfully and related it to prior experience. She seems to have thought through her different comparisons and reflections carefully, although this would need to be supported by teacher observation and questioning. This would be necessary at the higher level in terms of her ability to reflect on the use of the formula and the consequent calculations for the “best value” pizza.
my family has take away, approximately twice a week.  
we usually buy a family deal pizzas. It consists of 2 large pizzas, garlic bread and 1.5 litre coke. This costs around $22.00. 
another takeaway which we usually buy is some sort of chicken family meal. This costs around $25.00  
Total: $47.00 a week.

**Eat in**

My boys are fussy so, I would order a margherita - large: - $11.00  
I would have: All Polo - main: - $11.00  
My partner would have: - Porterhouse Steak. $14.40.  
Drink = $ 5.00  
TOTAL: $ 41.40

**TAKE AWAY**

Pizza - Family Deal : $25.00 (no drinks)

For $50 I could feed 4 people if I were to eat in. 
but takeaway I could feed the same 4 people twice.  
the best value pizza from Don Ciccio's - for me is Don Ciccio Special.

Conclusion: I'll continue to buy my pizza meal deal from my local Pizza Shop.

**Sample of student A's calculations for the 'best value per dollar' pizza.**

<table>
<thead>
<tr>
<th>Don Ciccio Special - 7 Toppings:</th>
<th>$7.00</th>
<th>$9.00</th>
<th>$12.70</th>
<th>$14.90</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$3.14 \times r^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$3.14 \times 12^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$A = 452$</td>
<td>$A = 706$</td>
<td>$A = 962$</td>
<td>$A = 1134$</td>
<td></td>
</tr>
<tr>
<td>$706 \div 7.00$</td>
<td>$90 \div 9.00$</td>
<td>$962 \div 12.70$</td>
<td>$1134 \div 14.90$</td>
<td></td>
</tr>
<tr>
<td>$= 64.57 \text{ cm}^2$</td>
<td>$= 78.44 \text{ cm}^2$</td>
<td>$= 75.74 \text{ cm}^2$</td>
<td>$= 76.10 \text{ cm}^2$</td>
<td></td>
</tr>
</tbody>
</table>

At Don Ciccio's restaurant a medium pizza is better value per dollar, per slice.
Student B

Select relevant information
Student B has given little written indication that she has understood the requirements of the task, although she seems to have identified some of the information given on the pizza menu - the names and the prices. This student was from a non-English speaking background and may have not understood the teacher's instructions, and/or found it difficult to give written responses. It is important to therefore observe what the student does and check to see how much they can answer orally.

Choose strategy
Student B has shown a limited understanding of the process(es) required for the task and from the written response it is difficult to tell whether she chose appropriate strategies or not.

Apply Strategy
The only strategy apparent here is a simple choice of the special price and then the apparent random choice of two types and sizes of pizzas to add together for the choice of what she would buy and how much it would cost. However, the choice of the 'Special deal' indicates that there is some sense of value and of having made some comparisons. This would need to be checked via teacher questioning and observation.

Reflect on outcomes
Here student B shows no written indication of having been able to reflect on the task or the outcomes. But, as mentioned already, this would need to be confirmed by observation and questioning.

When students are from a non-English speaking background they may have difficulty understanding teacher's instructions, especially written instructions - so it important to give clear oral instructions. In addition, giving written responses may be a major problem. Therefore it is essential to observe the student doing the tasks and allowing and encouraging oral answers and responses. The use of a recording sheet in these situations is most helpful.
Anyone for Pizza?

Sample Recording Sheet for Individual students

Student Name: ______________________ Date: ________________

Task or questions undertaken: ____________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
☐ Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
☐ Identified & interpreted relevant information on the menu

Choose strategy
☐ Selected strategy that demonstrates understanding of the task/process required – e.g. experimented by calculating combinations of prices

Apply strategy
☐ Interpreted prices as decimals
☐ Chose appropriate operations for calculations
☐ Correctly performed addition of decimal numbers in context of money
☐ Correctly performed multiplication of decimals by whole numbers in context of money
☐ Correctly performed division of decimals by whole numbers in context of money
☐ Used calculator appropriately for money calculations

Reflect on outcomes
☐ Expressed results sensibly and meaningfully
☐ Judged reasonableness of results by referring to prior experience
☐ Checked results using rough estimations

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
Anyone for Pizza?

Sample Key for Class Observation & Recording Sheet

Group: ___________________________ Date: ___________________

Task or questions undertaken: __________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
a) Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
b) Identified & interpreted relevant information on the menu

Choose strategy
c) Selected strategy that demonstrates understanding of the task/process required – e.g. experimented by calculating combinations of prices

Apply strategy
d) Interpreted prices as decimals
e) Chose appropriate operations for calculations
f) Correctly performed addition of decimal numbers in context of money
g) Correctly performed multiplication of decimals by whole numbers in context of money
h) Correctly performed division of decimals by whole numbers in context of money
i) Used calculator appropriately for money calculations

Reflect on outcomes
j) Expressed results sensibly and meaningfully
k) Judged reasonableness of results by referring to prior experience
l) Checked results using rough estimations

Other
m) __________________________________________________

n) __________________________________________________

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[l] – indicates the student took a leading role in strategy and decision making.
** Anyone for Pizza? - Sample Class Observation & Recording Sheet **

Group: __________________________________________________________________________

Date: __________________________________________________________________________

<table>
<thead>
<tr>
<th>Responses against the Task Process Cycle</th>
<th>Selects relevant info</th>
<th>Chooses strategy</th>
<th>Applies strategy</th>
<th>Reflects on outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student's name</td>
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</tbody>
</table>

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**REALITY-BASED & OPEN-ENDED TASK - ANYONE FOR PIZZA?**

171
Australia’s Growing Population

This is a task that Chris used successfully with her middle level class. It involves students translating information presented in one form - diagrams and text - into an alternative form using some kind of graph. It is an open-ended task because students choose the aspects of the information that interest them the most, as well as the type of graph they use to present it.

Potential levels, skills and knowledge

**Medium:** Interpretation and analysis of data and numerical information, construction of graphs and charts.

Preparation

Materials required

  Or you could use a more recent source of population growth figures if available
- Rulers
- A variety of graph paper and pie chart paper (see p. 184)
- Sample recording sheet (see pp. 181 - 183) - optional.

Formulating the task or question(s)

**Suggested question:**
Can you draw a graph to represent some or all of this information?

Suggested procedure

Tuning in to the topic

Discuss students’ existing knowledge about Australia’s population.

For example ask:
- Do you have an estimate of the current population of Australia?
- Which states do you think have the greatest/least population?
- Are you aware of people moving across states?
- Which states do you think people are moving to?
- Why do they think they are moving?
Give out copies of the information sheet, and provide time for them to look at the information conveyed.

Ask students whether the sheet confirms their opinions about Australia’s population?

Ask them what information they can see on the sheet. For example:
• What years are the figures from?
• What does the +3.2% mean next to VIC?
• Why might you need to work it out?
• What was Australia’s total population for 1996?
• How could you work it out?

Introducing the task

Students can either work individually or in pairs.

Now ask them to make a graph of some part of the information provided. Ask if they think it is possible to graph all the information on the one graph.

Reflecting on the task

Beginning in pairs, allow students time to discuss and clarify what they are planning to graph. Some students may not know what to graph, so hearing other people’s ideas may help them.

This is also an opportunity for the teacher to do some assessment by listening to what students are asking and by directing questions to particular people.

Focussing students’ ideas and strategies

Ensure that students realise there are a number of different graphs that can be drawn.

List the students’ proposed graph types on the board, for example:
• A pie chart of the population for each state/capital city
• A bar graph for comparison of the increase in population for each state and capital city.

Encourage students to create the graph that interests them or types of graphs that they have had less practice with in the past.
Working on the task

Allow students time to construct the graph. Make different types of graph paper available if they want to use it.

Encourage some students to attempt a graph that they are not as familiar with.

One of Chris' students also calculated the population in 1991. She needed confirmation from Chris regarding her calculation method as she did it.

Observing how students go about constructing a graph, and discussing their choices with them as they work will allow you to gain information about their ability to read, analyse and display data.

Encouraging evaluation and reflection – Is it reasonable?

Ask students to make a verbal or written statement about what they have graphed and what the graph tells them. Ask them to consider:

• Whether the graph presents the information clearly
• Whether it might have been improved in any way
• Alternative graphs that might have been used to convey the information more clearly.

Recording student outcomes

For this task, students will have a graph and some record of their calculations, which can be mapped against the assessment criteria. They may also have made a written or verbal statement to interpret their own graph. Conversations during the task discussion may also allow teachers to observe the students' capacity to comprehend the original data display. Notes of such observations could be included as further evidence in student portfolios or attached to tasks submitted for moderation or verification.

There are sample recording sheets provided for this task (see page #). These recording sheets may also be suitable for use with other data type questions where the stages of the Task Process Cycle may be very similar.

Links, extensions, follow-up tasks

At a higher level, students could calculate a prediction for Australia's current population that could be made using the same percentage increase for the following five years to 2001 and then compare with actual figures.

The task could be integrated with reading, writing and research regarding Australia's population, multiculturalism, or employment change and demographics.
Australia’s Growing Population - stimulus

HOW AUSTRALIA HAS GROWN
% Population increase between 1991-96 and the population in 1996.

Darwin +7.4%
82,408

WA +7.9%
1,765,738

NT +9.9%
181,923

QLD +12.8%
3,339,109

NSW +5.2%
6,203,894

VIC +3.2%
4,560,817

ACT +6.7%
308,025

Brisbane +12.0%
1,520,956

Sydney +5.6%
3,879,370

QLD +12.8%
3,339,109

SA +1.9%
1,474,389

ACT +6.7%
308,025

SA +1.9%
1,474,389

TAS +1.7%
474,592

● Australia +5.9%
18,311,486*

* Adjusted

Perth +8.9%
1,295,132

Adelaide +2.1%
1,079,184

Melbourne +4.0%
3,283,014

Brisbane +12.0%
1,520,956

Sydney +5.6%
3,879,370

QLD +12.8%
3,339,109

SA +1.9%
1,474,389

TAS +1.7%
474,592

● Australia +5.9%
18,311,486*

* Adjusted
Sample student responses

Summary of student responses

In their responses to this task (presented on the following two pages), the students successfully undertook a combination of some complicated calculations with whole numbers, decimals and percentages as well as plotting data. But there was little evidence of reporting or reflecting on what they did or produced - the focus seemed to be just on the process of correctly plotting the data. In terms of the Task Process Cycle the students have been involved in three of the four processes - selecting relevant information, and choosing and applying correct strategies – but there was no written evidence of any reflection on outcomes.

