DOCUMENT RESUME

ED 384 709 CE 068 967

AUTHOR	Halliday, Penny, Ed.; Marr, Beth, Ed.
TITLE	Not One Right Answer--Mathematics within the Certificates of General Education for Adults.
INSTITUTION	Adult, Community, and Further Education Board, Melbourne (Australia).
REPORT NO	ISBN-0-7306-7444-4
PUB DATE	95
NOTE	221p.
AVAILABLE FROM	Adult Basic Education Resource and Information Service (ARIS), National Languages and Literacy Institute of Australia, GPO Box 372F, Melbourne, Victoria 3001 Australia ($25 Australian plus postage; quantity price, on application).
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	*Adult Basic Education; Adult Literacy; Educational Certificates; Foreign Countries; Instructional Materials; Learning Activities; Lesson Plans; *Literacy Education; *Mathematics Curriculum; Mathematics Instruction; *Numeracy; Program Descriptions; Student Certification
IDENTIFIERS	*Certificates of General Educ Adults (Australia)

ABSTRACT

This publication provides curriculum ideas for the mathematical stream of the Certificates of General Education (CGE) for Adults in Victoria, Australia. It is intended to support people developing numeracy or basic mathematics courses in adult literacy and basic education. An introduction defines numeracy, describes the accreditation framework for the certificates, and places numeracy within that framework. The remainder of the publication describes eight successful courses currently being delivered by practicing teachers and demonstrates how these courses relate to the accreditation framework. The curriculum examples attempt to cover a range of types and levels. The following courses are described: a special needs program at level 1, an integrated numeracy/literacy program at level 1/2, an industry numeracy program at level 1/2, numeracy by telematics at level 2, a return to study mathematics course for women at level 2/3, and a bridging math course at level 4. For each course, with its own individual teacher and program designer, there is a brief outline and description, an explanation of the relationship of the course to the competencies of the CGE for Adults and sample course outlines and activities. Some sections conclude with a bibliography. (YLB)

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Adult Education in the Community

Not one right answer -

Mathematics within the Certificates of General Education for Adults

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Not one right answer- Mathematics within the Certificates of General Education for Adults

ISBN 0 7306 7444 4

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The views expressed in this publication are the authors' and do not necessarily reflect the policy of the Adult, Community and Further Education Board

This Adult Literacy and Basic Education project was funded by the Adult, Community and Further Education Board, Victoria.

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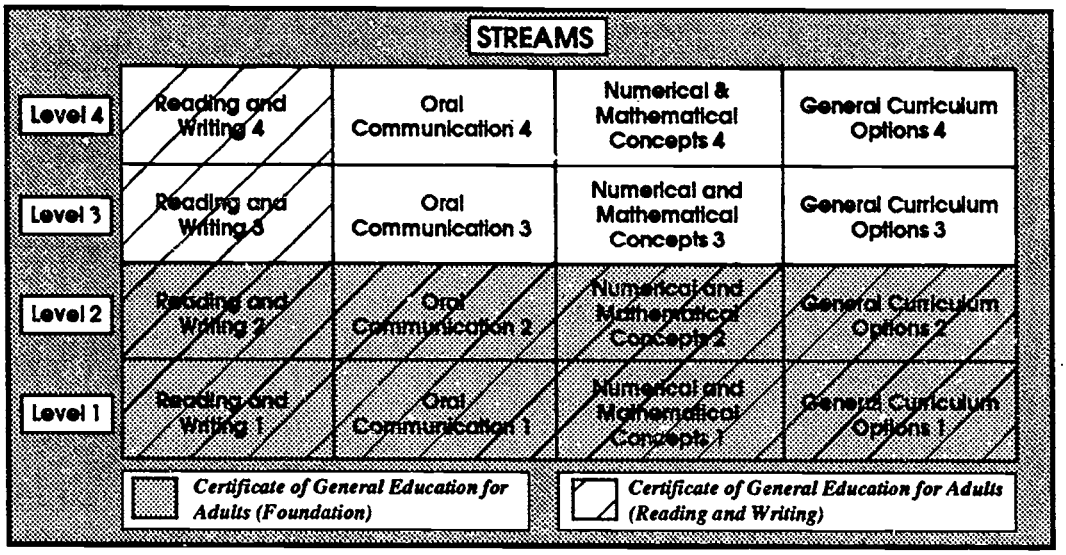
THE PURPOSE OF THE DOCUMENT