See the Mapping to Curriculum Outcomes booklet for more details.
Analysis of student responses

**Student A**

This student has successfully undertaken some complicated calculations with whole numbers, decimals and percentages in order to represent the data graphically in pie charts.

However, the student may not have selected the best way to illustrate differences between the 1991 and 1996 populations.

The student has undertaken the Task Process Cycle – extracted information, and selected and undertaken appropriate calculations – but there is no written evidence that the student has reflected on the results.
Students B and C

Both written responses show that the students have been able to:
• Select an appropriate graphical format for representing the data;
• Accurately plot the percentage values (to one decimal place) on appropriate sections of the graph.

Student B has also:
• calculated the mean and median and judged that the mode is not appropriate in this instance.

Student B has tried to include too much information, while Student C's graph is easier to read. Neither of the responses described or interpreted the changes in words, although asked to do so.
However, in response to prompting, Student B realised that her graph was difficult to interpret. She made two suggestions for improvement. The first was to graph results for cities and states separately. The second was to plot the data in order from smallest change to largest change.

In terms of the Task Process Cycle the students have extracted information, and selected and undertaken appropriate calculations and actions – but there is still no written evidence of reflection on outcomes.

None of the written responses initially described or interpreted the changes in words, although asked to do so. However it is common that this requirement can be met orally with teacher prompting and classroom discussion, and then can be encouraged in future written work.
## Australia's Growing Population

### Sample Recording Sheet for Individual Students

<table>
<thead>
<tr>
<th>Student Name: ______________________</th>
<th>Date: ____________________</th>
</tr>
</thead>
</table>

### Observed Stages of the Task Process Cycle:

#### Select relevant information
- [ ] Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
- [ ] Identified & interpreted relevant information on the chart

#### Choose strategy
- [ ] Decided on which data to use and how to analyse and/or represent it
- [ ] Decided what type of graph to use.

#### Apply strategy
- [ ] Interpreted data correctly
- [ ] Chose appropriate operations for calculations
- [ ] Correctly performed calculations with percentages
- [ ] Correctly constructed axes using appropriate scales and labelled graph
- [ ] Correctly plotted data onto graph
- [ ] Calculated mean, median and mode appropriately and correctly

#### Reflect on outcomes
- [ ] Expressed results sensibly and meaningfully
- [ ] Interpreted (in writing or orally) the data, graph(s) and statistical analysis

### Possible annotations

It is possible that ticks be supplemented with annotations. Some suggestions:
- [p] – indicates prompting from teacher
- [a] – indicates a significant amount of assistance from other student or teacher
- [l] – indicates the student took a leading role in strategy and decision making.
Australia’s Growing Population

Sample Key for Class Observation & Recording Sheet

Group: ____________________________ Date: ________________

Task or questions undertaken: ______________________________________________________

Observed stages of the Task Process Cycle:

Select relevant information
a) Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
b) Identified & interpreted relevant information on the chart

Choose strategy
c) Decided on which data to use and how to analyse and/or represent it
d) Decided what type of graph to use.

Apply strategy
e) Interpreted data correctly
f) Chose appropriate operations for calculations
g) Correctly performed calculations with percentages
h) Correctly constructed axes using appropriate scales and labelled graph
i) Correctly plotted data onto graph
j) Calculated mean, median and mode appropriately and correctly

Reflect on outcomes
k) Expressed results sensibly and meaningfully
l) Interpreted (in writing or orally) the data, graph(s) and statistical analysis

Other
m) ______________________________________________________

n) ______________________________________________________

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[l] – indicates the student took a leading role in strategy and decision making.
Australia’s Growing Population - Sample Class Observation & Recording Sheet

Group: ___________________________ Date: ___________________________

### Responses against the Task Process Cycle

<table>
<thead>
<tr>
<th>Student’s name</th>
<th>Selects relevant info</th>
<th>Chooses strategy</th>
<th>Applies strategy</th>
<th>Reflects on outcomes</th>
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<td>o)</td>
<td>p)</td>
</tr>
</tbody>
</table>

- a) Demonstrated understanding
- b) Identified & interpreted info
- c) Decided which data to use
- d) Decided on type of graph
- e) Interpreted data
- f) Performed calculations
- g) Correctly constructed graph
- h) Correctly plotted graph
- i) Interpreted data
Pie Chart Template

Note: Marks are at 5% intervals or 18°
How Many Drinks?

This is a simple task that allows students to demonstrate their level of competence with practical measurement and calculations using metric units. It is open-ended because students can determine their own method of gaining the information needed and choose the size of drinking vessel to correspond with those they use themselves. They can also be given the opportunity to extend the task to varying levels of complexity to suit each individual student. The task has developed further as a result of a trial run by Sue with a group of low-level numeracy students and work-shopping ideas with teachers in professional development sessions.

Potential level, skills and knowledge

Low/medium: Practical measurement of volumes using domestic measuring equipment. Number calculations in the context of metric units of measurement

Preparation

Materials required

For all of these tasks you would need to supply the real items:
• A selection of different sized glasses, cups and/or paper cups
• Selection of spoons (if using coffee or chocolate)
• Several household measuring jugs, cups and spoons, as appropriate to the drinks chosen.
• A selection of drink containers to match the selected questions, e.g. large bottles (greater than 1 litre capacity) of the chosen drink, preferably partially used.
• An available supply of water
• Copies of the observation sheets (pp. 189 - 191) – either one observation ticksheet for the whole class, or one copy per student of the individual student observation sheet.

Formulating the task or question(s)

Use one or more of the following, depending on the students' reading level and their probable identification or interest in the various drinks. It is important that no numerical information be given within the questions, so that students have to obtain information about the capacity of the containers and drinking vessels from the actual real-life objects.
Suggested questions:
• How many drinks could you get from this?
• How many drinks of soft-drink, could you get from this bottle?
• How many drinks of chocolate could you get from this tin?
• How many drinks of wine could you get from this wine cask?
• How many drinks of cordial could you get from this bottle?

Suggested procedure

Tuning in to the topic

Show students the array of products and containers and tell them you will be using these for some tasks during the session.

Encourage them to examine the items, especially the measuring equipment and labels on the bottles, by asking them if they are familiar with these things, or which of them they use at home.

Introducing the task

With students initially working in pairs, give them the question(s) you have selected, on a card beside the appropriate bottle(s) or container(s).

It is a good idea to leave the selection of the appropriate drinking vessels to the students, so place the collection of glasses, cup etc. in a central place.

You could ask students to make an initial ‘guess’, based on their past experience, before they begin to work on the task.

Reflecting on the task

Ask the students to discuss with their partner how they might go about the task.

Working on the task

Allow students time to work on their personal, or pair, responses to the question, recording their results as clearly as possible, so that they can share it later with other students, or with you, the teacher. Encourage some students to widen their enquiry, depending on individual progress and ability to respond to differing levels of challenge.

After a few minutes ask students to try out their method, encouraging them to pick out the appropriate equipment, use the water, mix drinks to suit their own tastes etc.

As they do this, circulate to each pair of students, observing how they go about the task and asking them to explain their process.
Use the observation sheets to make records about their understanding of the task, appropriate selection and use of measuring equipment, and other aspects indicated on the sheets.

If students have chosen a method that does not reflect their potential competence, then you could encourage them to check their results using another method. For example, students who have used measurement, but no calculation, could be encouraged to compare what they get by calculation and consider which method is more useful or efficient for them.

Whilst it is good to encourage students to demonstrate their maximum potential, care should be taken not to de-value methods they have chosen or push them into a process they will not be able to manage confidently, unless you work through it with them as part of the teaching process.

Some students could be encouraged to investigate in more depth (see extensions below).

**Encouraging evaluation and reflection - Is it reasonable?**

Ask students to comment on whether their result seems reasonable.

How did it compare with any guesses based on experience?

Did different students get different results and why?
• Were different sized glasses chosen?
• Were different strength of cordial /chocolate preferred?

**Links, extensions, follow-up tasks**

• What is the cost per drink?
• How does the cost change with different sized containers – large vs small bottles?
• How many drinks might you get if you thought about averaging the size of glasses and strength of drink?
Recording student outcomes

It may be helpful to record student outcomes according to the response sheet on page 189. This response sheet could also be used to assess verbal responses of low literacy students.

Note that the response sheet allows you to record different methods for solving the task. It allows for students who do this on a very practical level - by filling cups repeatedly and counting them until they fill the bottle. It also allows for those students who solve it at a more formal level by measuring volumes and calculating their answers.
How many drinks?

Sample Recording Sheet for Individual students

Student Name: ______________________ Date: ______________________

Task or questions undertaken: ____________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
☐ Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
☐ Identified capacity of container & interpreted metric units

Choose strategy
☐ Selected strategy that demonstrates understanding of the task/process required – e.g. chose appropriate measuring equipment

Apply strategy
☐ Filled one cup repeatedly to practical level, counted whole numbers
☐ Expressed remainder as a fraction
☐ Filled one cup to practical level, accurately measured in some graduated vessel & correctly interpreted metric units
☐ Interpreted metric quantity on label & correctly converted units for comparison
☐ Correctly performed a calculation using addition
☐ Correctly performed a calculation using multiplication
☐ Correctly performed a calculation using division

Reflect on outcomes
☐ Expressed results sensibly and meaningfully
☐ Judged reasonableness of results by referring to prior experience
☐ Checked results using rough estimations

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
How many drinks?

Sample Key for Class Observation & Recording Sheet

Group: __________________________ Date: __________________________

Task or questions undertaken: ______________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
a) Identified/recognised capacity of container interpreting metric units
b) Demonstrated understanding of task — translated task into words, communicated meaning of task, rephrased task in own language

c) Selected strategy that demonstrates understanding of the task/process required — e.g. chose appropriate measuring equipment

Choose strategy

Apply strategy
d) Filled one cup repeatedly to practical level, counted whole numbers
e) Expressed remainder as a fraction
f) Filled one cup to practical level, accurately measured in some graduated vessel & correctly interpreted metric units
g) Interpreted metric quantity on label & correctly converted units for comparison
h) Correctly performed a calculation using addition
i) Correctly performed a calculation using multiplication
j) Correctly performed a calculation using division

Reflect on outcomes
k) Expressed results sensibly and meaningfully
l) Judged reasonableness of results by referring to prior experience
m) Checked results using rough estimations

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] — indicates prompting from teacher
[a] — indicates a significant amount of assistance from other student or teacher
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# How many drinks?
## Sample Class Observation & Recording Sheet

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</table>

## Responses against the Task Process Cycle

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<tr>
<td></td>
<td>a) Demonstrated understanding</td>
<td>b) Identified capacity &amp; units</td>
<td>c) Selected strategy</td>
<td>d) Filled one cup repeatedly</td>
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191
Design a better box

This task is based on one that has been used by Penny for many years with her bridging students. She asks students to calculate the surface area of existing cereal packets, and investigate other shapes that would hold the same amount of cereal. The task is open-ended, in that students can choose the packet they wish to work from, create their own alternative shapes, investigate a variety of shapes, or experiment to find the most economical, according to their level of ability. It uses real-life containers so that students participate in all phases of the Task Process Cycle, rather than being given a set of measurements to work from.

Ideally this task would follow from volume estimation exercises in which the packaging shapes of bottles and other household products were discussed.

Potential levels, skills and knowledge

Medium-high: Measurement - use of formulae for area and volume, calculations of surface area.
Shape and space - nets and solids.

Preparation

Materials required

• A selection of different shapes and sizes of cereal packets
• Rulers for taking measurements
• Card or stiff paper for creating the final products (optional)

If no prior discussion of packaging has taken place, then you could also use a collection of similar supermarket items of different shapes, such as alternatively shaped 'Smarties' or other confectionery packets, different shaped litre ice-cream containers, shampoo bottles.

Formulating the task or question(s)

One suggested question is:
• Can you make a more economical box for this cereal?
  - Select one of the boxes on the table.
  - Comment on which design is better, yours or the maker's.
  - Why?
Suggested procedure

Tuning in to the topic

If no other tasks involving packaging have been done then some estimations of the capacity of alternative shaped bottles and packets could help students to start thinking about packaging shapes.

Ask students to:
• Quickly estimate the volume of the collection
• Discuss any deceptive shapes
• Think about why packages are the shapes they are.

Responses could include:
• Marketing deception
• Room for advertising on the outside
• Pleasing appearance
• Ease of handling
• Shelf packing and storing.

Introducing the task

Bring students’ attention particularly to the cereal boxes, and discuss shape and packaging. For example:
• Do you think these are examples of deceptive packaging?
• There seems to be a lot of empty space in some of them, why?
• Do you think they use more cardboard in making them than they need to?
• Could you make them more efficiently?

After these preliminary discussions, give students the prepared question.

Reflecting on the task

Allow a few moments for students to pair up and discuss what they might do.

Focussing students’ ideas and strategies

Encourage students to share a few ideas about:
• What sort of shapes might use less cardboard
• How they will find out the amount of cardboard.
Focus student attention on:
• The concept of surface area and how it differs from volume
• The measurements they will need to make in order to calculate it
• Drawing and labelling diagrams to go with a task like this.

Try to steer the discussion to keeping the volume the same.

A few minutes demonstrating to students the simple technique for drawing a box shape can be very helpful for adult students.

Working on the task

Encourage students to begin by taking accurate measurements, then experimenting with diagrams and calculations to find the dimensions of their alternative box.

As you circulate, asking students for explanations about what they are doing may help them clarify their own thinking.

Some students may need your assistance during a task of this nature - for example your questioning might assist them to work out the number of faces that are the same on the box.

Whilst they are performing this task it should be clear who has a reasonable understanding of the concepts of surface area and volume and how they are calculated, and who needs extra experience with the ideas and formulae.

Students at this level should also be encouraged to perform estimated calculations as a check on their calculator computations.

Students who have found one solution easily may be encouraged to find an alternative shape, for example, one that uses the least possible amount of cardboard. [If anyone thinks they have found this, other students could be challenged to find a more economic version.]
Encouraging evaluation and reflection - Is it reasonable?

One suggestion for evaluation is to make the container from paper in the dimensions decided. The volumes could be checked by measuring - filling with polystyrene foam and pouring into a measuring jug. [This will serve to reinforce the link between liquid volumes of millilitres and the calculated volume in cubic centimetres.]

Another suggestion is peer assessment, with another student making measurements and performing rough calculations to see if the dimensions seem reasonable.

Real world considerations such as the practicality of their resultant shapes should also be addressed as a group following the task.

Recording student outcomes

At this level students should produce a written report, including diagrams, calculations and some written text that incorporates aspects of the evaluation and discussion of the real-world considerations of their own container.

Links, extensions, follow-up tasks

Some students might be encouraged to do a similar task using containers with more complex shapes, such as cylindrical soft-drink cans, triangular or hexagonal prisms like those used for some chocolate packaging.

Similar tasks

Any product with a variety of package shapes and sizes can stimulate similar investigations for students. For example, one of Beth's students investigated the volume and surface area of five different shaped “Smarties” packets before designing her own version.
The Price of Biscuits - Comparing Costs

This task grew from a task Chris gave her students in which they compared the cost of home-made biscuits with the commercially made variety. It follows a practical session where students made the biscuits in class. (See p. 133 for a description of this task.) The students were asked to decide on the cost of the ingredients for making the biscuits by referring to the full prices and the amounts used. The decisions about appropriate strategies for calculating the cost of each ingredient led to a variety of student approaches, making the task open-ended in many respects.

Potential levels, skills and knowledge

Medium: Calculations with money, metric units and fractions.

Preparation

Materials required
- Packets of the commercially produced alternatives to the biscuits made in class
- Left-over ingredients from the biscuits made in class
- Supermarket dockets for ingredients of the home-made biscuits and the commercial packets
- Copies of the recipes used to make the biscuits
- The measuring equipment used when making the biscuits.

Formulating the questions

Questions you might use are:
- How much does it cost to make a biscuit?
- Which is better value: a home-made biscuit or a bought biscuit?

Suggested procedure

Tuning in to the topic

Encourage discussion of the pros and cons of home-made and bought biscuits. These may include cost, convenience and taste.
Introducing the task
Give the questions to pairs or small groups. At this point also give out the recipes and supermarket dockets so that students have some real-life information at hand.

Reflecting on the task
Tell students you will give them a minute or two to talk to their partner about how they could approach the task before discussing it as a whole class. Encourage them to think about what information they would need, and how they might use it.

Focussing students' ideas and strategies
Ask who would like to share what they started thinking about. Focus students' thinking to consider various strategies for working out:
• (roughly) the proportion of the ingredient that was used and how much is left over
• the approximate cost of what was used
• the cost of a cup, or a spoon, if the container is labelled in grams, kilograms, litres or millilitres
• They might need to consider if the rest of the ingredient is useable later or if it will be discarded.

Working on the task
Students will use a range of strategies. As you circulate, encourage them to explain verbally, or in writing on their individual reports, how they are working out the cost of each ingredient.

Encourage higher-level students to aim for accuracy in measurement and calculations (eg fractions of ingredients).

Encouraging evaluation and reflection - Is it reasonable?
When students are finalising their responses, encourage them to think about whether their response is reasonable. Suggest that they also compare their results with other groups, and reflect on why they might have reached different conclusions. Encourage consideration of other factors that would affect their choice of biscuit such as taste, and the time taken to make home-made biscuits. Encourage them to check their calculations, and reflect on ways that the task could have been done better. Higher level students could be encouraged to think about ways in which their final estimations could be made more accurate.

Recording student outcomes
Students should be encouraged to produce written records of their strategies and calculations that you can map against the assessment criteria. This task also allows observation of students whilst they are working. Records of observation can be made on a class sheet or as individual student records to attach to their written work, as evidence of the practical measurement skills.
You may be able to adapt the sample recording sheets provided for the related task of Making Biscuits - see pages 136 - 138.

Sample student responses for this task are included on pages 201 - 203, with an accompanying analysis of the responses.

Similar tasks

A similar task could be designed around any practical cooking task such as the cost of making Pizza, a cake, a hot-dog, a hamburger, compared to buying it.
The Price of Biscuits

Sample stimuli

Anzac Biscuits

INGREDIENTS
1 cup rolled oats
1 cup coconut
1 cup plain flour
\(\frac{1}{2}\) cup sugar
125g (4oz) butter
1 tablespoon golden syrup
1 teaspoon bicarbonate of soda
2 tablespoons water

Preheat oven to 150°C
Mix oats, flour, sugar and coconut together.
Melt syrup and butter together.
Mix soda with boiling water and add to melted butter and syrup.
Add to dry ingredients.
Place 1 tablespoonfuls of mixture on greased tray (allow room for spreading).
Bake for 20 minutes.
Loosen while warm, cool on trays.
(makes about 35)

HI-LO SUPERMARKET

TAX INVOICE
ABN: 12 345 678 901
CASHIER#: 312

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<th>Item</th>
<th>Quantity</th>
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</thead>
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</tr>
<tr>
<td>Coconut 250g</td>
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<td>$1.03</td>
</tr>
<tr>
<td>Golden Syrup 1.99</td>
<td></td>
<td>$1.80</td>
</tr>
<tr>
<td>Butter 500g</td>
<td>1</td>
<td>$2.05</td>
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<tr>
<td>Sugar 1kg</td>
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<td>Flour 2kg</td>
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<td>$2.55</td>
</tr>
<tr>
<td>Oats 250g</td>
<td>1</td>
<td>$1.51</td>
</tr>
</tbody>
</table>

TOTAL $12.20
CASH 20.00
RAISING +.00
CHANGE 1.80
GST 0.18
INCLUDED IN TOTAL

% = TAXABLE ITEMS
RETAIN FOR REFUND

---

200
The Price of Biscuits - Sample Student Responses

Summary of student responses

This was a reality-based task in which students worked together in small groups to decide upon and implement a strategy. Two student responses are shown here for comparison.

Student B's written contribution is part of a team's effort but is not a complete response, whereas that of student A is a thorough written report of the entire process.

See the Mapping with Curriculum Outcomes book for more details.

Analysis of student responses

Student A

See response on following page.

Student A has described fully all aspects of the Task Process Cycle: selecting information from the packets, docket and recipe; the strategies used to cook the biscuits, and then compare and calculate the costs (including some hindsight on strategies which might have been more efficient); the complete details on applying the strategy are shown in her calculations and working out; and she has a clear statement of conclusion and reflection on both the mathematics and real factors relating to the outcome.

Her calculations show an unusually high level of comfort and expertise with the meaning and application of proportions and fractions.