This document is designed to be read in conjunction with **The Certificates of General Education for Adults within the Victorian Adult English Language, Literacy and Numeracy Accreditation Framework**. There are four levels and four areas or streams of study in the **CGE for Adults** as represented by the following diagram.



The **CGE for Adults** aims to support program provision that occurs in a wide variety of places including community based providers, TAFE Colleges and workplaces. It is designed to:

- provide sequential learning arrangements for students in a range of contexts;
- articulate into employment, adult, community and further education, vocational education and training;
- facilitate personal and community development needs; and
- provide a common language for practitioners to use to report on student progress.

The **CGE for Adults** provides recognised credentials for students at a range of levels. Level 1 is the beginning level, and Level 4 the most advanced. There are two certificates that can be awarded:

- The **CGE for Adults (Foundation)** is granted after a student has successfully demonstrated competence at Level 2 in all four streams.
- The **CGE for Adults** is granted after a student has successfully achieved Level 2 competencies in all 4 streams and Level 4 in one other stream. The stream which is achieved at level 4 will appear in brackets, e.g. **CGE for Adults (Numerical and Mathematical Concepts)**. A student may choose to pursue all 4 streams to Level 4.

Students may choose to study any number of streams and any number of levels within those streams. **A Statement of Attainment** can be granted for each module in which competency has been achieved.

The CGE for Adults and the Accreditation Framework are designed to be flexible, and curriculum can be structured around areas of student interest or work. It is therefore expected that courses provided in a wide range of learning contexts will be designed to meet the needs of particular students and groups, and be reflected in a range of diverse curriculum content and delivery modes.

Not One Right Answer – Mathematics within the Certificates of General Education for Adults addresses the stream Numerical and Mathematical Concepts, and is intended to support people developing numeracy or basic maths course in the adult literacy and basic education sector. Such courses can be either stand alone courses, or integrated with other streams. There is a range of curriculum examples illustrated, which attempt to cover a range of types and levels of numeracy and basic maths provision.

■ WHY IS NUMERACY INCLUDED IN THE ACCREDITATION FRAMEWORK?

Today it is necessary to absorb and critically evaluate large amounts of information, much of which is presented in numerical or graphical form. In order to interpret this information when listening to radio, watching television, reading books, newspapers or magazines, and to understand diagrams and instructions in the workplace, a range of mathematical skills is needed.

Other mathematical needs of adult daily life include the ability to record numbers and to count, tell the time, pay for purchases and give change, weigh and measure, understand timetables and simple graphs and charts and to carry out the necessary calculations associated with these. Also needed is the feeling for number that permits sensible estimation and approximation and enables straightforward mental calculations to be accomplished.

Although these activities vary depending on the culture and the context in which they occur, they depend on a range of mathematical skills which include basic number skills, spatial concepts, use of measuring equipment and techniques and logical problem solving.

These skills, referred to as numeracy, are essential for participating effectively in today's advanced technological society.

■ WHAT IS NUMERACY?

Although there are no universally accepted definitions of numeracy or agreement about the ways in which numeracy differs from mathematics, certain emphases can be noted in the definitions of numeracy. These are emphases on the practical or functional.

> *To be numerate is to function effectively mathematically in one's daily life, at home and at work* (Willis, 1990).

Numeracy is defined by the Beazley committee as

> *the mathematics for effective functioning in one's group and community, and the capacity to use these skills to further one's own development and of one's community* (Beazley, 1984).