Student A's report also shows a great deal of analytic skill. Assumptions made, which items to ignore and why, have been explained in her written record.
The cost of biscuits

For this task we were separated into small groups and given tasks to perform.

We were each given a photocopied copy of a shopping docket. The docket contained items and prices of products that were to be used to cook/make.

My group consisted of three other people.

We were given a recipe for Anzac Biscuits. We were then required to make them in the kitchen. We all were given a separate bench and oven/cut top to use. We gathered the utensils such as a bowl, wooden spoon, saucepan to heat butter etc.

We followed the recipe measuring the ingredients as we went along and placed the mixture on cooking trays and then put them in the oven. After 10 minutes we took the biscuits out and tasted them. They were

We then had to answer a few questions on cost and taste of the cooked biscuits vs bought biscuits.

We realized that we should have weighed after measuring them. Although we were determine how much was used by weighing etc and dividing the missing weight between the other group. The other group all biscuits.

The recipe for Anzac Biscuits is as follows:

1 cup plain flour
1 cup rolled oats
1 cup coconut
1/2 cup sugar
125 gms butter
1 large tablespoon Golden Syrup
1 tablespoon bicarb soda
2 tablespoons water

To determine the cost of the bought biscuits, I first looked at the docket and saw that the Anzac Biscuits were $1.99. They contain 24 biscuits.

1 then divided 24 into $1.99 = 8 cents approx.

We made 32 biscuits out of our mixture.

To determine the costs of a home-made biscuit, I used a couple of operations. I did not consider the cost of 2 tablespoons of water as it would be difficult. The same goes for the bicarb soda.

250 gms bag of coconut cost $1.03

We used 75 gms which is approx $\frac{1}{3}$

So $\frac{1.03}{3} = 34c$

Golden syrup in a 400 ml bottle costs $1.80

We used 25 ml. This is $\frac{1}{16}$ of the contents

So $\frac{1.80}{16} = 11c$ approx

500 gms of butter cost $2.05

All groups needed 125 gms. $500 \div 4 = 125$, so $2.05 \div 4 = 51c$

2 kgs of Plain Flour costs $2.55

We used 155 gms which is approx $\frac{1}{13}$

So $\frac{2.55}{13} = 20c$ approx

1 kg of sugar cost $1.27

We used 125 gms which is $\frac{1}{8}$

So $\frac{1.27}{8} = 16c$ approx

250 gms of oats cost $1.81

We used 75 gms which is approx $\frac{1}{3}$

So $\frac{1.81}{3} = 61c$

Total costs of 32 home-made biscuits = $\frac{1}{8}$

$\frac{1.81}{32} = 6c$ approx. (may add a couple of cents for electricity.)

I conclude that our home-made biscuits are slightly cheaper to make than the bought biscuits. In my opinion the home-made biscuits taste better.

Student A’s written report
**Student B**

Student B’s written work demonstrates understanding of metric conversions (kg to g) and some kind of ability to calculate with fractions (although the actual method is not shown). Implicit in the information and calculation results shown is the ability to weigh and measure ingredients and a degree of problem solving. As such there is evidence of undertaking the first two stages of the Task Process Cycle.

Even for roughly recorded calculations, student A’s written record shows no indication of where the final answer of 5c per biscuit comes from and some components of the cost, such as the cost of the oats, do not appear. There is also no written record of reflection on the two types of biscuit, although it is likely that it occurred as part of the group discussion.

In this case the teacher would need to record observations of the students’ work and processes or encourage the student to explain or record their strategies more fully.

---

**Hi-Lo Supermarket**

**TRX INVOICE**

ABN: 12 345 678 901

CASHIER#: 312

<table>
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<th>Item</th>
<th>Amount</th>
<th>Price</th>
<th>Cost</th>
</tr>
</thead>
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<td>400 packets of 2.4g</td>
<td>1.99</td>
<td>7.96</td>
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</tr>
<tr>
<td>75g of 2.5 mls bottle</td>
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<tr>
<td>2.5 mls of 400 ml bottle</td>
<td>1.80</td>
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<td></td>
</tr>
<tr>
<td>12.5g of 5% coconut</td>
<td>2.05</td>
<td>2.05</td>
<td></td>
</tr>
<tr>
<td>12.5g of 15% sugar</td>
<td>1.27</td>
<td>1.27</td>
<td></td>
</tr>
<tr>
<td>2.5kg of 2% butter</td>
<td>2.55</td>
<td>2.55</td>
<td></td>
</tr>
<tr>
<td>2.5kg of 1% flour</td>
<td>1.51</td>
<td>1.51</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** $12.20

**CASH** 20.00

**CHANGE** 7.80

**GST** 0.18

% = TAXABLE ITEMS RETAIN FOR REFUND

---

*In group tasks such as this one, it is important that the teacher use a range of methods for assessing the individual student’s work. For example:*

- asking students to write a written report of what they did
- an oral explanation with questioning from the teacher
- observation of student’s work and completion of recording sheet.*
Orange Juice - Freshly Squeezed or Bottled?

This task is based on an idea tried out by Ruth Goddard several years ago. It has been adapted in many forms by many adult numeracy teachers since then. The task uses real-life products and invite students to consider a question that is likely to be relevant to their own situations, particularly those with families.

Tasks of this type offer a 'natural' opportunity to observe students' measuring skills.

Potential level, skills and knowledge

Low/Medium: Measurement – focusing on small units for volume and weight and the use of small measuring instruments for liquids. Number calculations in the context of metric units of measurement and time.

Preparation

Materials required

- Bag of oranges and container of orange juice (both with quantity and price labels)
- Pictures of these items from supermarket catalogues and some oranges (at least one per pair of students)
- Measuring jugs or cups marked in millilitres
- Selection of drinking glasses or paper cups (include a few different sizes to indicate not all glasses hold the same volume)
- Orange juice squeezer(s)
- Copies of the observation sheets (pp. 208 - 210) – either one observation tick-sheet for the whole class, or one copy per student of the individual student observation sheet.

Formulating the task or question(s)

Suggested questions:
- Is it cheaper to squeeze your own orange juice or buy it in a bottle?
- Which juice is cheapest?
Suggested procedure

Tuning in to the topic

A possible beginning of the discussion might be:

We are going to look at juice prices today.
- Who has orange juice at home?
- What size container do you buy?
- Do you squeeze your own?
- Which do you think tastes better?

Introducing the task

Following on from the discussion introduce the task:
- I want you to decide which is the cheapest way to get orange juice – squeezing it or buying it in a bottle?

Reflecting on the task

Ask the students to think for a minute or two how they might start investigating the question.

Beginning in pairs would encourage thinking out aloud about strategies and extending ideas. It is also a less threatening way to begin.

Focussing students’ ideas and strategies

Discuss some of the students’ initial suggestions.

Focus students towards thinking about variables such as:
- The amount of juice that can be squeezed from an average orange
- Amount of juice in a serve
- Cost per orange
- Cost per serve.

Working on the task

Allow plenty of time. Encourage hands-on volume measurement which you can observe and record against assessment criteria. Students’ capacity to calculate with the measurements they make is also important in this task.
Encouraging evaluation and reflection - Is it reasonable?

Discuss results, focusing on students’ past experience.

Other factors to consider include:
- Convenience
- Taste
- Nutrition

You might also ask students to consider the cost of buying juice away from home, in cafes or milk bars, and/or the difference to the cost if small bottles of juice were used in the price calculations.

Recording student outcomes

Depending on the level of student response, student outcomes can be recorded solely by observation or by a combination of observation and the students' written responses for the task.

Suggested recording sheets are provided for this purpose on pp. 208 - 210. Proforma 1 allows for individual records to be made for each student. Proforma 2 can be used to make records for a larger group of students. The recording sheets allow for a range of calculation strategies from manipulating simple addition through to using division.

Links, extensions, follow up tasks

Possible follow-up tasks for numeracy:
- Comparison of different orange juice labels for proportion of ingredients.
- Consideration and investigation of ‘100% Juice’ labels.

Possible extensions for literacy and study skills:
- Discussion/ research/ websearch regarding the reasons for availability of cheap orange juice – effects of imports on local producers.

Similar tasks

How many drinks? (See p 185.)

Is it cheaper to make your own __________ or buy it?
[possible inserts could include: cakes; pizzas; hamburgers; chips; knitwear; children’s clothes, and so on. The list is endless depending on the interests of the students.]
Orange Juice - Freshly Squeezed or Bottled?

Sample Recording Sheet for Individual Students

Student Name: ___________________________ Date: ___________________________

Task or questions undertaken: _______________________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
□ Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
□ Identified and interpreted relevant information, including metric units and prices, from container label and price tags or leaflets
□ Identified and interpreted calibrations on measuring equipment

Choose strategy
□ Selected strategy that demonstrates understanding of the task/process required – e.g. recognised a two staged comparative process, chose appropriate equipment for each aspect

Apply strategy
□ Correctly used appropriate measuring equipment
□ Converted measurements to units appropriate for calculation
□ Chose appropriate operations for calculations
□ Used calculator appropriately for money calculations
□ Correctly performed a calculation using addition,
□ Correctly performed a calculation using multiplication, or
□ Correctly performed a calculation using division

Reflect on outcomes
□ Expressed results sensibly and meaningfully
□ Judged reasonableness of results by referring to prior experience
□ Checked results using rough estimations

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[I] – indicates the student took a leading role in strategy and decision making.
Orange Juice - Freshly Squeezed or Bottled?

Sample Key for Class Observation & Recording Sheet

Group: ___________________________ Date: ________________

Task or questions undertaken: _______________________________________________________

Observed Stages of the Task Process Cycle:

Select relevant information
a) Demonstrated understanding of task – translated task into words, communicated meaning of task, rephrased task in own language
b) Identified and interpreted relevant information, including metric units and prices, from container label and price tags or leaflets
c) Identified and interpreted calibrations on measuring equipment

Choose strategy
d) Selected strategy that demonstrates understanding of the task/process required – e.g. recognised a two staged comparative process, chose appropriate equipment for each aspect

Apply strategy
e) Correctly used appropriate measuring equipment
f) Converted measurements to units appropriate for calculation
g) Chose appropriate operations for calculations
h) Used calculator appropriately for money calculations
i) Correctly performed a calculation using addition,
j) Correctly performed a calculation using multiplication, or
k) Correctly performed a calculation using division

Reflect on outcomes
l) Expressed results sensibly and meaningfully
m) Judged reasonableness of results by referring to prior experience
n) Checked results using rough estimations

Possible annotations
It is possible that ticks be supplemented with annotations. Some suggestions:
[p] – indicates prompting from teacher
[a] – indicates a significant amount of assistance from other student or teacher
[l] – indicates the student took a leading role in strategy and decision making.
# Orange Juice - Freshly Squeezed or Bottled?

Sample Class Observation & Recording Sheet

<table>
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<tr>
<th>Responses against the Task Process Cycle</th>
<th>Selects relevant info</th>
<th>Chooses strategy</th>
<th>Applies strategy</th>
<th>Reflects on outcomes</th>
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<td>b)</td>
<td>c)</td>
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<td></td>
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<td>W)</td>
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<td>Z)</td>
</tr>
</tbody>
</table>

Group: ________________________________  Date: ________________
Battery Hen Cages

This task was originally given to Chris' bridging students. It is based around a newspaper article regarding the so-called improvement to the living conditions of battery hens, a subject that interested Chris and her students. The task asks students to create, in paper, the floor plan of a cage that meets the specified area regulations. It has potential to develop new understandings about area and shape whilst assessing students' ability to use area formulae and units appropriately.

Potential levels, skills and knowledge

High: Area concepts, metric units for measuring length and area, use of the formula for area of a rectangle.

Preparation

Materials required

- Copies of the newspaper article extracts on p. 214 – one per student or pair of students
- Paper to cut out
- Rulers
- Scissors.

Formulating the task or question(s)

Suggested question wording:

The first newspaper article describes the regulation floor area of the battery hen cages.
- First estimate roughly on your tables how big that area is
- Then use accurate measurements and cut out paper to show me what the floor might look like.

The second of the two articles talks about the increase in the regulation floor area from 450 cm² to 550 cm². This could form the basis of further investigations for students in comparing the two areas.
Suggested procedure

Tuning in to the topic

Give copies of the newspaper article(s) to the students individually or in pairs.

Provide a chance for the students to read and discuss their feelings about the issue. Students may have personal experience of these farms to share.

Introducing the task

Ask the first part of the question verbally.

After a minute of reflection compare students initial responses.

Discuss general ability to estimate areas.

Ask the second part of the question verbally or give it out on paper.

Reflecting on the task

Allow time for each for each student to consider how they might begin.

Focusing students’ ideas and strategies

By considering some initial responses, discussion might make it clear that different configurations of length and width can lead to the same area.

Perhaps, as a class, the problem solving strategy of considering a simpler case would help. For instance, a 12 cm² area can be made from many differently shaped rectangles. Here are three possibilities:
Working on the task

Provide plenty of paper for students to experiment with. Perhaps encourage some students to investigate several differently shaped rectangles, and choose the best alternative.

Asking questions about appropriate units may also be of assistance.

As students work on this task you should be able to observe a great deal about their understanding of area and the associated metric units.

Encouraging evaluation and reflection - Is it reasonable?

Ask students to check the accuracy of each others' versions of the cage floors.

In this case the feasibility of a real bird fitting into the space would be part of the evaluation.

The real world implications are obvious.

Recording student outcomes

Students' written records should be available for mapping against assessment criteria. Records of any observations you made whilst discussing the problem with students could be attached to supplement their written work.

Links, extensions, follow-up tasks

This task offers possibilities of integration with reading, writing, oracy and study skills through further investigation of battery farming versus barn and free-range situations, creating posters, letter writing or debates.

Similar tasks

Many articles on environmental issues in the newspaper provide scope for numeracy exploration and visualisation.
Battery Hen Cages - Extracts of Articles

Poultry farmers push for chooks to enjoy the land of the free

The average battery hen under 2.4 kilograms has a minimum floor space of 450 square centimetres. Free range chooks at Patricia and Raymond Brooks’ farm have as far as the fenceline will take them.

To many this is the crux of the perennial egg question: free range or battery? It is a debate about animal welfare, production costs, nutrition and, the main arbiter, retail price.

Judging by supermarket sales, where cheaper caged-birds eggs account for about 95% of the market, free-range eggs are not all they are cracked up to be. Market research shows that Australians – who eat an average 129 eggs a year – want to buy the free range variety, but sales figures show this sentiment does not translate to sales.

Much of this is set to change, according to the Victorian Free Range Egg and Poultry Association, which is making a marketing push for their product and hoping to raise awareness of free-range alternatives.

Chickens free from yoke

Jac Grangien is a mother and a “cage-free” egg producer—all of which helps her to believe she knows more than the State’s agriculture ministers about what Australia’s egg consumers increasingly want.

This is why, when ministers baulked on Friday at demands to ban or phase out battery-hen egg production in the interests of hen welfare, she thought the ministers were in danger of becoming irrelevant to emerging egg-market trends.

Although they specified some improvements to cages, including increasing space for hens from 450 square centimetres to 550 square centimetres, the ministers have guaranteed the cage system for at least 20 years.

RSPCA Australia president Hugh Wirth said the decision was a lost opportunity to do away with farming that involved “unquestionably cruel confinement”—a system the RSPCA is trying to circumvent.

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1 This extract is from an article titled ‘Poultry farmers push for chooks to enjoy the land of the free’ by Dugald Jellie, *The Age*, March 29, 1995.

2 This extract is from an article titled ‘Chickens free from yoke’ by Paul Heinrichs, *The Age*, August 20, 2000.
Sample student response

Perimeter

- 3 cm
- 8 cm
- 8 cm
- 2 cm
- 10 cm
- 24 cm
- 2 cm
- 10 cm
- 9 cm
- 3 cm
- 6 cm
- 6 cm
- 2 cm
- 2 cm
- 9 cm

Know the perimeter of a rectangle does not necessarily give the area.

Battery house (control feeding) lights on.
Freezing house (cut off heat & doors. No see)
Barn laid house (free to roam)

450 cm²

100 x 2

450 cm²

125 x 250

45 x 10

125 x 250

91.5

1 m = 100 cm

100 cm

24 m²

67.5 m³

20 m²
Analysis of student response

Select relevant information
This student selected information from the newspaper article in terms of the floor area of the cage (450 cm²).

Choose strategy
The student's response indicates an investigation into the relationship between perimeter and area using trial and error, since there was no direct formula that could be used. There is a written conclusion ("Know the perimeter of a rectangle does not necessarily give the area") that indicates she has understood that relationship and demonstrated an understanding of perimeter and area of a rectangle and the related units. She then appears to have progressed to investigating the dimensions of the hens' cage by working backwards to find pairs of numbers which multiplied to give 450.

Apply strategy
Her initial investigation shows competent application of area formula, using correct units. The second shows a clear understanding of factor relationships and multiplication.

Reflect on outcomes
There is no written conclusion to the investigation, apart from the listing of possible lengths and widths. Although there is no written evidence on this page, the student had cut out diagrams of these shapes to illustrate the possible sizes. Discussion of the consequences of the investigation happened in class with the other students and the teacher. If this task was to be counted formally for assessment purposes, along with this sheet of work, some record of this discussion would need to be included in the student's folio.
Comparing the Age Distributions of Indigenous Australians with the General Population

This task, relating to the age distributions of Indigenous people compared to the general population in Australia, comes from an idea developed by Penny in her bridging course. It involves students comparing two sets of data, choosing appropriate graphs to illustrate it, calculating appropriate statistics and using these to interpret the data. The task is open-ended, in that it leaves it up to the students to choose what graphs to draw and what statistics to calculate. This enables the teacher to assess whether students understand what the different graphs and statistics illustrate, not merely if they can draw/calculate them. Having students write a report indicates their ability to interpret the data.

Potential levels, skills and knowledge:

Medium: A similar task, using a simpler newspaper data representation, would allow students to create alternative tables, graphs or charts to display the data.

High: Appropriate use of graphs and statistics to display, interpret and analyse data.

Preparation

Materials required

Photocopies of data showing the age distribution of the Australian population as a whole and the distribution of the Aboriginal population (see p. 220).

Articles from newspapers that include tables and/or graphs and an analysis of the data in them. These can be used to illustrate how to analyse and interpret data and write a report.

If possible, other newspaper or internet articles about Aboriginal health, birth rate in Australia, and relative life expectancy.

Formulating the task

Possible question:
Write a report that compares the age distribution of the Australian Aboriginal population with the age distribution of all Australians. Include statistics in your report and at least two types of graph. Comment on your findings.
Suggested procedure

Tuning in to the topic

Discussion starters might include:

- What do you know about average life expectancy in Australia?
- What about life expectancy amongst the Aboriginal population?
- What do you know about trends in Australia's birth rate over the last 100 years?

If you have found article(s) about Aboriginal health, the birth rate or life expectancy, then distribute them amongst students and provide opportunity for discussion around the issues they cover.

It would also be useful at this point to look at how the data is presented in the articles.

Introducing the task

Tell students that they are going to use statistics to compare two sets of data. Hand out copies of the data (page 220) and allow time for students to discuss it in pairs or small groups.

Hand out a copy of the question to each student.

Reflecting on the task

Ask the students to think for a minute about what they might include in a report on the data.

Focussing students’ ideas and strategies

Allow time for class discussion about:

- Possible reasons for the differences in the distributions
- What graphs students might include in their report
- What statistics they might use.

Distribute newspaper articles that discuss data in order for students to get ideas about how they might write their report. [The articles used earlier could also be used for this purpose.]

While students need time to discuss ideas together as a class, it is important that the teacher not be directive at this stage but allow the students to make their own decisions as to what they are going to include in their reports.
Working on the task

Give students time to start the task in class. They can then continue to work on the task at home.

In a later class, before they have to submit their completed task, give students feedback on what they have done and the opportunity to ask questions that may have arisen while they worked on the task.

Encouraging evaluation and reflection – Is it reasonable?

Discuss the students’ reports with them:
• Why did they choose to use the types of graphs that they did?
• Do they think that the graphs they have included give a good picture of the distributions and show the differences between them?
• Do they feel that the statistics they have used highlight the differences between the two sets of data?
• Would somebody reading their report get a good overall picture of the data?
• Are there any other possible explanations for the differences in the age distributions (depending on what they have written)?

Recording student outcomes

Students should have extensive written responses for this task. However, their ability to interpret data representations and appreciate the purpose of alternative display methods will also be apparent during discussions of the task. Brief notes of appropriate teacher observations could be included with the written task.

Students could also be encouraged to discuss these questions in pairs or small groups, so that they can learn from exposure to alternative interpretations.

Links, extensions, follow-up tasks

This task integrates reading, writing and numeracy competencies and could be used to further develop literacy skills pertaining to researching, writing and developing arguments.

Follow-up tasks might include:
• Web research regarding other indigenous populations
• Analysis of other comparative data displays.
Comparing the Age Distributions of Indigenous Australians with the General Population

Stimulus material

The table below shows the age distribution of the Aboriginal population of Australia and the age distribution of the whole population, e.g. 13.9% of the Aboriginal population is aged between 0 and 4 years while 7.7% of the total population is aged between 0 and 4 years.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Percent of Aboriginals</th>
<th>Percent of all Australians</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>13.9</td>
<td>7.7</td>
</tr>
<tr>
<td>5 - 9</td>
<td>12.4</td>
<td>7.5</td>
</tr>
<tr>
<td>10 - 14</td>
<td>13.2</td>
<td>8.2</td>
</tr>
<tr>
<td>15 - 19</td>
<td>12.7</td>
<td>8.4</td>
</tr>
<tr>
<td>20 - 24</td>
<td>10.5</td>
<td>8.2</td>
</tr>
<tr>
<td>25 - 29</td>
<td>8.6</td>
<td>8.4</td>
</tr>
<tr>
<td>30 - 34</td>
<td>6.8</td>
<td>8.0</td>
</tr>
<tr>
<td>35 - 39</td>
<td>5.4</td>
<td>8.0</td>
</tr>
<tr>
<td>40 - 44</td>
<td>4.2</td>
<td>6.3</td>
</tr>
<tr>
<td>45 - 49</td>
<td>3.5</td>
<td>5.4</td>
</tr>
<tr>
<td>50 - 54</td>
<td>2.7</td>
<td>4.5</td>
</tr>
<tr>
<td>55 - 59</td>
<td>1.9</td>
<td>4.6</td>
</tr>
<tr>
<td>60 - 64</td>
<td>1.6</td>
<td>4.4</td>
</tr>
<tr>
<td>65 - 69</td>
<td>1.2</td>
<td>3.5</td>
</tr>
<tr>
<td>70 - 74</td>
<td>0.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Over 74</td>
<td>0.7</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Write a report that compares the age distribution of the Australian Aboriginal population with the age distribution of all Australians. Include statistics in your report and at least two types of graph. Comment on your findings.
OPEN-ENDED TASK - SAVING WATER

Saving Water

This task has grown from one that was originally used by Beth in her women's bridging course. It has been developed over the years to encourage students to incorporate information available in the media regarding water shortages and conservation issues. One version of the task draws on a recent government campaign slogan for saving water. This type of task is open-ended because it invites students to consider their own homes and water usage, and come up with individual solutions to how they could save water at home. Tasks of this type are ideal for integration with reading and writing tasks.

Potential level, skills and knowledge

Medium
Measurement:
- focusing on a wide range of units for volume from millilitres to kilolitres and time from seconds to years
- the practical use of measuring instruments for liquids and time.

Number:
- calculations in the context of metric units of measurement and time
- interpreting numerical information and measurement data.

Preparation

Materials required

- Newspaper articles re current issues related to water usage, drought, etc.
- Pamphlets, articles or websites about typical consumption by standard appliances (often available from State or local water authorities)
- A typical water bill for the local area.


The more recent and local these are the better, because then students can relate to the task as reality, rather than something from a text-book.

- Some volume measuring equipment such as household measuring jugs
- A clock or timing device
- The questions, chosen from those below, presented on cards (eg one question per card for students to choose from).
Formulating the task or question(s)

Suggested Questions:
- How could you save three buckets of water a day?
- How could your household save 10% [or 20% etc] of its water consumption?
- How much water would you save if you
  - fixed dripping taps?
  - cut down on showers by ½ [or 2 etc] minutes per shower or reduced showers by 20% [or 50% etc].

You could select a single question for the whole class or decide on a selection, of varying degree of challenge, for the students to choose from.

Suggested procedure

Tuning in to the topic
Discuss a newspaper article or recent news reports about water shortages.

You might pose the question:
- Is there anything we can do about it?

Possibly bring the conversation around to personal consumption by your own confession. For instance:
- “I feel guilty about how long I stay in the shower, because I always do lots of thinking and planning in the shower.”
- Do you have any bad habits with water?
- Is there anything that other people do with water that annoys you?

Look at copies of a sample water bill and discuss typical use per day. Note the units used to measure and charge for water consumption.

In Australia, domestic water is measured and charged in ‘Kilolitres’ (lots of 1 000 litres) – imagine one cubic metre of water. (See page 226 for an explanation.)

Introducing the task
Tell students you are asking them to do some calculations to become aware of possible strategies for saving water.

Your introduction will vary, depending on whether you have chosen one question in advance or have decided to let the class negotiate their questions.

The questions, chosen from those above, could be presented on cards, one question per card, or listed on the board.
You could ask students to choose one question for the whole group, or to select their own preferred question.

Reflecting on the task

Ask students to think about how they might begin. Allow discussion in pairs to get ideas flowing.

Focussing students’ ideas and strategies

Focus on sharing strategies. For example, invite ideas on how students plan to measure the amount of water used in their shower or for garden watering.

Compare methods, focussing on rates of flow and the length of time you would need to take the measurement for reasonable accuracy. For example, you don't need to measure a whole shower, just enough to decide on the volume of water per minute. Also units of measurement and conversion might need exploring. For example, if you measure with a jug marked in millilitres how will you compare it to information given in litres, or kilolitres?

Working on the task

Some of the work for this task, such as measuring the actual consumption, will need to be done by students at home. However, a discussion in pairs or small groups about the strategies they might use is a valuable part of the exercise to do in class time. To test their strategies, student might even do a trial run of measuring water from taps or hoses on the site.

Encouraging evaluation and reflection - Is it reasonable?

Focus on questions such as:
- Is it realistic to save water this way?
- What would this amount of water look like?
  - A bath full?
  - A swimming pool?

Encourage students to perform rough calculations using rounding techniques to check their own, and perhaps one other student's result.

Recording outcomes

Most students undertaking this task would produce a written report that can be mapped against the assessment criteria. However, if experimental measurements were taken in class, there would also be an opportunity to observe students using volume-measuring equipment accurately and interpreting the units of measurement.
Links, extensions, follow-up tasks

Investigate impact on a wider scale by extrapolating the results to larger numbers of people and/or longer time frames. For example, encourage rough estimates of the impact of one person or household over:
- a week
- a month
- a year
And if
- 10 people did it
- 100 people did it.

Similar Tasks

One task that Beth has frequently used with a range of students:
- How much water is lost in a year from a dripping tap?
- Make a poster that encourages the public to fix their taps.
  [Try to describe the amount of water so that it can be visualised easily by others. Pictures are effective.]

The questions integrate presentation and writing skills.

Other suggestions:
- How much water is used to water your garden each summer?

- How much water might you save by:
  - Using timers on your watering system?
  - Recycling grey water?

- How much water might be saved if we stopped using dishwashers and instead did all our washing up by hand?

- Investigate the costs and benefits of installing a rain-water tank.
Saving Water

Sample stimuli


Saving Water

About metric volume units

1 millilitre (ml) \(= 1 \text{ cm} \times 1 \text{ cm} \times 1 \text{ cm} \text{ cube} = 1 \text{ cubic centimetre (cm}^3)\]

1000 of these millilitres make up 1 litre

1 litre (l)

10 cm \times 10 cm \times 10 cm \text{ cube} = 1 \text{ litre}

1 kilolitre (kl)

[not drawn in proportion to the others - it is much bigger than this!]

1000 of these litres make up 1 kilolitre

\([= 10 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm} \text{ cube} = 1 \text{ cubic metre (m}^3)\)]
Which Product is Healthier?

In this task students interpret nutritional information on a range of familiar grocery items such as biscuits, cereals or milk products. They select personally relevant nutritional information, record this information and make comparisons between different products on the basis of their nutritional content.

This task is open-ended to a certain extent because students decide which products to compare, and which nutritional components to investigate. They also devise their own method for recording information.

Potential levels, skills and knowledge

Medium: Interpreting metric measurement (e.g. grams per serve, grams per 100)  
Recording and interpreting data.

Preparation

Materials required

Collect a range of supermarket packages, and/or encourage students to bring along empty packets of their favourite biscuits and cereals, and empty milk cartons of different types of milk. Ensure that you have at least three or four different packets or cartons of each type so that students have a good range of products to choose from.

Formulating the task or question(s)

Possible question:
- Which product is healthier?

Suggested procedure

Tuning in to the topic

Before you begin the discussion, make sure that each student has a package or carton to examine and discuss, preferably one they brought along themselves.

Ask students to talk about the products in the packages they have brought in; what they are, what they like about them. Encourage them to articulate the reasons why they selected this product over an alternative (e.g. taste, price, healthier).
Introducing the task

Hand out the prepared question to individuals or pairs – one between two if you want them to work together or share ideas.

Reflecting on the task

Tell students you will give them a minute or two to think about the question. Encourage students to discuss with their working partner or nearby students how they might go about answering the question.

Focussing students’ ideas and strategies

Encourage students to articulate what it means for a product to be ‘healthier’. Steer the discussion towards:

- Identifying the nutritional (you may need to direct them to the nutritional information given on the packet) components of a product (e.g. protein, fibre, sugar, salt, fat, calcium vitamins)
- Comparing products in terms of their nutritional components
- Comparing like products (e.g. comparing cereals with cereals, biscuits with biscuits).

Encourage students to form pairs or small groups according to their choices of products. For example, students who brought along their favourite cereal packets could team up to make comparisons of different cereals. Students who brought along biscuits could do likewise.

Give students a few minutes to look at their packages and share information about the ingredients they contain. Encourage students to make comparisons (eg. Mine has less sugar; mine has more protein).

At this time it may be helpful to focus on the different ways nutritional information is presented. (It is usually given as either a typical serving size or in relation to 100 grams of the product).

Ask students to suggest how they might record the nutritional information they have about the products they are comparing. (Encourage and, if necessary, model appropriate formats such as a list or table on the board.)
REALITY-BASED TASK: WHICH PRODUCT IS HEALTHIER?

**Working on the task**

Students finalise their decisions about the range of nutrients they will consider and start recording the information. Circulate and facilitate the process of selecting and recording their information.

Encourage students to write a couple of sentences that summarise the information they have recorded. [Students with low literacy levels could do this verbally.]

**Encouraging evaluation and reflection - Is it reasonable?**

When students are finalising responses, facilitate reflection by asking them to explain their responses. Possible questions:

- Did you learn anything new or surprising from this activity?
- Can this information really help you decide which product is healthier?
- Is there such a thing as a healthy choice of this product?
- Would you consider nutritional information in the future when making choices about food products?

**Recording student responses**

Students should produce a written report that contains:

- A written record of their data such as a table or list of the products they compared and the amounts of sugar, salt, etc. in each product
- A summary of their main findings in one or two sentences
- A statement about how the task may have impacted on their personal product choices.

**Links, extensions, follow-up tasks**

**Examining samples of breakfast cereals**

Students could bring along samples of their favourite breakfast cereals (or you could provide servings of alternatives known to be more or less healthy). Students could then prepare a typical bowlful, weigh it and calculate the nutritional content using the nutritional information on the packet.
How Long Might This Medication Last?

This task is based on ideas discussed at a teacher workshop. It allows students to demonstrate their practical measuring skills and their ability to calculate with metric units and time, whilst discussing a topic of potential interest. It is open-ended because it allows students to personalise the task to their own family circumstances, and can also be tackled at different levels of complexity.

Potential levels, skills and knowledge

Low – medium: Measurement – focusing on small units for volume and weight and the use of small measuring instruments for liquids.

Number calculations in the context of metric units of measurement and time.

Preparation

Materials required

- Empty medicine bottles of different sizes such as cough medicine, aspirin, etc. (include both adult and child medications)
- Include both solid and liquid medications
- Medicine glass
- Eye dropper
- Selection of different sized teaspoons.

Formulating the task or question(s)

Choose from questions such as:

- How long will this last in your house?
- Which of the two bottles would go further for your family?
- How many doses could you get for your child from the bottle?
- What's the easiest way to measure the dose?

Questions could be displayed on cards placed beside the relevant product, especially if more than one is to be used.
Suggested procedure

Tuning in to the topic

Place the selection of products in front of the class and encourage them to compare notes on the products they use: how they measure the doses and what they use them for.

Possible discussion starters include:
• Do you recognise these?
• Which do you use?
• We buy a lot of these at home do you?
• How do you work out the dosages – spoon, medicine glass, guess?
• How easy do you find the instructions on these bottles?

Introducing the task

Give a selection or single question to the class to think about, individually or in pairs (You could give each pair a different product). If using liquid medicines tell them you want them to do some measuring and calculating and would like them to think for a minute on how they will begin.

Reflecting on the task

Allow a few minutes for considering responses before asking the class to compare

Focussing students’ ideas and strategies

Focus on:
• How much the different measurement instruments such as medicine glasses and teaspoons hold, and how the units of measurement are written on the bottles/packets
• Dosages and what they look like
• Time-intervals, and the different ways of writing them
• The age of the person taking the medicine.

Working on the task

Encourage students to read dosage instructions carefully and perform actual measurements whenever applicable.

As they work you should be able to observe their practical measuring skills, their understanding of appropriate number operations and their skill with calculation methods.
Encouraging evaluation and reflection - Is it reasonable?

Encourage students to compare solutions and relate them to their own experience.

Perhaps discuss whether it is better to buy bigger bottles, considering issues of cost and 'use by dates' or how long the product lasts.

Recording student outcomes

There should be a written record of each student's calculations that can be mapped against appropriate assessment criteria. The task also offers the opportunity to observe students' practical measuring skills. These observations could be recorded on individual record sheets for the task which are later attached to the students' written work.

Links, extensions, follow-up tasks

Calculate the cost per dose for different sizes of bottles.

Read, write, debate about issues of child medication, addiction to over-the-counter medicines, such as pain-killers.

Compare quantities of different ingredients by reading labels and comparing different products (see p. 227)

Similar tasks

See also ‘How many drinks?’ task (p. 185).
Square Numbers

This task is an example of building an assessment task from a question posed by a student. Di's higher level numeracy students had been learning about square numbers and square roots using a diagram of a square. A student then came up with the question: "If 15 equals 10 plus 5, why doesn't 15² equal 10² plus 5²?"

Di saw the opportunity to capitalise on the students' curiosity, and encouraged the student to explore the question for herself. The student subsequently demonstrated diagrammatically why \(10^2 + 5^2 \neq (10 + 5)^2\). She also went on to devise a general rule for squaring the sum of two numbers. The student wrote up the task and it was used as part of her assessment portfolio.

Potential levels, skills and knowledge

High: Use of algebra.

Preparation

Formulating the task or question(s)

This is an example of a student-initiated question, so there is little preparation necessary, apart from actively supporting and encouraging the student.

In this case, in conjunction with the student, a number of questions were posed and agreed to:
- Demonstrate graphically why \(10^2 + 5^2 = (10 + 5)^2\) is not true
- Work out a reason for the above, using numbers or algebra
- Formulate a general rule for finding the square of numbers.

Suggested procedure

Tuning in to the topic

Given that this has been generated by the student, there is little to do in terms of tuning the student in to the topic and task. The important thing here is to ensure that the students have the concepts, skills and knowledge they will need to attempt the task.
Focussing students’ ideas and strategies

Students often need assistance in narrowing down their enquiry into a manageable task or set of questions. Steer students’ thinking towards the knowledge and skills needed to address the question. In this case the student was quite focussed and she was able to undertake the task individually.

Working on the task

The student undertook this task independently and documented her process, using a range of strategies and skills. Her main breakthrough was in representing the problem diagrammatically.

Encouraging evaluation and reflection - Is it reasonable?

Students often benefit from reflecting on the value of the task to them personally, in addition to the outcome of the task. In the case of negotiated tasks like this one, the self motivation is so high, that students often get sufficient reward themselves that they need little extra support or encouragement from you as the teacher.
Sample student response

Question: estimate when calculate \( 15^2 \) (15 x 15)

I estimated that \( 10 + 5 = 15 \) therefore \( 10^2 + 5^2 = 15^2 \) would be the answer =125 but the calculator gave the answer 225... ??

Back to the drawing board!!! draw 15x15 square

One way of finding the answer is by breaking the number into 10s + Units

\[ 10^2 + 5^2 + 5 \times 10 + 5 \times 10 = 225 \]

which is the correct answer, and easy to see on paper.

I then set out to create a formula for squaring numbers, breaking the number into 10s + Units.

If \( 10 = a \) and \( 5 = b \) and the answer is \( x \)

\[ x = a^2 + b^2 + (a \times b) \times 2 \]

where \( x = a + b \)

Question: estimate \( 22^2 \) using my formula.

\[ a = 20 \quad b = 2 \quad x = a^2 + b^2 + (a \times b) \times 2 \]

\[ x = 20^2 + 2^2 + (20 \times 2) \times 2 \]

\[ x = 400 + 4 + 80 \]

\[ x = 484 \]

Question: estimate \( 56^2 \) formula. \( x = a^2 + b^2 + (a \times b) \times 2 \)

\[ x = 50^2 + 6^2 + (50 \times 6) \times 2 \]

\[ x = 2500 + 36 + (300) \times 2 \]

\[ x = 2536 + 600 \]

\[ x = 3136 \]

The 10s = \( a \) = Units = \( b \), the same formula could be used to square numbers in the hundreds e.g. 100s = \( a \), 10s = \( b \), units = \( c \).
How Far is it to the Horizon?

This task was also based on a question initiated by a student. The question was: “How far is it to the horizon?” Di recognised the potential for exploring this question, and building it into an assessment task. Her response to this question was, “I don’t know Ken. That’s a great question”.

Potential levels, skills and knowledge

High: Use of algebra, graphical and diagrammatic analysis, and some knowledge of trigonometry.

Preparation

Formulating the task or question(s)

Again, as this is an example of a student-initiated question, there is little preparation necessary, apart from actively supporting and encouraging the student.

The initial question posed was:

- How far is it to the horizon?

In this case, in conjunction with the student, a number of further questions were posed and agreed to:

- What is meant by the horizon?
- What factors determine how far we can see?

Suggested procedure

Tuning in to the topic

In this case there was a discussion between the teacher and the student about seeing at long distances, and what impacts on the process. Examples such as climbing towers on ship’s masts were explored.
The activity was related to personal experiences of the student and the teacher, as Di stated:

We talked about what factors affected the distance of the horizon and I related a story about a time we came up from a dive and, because our heads were low in the water, and the water was choppy, we lost sight of our boat. We also talked about sailors in the old days climbing up the mast to sight land. I asked him if he thought that distance to the horizon is going to be constant and he said, 'no it's going to vary according to the height of the person above the earth.'

**Focussing students' ideas and strategies**

Students often need assistance in narrowing down their enquiry into a manageable task or set of questions. Steer students' thinking towards the knowledge and skills needed to address the question. In this case the student was quite focussed and he was able to undertake the task individually but with quite a lot of teacher guidance and suggestions.

He needed help to figure out a method. This was to basically use Pythagoras' Theorem, utilising the radius of the Earth as one side of the triangle. Fortunately he had already learnt about Pythagoras, so it was a great opportunity to build on and apply this knowledge.

![Diagram showing the calculation of the horizon distance](image)

\[
\text{Diameter of earth} = 12756 \text{ km} \\
\text{diameter} \div 2 = \text{radius} \\
12756 \div 2 = 6378 \text{ km}
\]
Working on the task

The student had to go and gather information, such as the radius of the earth, and to come up with what heights he was going to use. Then he did the calculations and drew a graph relating height above the surface of the earth to the distance to the horizon (see following pages).

Encouraging evaluation and reflection - Is it reasonable?

The student was encouraged to look at his graph and interpret what it meant in reality.

In addition, the task was very satisfying to him personally. He was encouraged by the teacher to appreciate the scope of his task and the independent, systematic way he had gone about both doing the task and documenting his findings (see p. 243).

Students often benefit from reflecting on the value of the task to them personally, in addition to the outcome of the task. In the case of negotiated tasks like this one, the self motivation is so high, that students often get sufficient reward themselves that they need little extra support or encouragement from you as the teacher.

\[
\text{Small child} - 1.7 \text{ m} \\
6778.0017^2 = 6778^2 + x^2 \\
40678900.58 = 40678884 + x^2 \\
x^2 = 40678900.58 - 40678884 \\
x = \sqrt{16.58} \\
\quad = 4.071854614 \\
x = 4 \text{ km}
\]

\[
\text{Crow's nest on Endeavour} - 20 \text{ m} \\
6778.02^2 = 6778^2 + x^2 \\
40679179.12 = 40678884 + x^2 \\
x^2 = 40679179.12 - 40678884 \\
x = \sqrt{255.1204} \\
\quad = 15.97248885 \\
x = 16 \text{ km}
\]

\[
\text{Hot air balloon} - 200 \text{ m} \\
6778.2^2 = 6778^2 + x^2 \\
40681475.24 = 40678884 + x^2 \\
x^2 = 40681475.24 - 40678884 \\
x = \sqrt{2551.24} \\
\quad = 50.50980107 \\
x = 51 \text{ km}
\]
### Summary of distances to the horizon for different situations

<table>
<thead>
<tr>
<th>Situation</th>
<th>Height above earth</th>
<th>Distance to the horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall person</td>
<td>2 m</td>
<td>5 km</td>
</tr>
<tr>
<td>Small child</td>
<td>1.7 m</td>
<td>4 km</td>
</tr>
<tr>
<td>Deck of the Endeavour</td>
<td>6 m + 2 m person</td>
<td>10 km</td>
</tr>
<tr>
<td></td>
<td>= 8 m</td>
<td></td>
</tr>
<tr>
<td>Crow's nest</td>
<td>2.0 m</td>
<td>16 km</td>
</tr>
<tr>
<td>Hot air balloon</td>
<td>200 m</td>
<td>51 km</td>
</tr>
<tr>
<td>Glider</td>
<td>1000 m</td>
<td>117 km</td>
</tr>
<tr>
<td>Light aircraft</td>
<td>3000 m</td>
<td>196 km</td>
</tr>
<tr>
<td>Jet flying</td>
<td>11,000 m</td>
<td>375 km</td>
</tr>
</tbody>
</table>

### Graph of distances to the horizon for different heights above earth

[Graph showing the relationship between height above earth and distance to the horizon]
Conclusions

- I was surprised when I worked out how far I (ie 2m at sea level) could see to the horizon, just over 5 km. That's with good eye sight and perfect conditions.

- The greatest change happens within the first 20 m of the earth. Roughly for every 1 m in height above the earth you see 1 km in distance.

- Then up to 500 m mark the curve is not as sharp, ie the further you go in height, the distance to the horizon continues to increase, but these increases become smaller for a given increase in height above the earth.

Other thoughts

I didn't know you could get so much information out of a graph. After I did all the calculations on the different heights and found the distances, I finished up with a lot of figures which didn't mean much to me. But when you put these figures into a graph it makes the figures mean something. It was amazing how easy it was to work out the distance you see to the horizon. I thought it would be a lot more complicated than it was. The hardest thing was knowing how to go about solving the problem, the maths was easy. Most times it isn't very complicated. You would be surprised what you could work out. I was very lucky I had someone I could ask to show me the way to work it out. It was a good task for me to do.
Formative Assessment Activities

This section presents photocopiable versions of a selection of discussion starters and writing prompts aimed at encouraging students to focus on the affective (feeling related) aspects of their learning.

They can be used:
• As a discussion starter in small groups or the whole class
• To facilitate individual teacher-student discussion
• As writing prompts for end-of class reflection
• As prompts for ongoing journals.

The prompts are presented in three suggested formats:
• Tick the box
• Short prompts or sentence beginnings
• Brief questions.

This variety of formats allows for diverse levels of student input, from merely ticking a box to responding to open-ended questions, either verbally or in writing. The three formats can also be seen as models that provide a means of varying formative assessment activities over the duration of the course.

Further detail regarding the rationale and suggested procedures for using these activities is provided in the sections:
• Focussing on Student Confidence (p. 91)
• Focussing on Student Awareness of Learning (p. 97)
• Focussing on Student Autonomy (p. 101).
Talking About Feelings

These discussion/writing prompts help students identify their feelings about numeracy. A range of formats is provided. The tick the box format in the first question provides a set of words to help students name their feelings more easily. Once these feelings are named, students can elaborate further, if they wish, in pairs (by sharing with another student), small groups or the whole class. Their responses can be handed in and kept by the teacher, who can repeat the exercise later in the year to see if students’ confidence has grown.

How I feel about numeracy at the moment ...
(tick the words that best describe you)

<table>
<thead>
<tr>
<th>OK</th>
<th>Worried</th>
<th>Confused</th>
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</thead>
<tbody>
<tr>
<td>Uncertain</td>
<td>Confident</td>
<td>Excited</td>
</tr>
<tr>
<td>Interested</td>
<td>Embarrassed</td>
<td>Relaxed</td>
</tr>
</tbody>
</table>

Any other words? ____________________________

________________________________________

________________________________________

________________________________________

________________________________________
When I think about doing maths I feel ...
(tick the words that best describe you)

OK  Nervous  Blank
Uncertain  Confident  Excited
Interested  Embarrassed  Relaxed

Any other words?

After the class today I feel

Because
How do you feel about numeracy at the moment?

You can use the following prompt by inserting a particular topic:

How do you feel about [topic] at the moment?
Focussing on Student Autonomy

Short prompts or sentence beginnings

Before asking the teacher 'Is it right?' I could

When I don't know how to get started I could

To help me feel more confident with I could
Something I can do at home to help my numeracy learning is

Brief questions

Do you think homework is important? Why?

What could you do at home to help you with numeracy?
How can you make sure you do some homework?

You have a spare 20 minutes. What could you do to help you with?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

What could you do with your child(ren) to help everyone learn some numeracy?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

What could you do outside class with other students to help each other with numeracy?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Focussing on Awareness of Learning

Short prompts or sentence beginnings

An activity I enjoyed recently was

During this activity I learned

252
Two or three important things I learned in numeracy recently are:

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Something important I have learned in numeracy is

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

I still want to learn about

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Something that helped me learn recently was


Something from numeracy class that I have used in other places (e.g. home, work, shopping) is


Brief questions

Similar to the prompts, these are designed to be used singly at various times during the course. They can be presented verbally or in writing.

What did you learn today?


What helped you learn about


What do you know now that you didn’t know at the beginning of today’s class?


Is there anything you feel uncertain about at the moment?


Tick the words that describe what helps you learn best.

<table>
<thead>
<tr>
<th>Asking someone else</th>
<th>Drawing pictures and diagrams</th>
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</thead>
<tbody>
<tr>
<td>Working with other people</td>
<td>Trying out different ways of doing things</td>
</tr>
<tr>
<td>Writing things down</td>
<td>Explaining things to someone else</td>
</tr>
<tr>
<td>Working on my own</td>
<td>Trying out what I've learned at home or work</td>
</tr>
<tr>
<td>Using materials and equipment</td>
<td>Thinking about what we have done in class</td>
</tr>
</tbody>
</table>

Any more thoughts on what helps you learn?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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256
Template for Open-Ended Tasks

This template is designed to assist teachers navigate their way through a task. The steps provide a guiding structure on how to begin and what procedures might be usefully incorporated to ensure that all stages of the Task Process Cycle are addressed.

We hope that it will be particularly valuable for tasks where students are encouraged to personalise a topic or question. For example, when a task asks students to decide on the cost of Pizza meals for themselves, their own friendship group or family, or to calculate how they could cut down on their personal domestic water use. These are tasks which require a substantial amount of thinking and calculation from the students after the class discussion and reflection.

As it stands, the template should be useful in guiding teachers and students through the Task Process Cycle. However, it is not expected that all of the steps described in the template are suitable for all tasks. Sometimes, formative assessment tasks introduced for the purpose of observing students' practical measurement skills and strategies, or their number understanding, will not benefit by discussions preceding the tasks.

Within this publication, the steps for each task have been described using headings consistent with those in the template, but only those steps applicable to each task have been included.
Template for open-ended tasks

Potential levels, skills and knowledge

Low:

Medium:

High:

Preparation

Materials required

Where possible, collect authentic, up to date, real-world items or articles from newspapers or the web as a basis for the task.

Formulating the task or question(s)

Prepare well worded question(s) that allow for a range of responses. Preferably questions which might be answered across a range of levels.
Suggested procedure

Tuning in to the topic

Provide a brief opportunity to discuss the topic or examine the realistic materials in a general way before looking at the specific questions.

Introducing the task

Hand out or display the questions. Either the same to the whole class, or different levels for different students.

Reflecting on the task

Allow students time to consider their initial responses in a non-threatening situation, either individually, or in pairs, before sharing their ideas with the whole class.
Focussing students' ideas and strategies

Provide space for students to share their initial thoughts about the question, and how it might be personalised, or different, for each of them. At the same time, use students' starting points to steer the conversation towards aspects that may need to be considered to perform the task.

Working on the task

Allow students time to work on their personal, or pair, responses to the question, recording their results as clearly as possible so that they can share it later with you or other students. Encourage some students to widen their enquiry, depending on individual progress and ability to respond to different challenges.

Encouraging evaluation and reflection - Is it reasonable?

Facilitate the 'evaluation' aspect of the Task Process Cycle by asking questions appropriate to their level. At lower levels encourage judging by personal experience. For example 'Does that seem reasonable to you?' At higher levels suggest rough estimates alongside calculations, and consideration of real-world implications of solutions.
Class Observation and Recording Sheet

Group: ________________________________  Date: ______________

Learning Outcome: _________________________________________

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Rethinking Assessment

Strategies for holistic adult numeracy assessment.
A resource book for practitioners, policy-makers, researchers and assessors

Beth Marr, Sue Helme & Dave Tout

Rethinking Assessment is both a practical and theoretical resource. It discusses key assessment issues, provides a bank of models of good practice in assessment and demonstrates how holistic assessment can be undertaken within the assessment criteria of accredited frameworks.

Rethinking Assessment is based on research conducted with experienced practitioners. It documents their current assessment practices and issues of concern, as well as drawing on an action research process in which existing models and methods of assessment were discussed and extended.

It has two main sections. Section 1 introduces readers to the findings of the research and the thinking behind the examples of practice presented. It includes discussion and descriptions of:
- a model of holistic competence
- record keeping strategies
- initial assessment techniques
- using reality-based assessment tasks
- open-ended and negotiated assessment strategies
- issues of student’s confidence, autonomy and awareness of learning.

Each of these chapters contains:
- explanation and discussion of the strategies and their rationale
- suggested general procedures with illustrative examples and ideas for further tasks
- a discussion of issues and difficulties associated with the strategy.

Section 2 presents detailed descriptions of a selection of the assessment tasks developed and documented during the project, along with templates for a number of the tasks and strategies. Suggested observation and recording sheets are included where appropriate and samples of student responses are discussed.