The Cockcroft Report states that the word 'numerate' implies

> *an 'at-homeness' with numbers and an ability to make use of the mathematical skills which enable an individual to cope with the practical demands of his everyday life* (Cockcroft, 1982).

It is clear from these definitions that numeracy implies a certain flexibility and is dependent on the needs and interests of the individual within the context of the peer group, community or occupation.

It is also clear that numeracy does not refer only to operating with numbers as the word suggests, but to a much wider range of skills.

Finally, the definitions imply certain attitudes as well as skills, an 'at-homeness' or 'confidence' with numbers. Skills can actually be put into practice because of freedom from anxiety.

■ TRADITIONAL MATHEMATICS CURRICULA

Traditional mathematics curricula throughout the world show little variation. Based on a Western European view of the world they tend to be esoteric and abstract, failing to take account of cultural differences and real life situations.

In the past, traditional mathematics was often regarded as an indicator of intelligence, so it is not surprising that many adult learners who 'failed' maths at school return to mathematics with much trepidation. Mathematics for them is associated with feelings of failure, stupidity and powerlessness.

To these people mathematics is a competitive and abstract subject filled with stressful tests and little explanation of why and how many of the skills being taught are used in society.

Mathematics has also been used as a social divider, creating a class distinction between these who can 'do maths' and those who cannot. It seems more than coincidence that success in mathematics appears to transfer to success in higher education and the professions.

The traditional maths curricula have disadvantaged women, in particular, as during their school days there was often little encouragement to persevere. Women who studied maths and science were considered 'unfeminine' and the absence of positive female role models further reinforced traditional choices. Text books rarely used female contexts or content and examples were generally related to typically male activities.

Australian educator, Mary Barnes, has documented the attitudes of women students and has noted that they find what is taught irrelevant to their interests, too abstract, impersonal and unrelated to people and their concerns. They comment that it is competitive, logical, rational and unemotional and the way it is taught does not suit their learning styles (Barnes, 1988).

■ WHAT DOES THIS MEAN FOR OUR TEACHING?

Today there is increasing awareness of the need for numeracy skills which will enrich the daily lives of the majority of people and be seen by them as valuable and relevant.

Adult learners need 'access' and 'success', their past anxieties and feelings of failure removed and replaced with positive attitudes. Failure must be replaced with success, competition with cooperation, irrelevance and mystery with relevance and clear, concrete, meaningful explanations. Adult students, in particular, need to be taught how to work cooperatively in an enjoyable, non competitive and supportive environment. They need to discover how to problem solve, discuss, guess, take chances, try things out, be wrong, and most importantly of all, they need to experience success with mathematics and feel that the problems they are tackling have real meaning.

People learn if they can slowly absorb ideas and construct their own meanings and understandings of mathematical concepts. They need to find out that there is rarely one right way, but in fact a wide variety of strategies that work perfectly well.

The goal of adult educators is therefore to assist students to develop mathematical concepts and relationships in ways that are personally meaningful.

Many basic mathematics courses are now taking into account their students' mathematical needs and building these into their courses. There is now a flexibility and an opportunity for student input on curriculum topics. Students are being taught that asking questions and seeking assistance from both teachers and peers is a desirable step that breeds a 'community of inquiry' approach, fosters teamwork and brings back desire and enjoyment to the educational process.

■ PURPOSE OF THIS CURRICULUM DOCUMENT

With the introduction of the **Victorian Adult English Language Literacy and Numeracy Accreditation Framework** and the new Certificate(s) of General Education for Adults many teachers are asking about the implications for their current practices.

This document describes a number of successful courses currently being delivered by practising teachers and demonstrates how theses courses relate to the **Accreditation Framework**.

It is hoped that practitioners can use the strategies described, modify them, have their own views reinforced by them or use them to inspire their own ideas for addressing the aims of the **Accreditation Framework** within their teaching.

We have selected courses taught in a range of settings for diverse groups of students:

- Special Needs Numeracy Program (Level 1): Carlton Reading and Writing Centre, Vic.

- Integrated Numeracy/Literacy for Unemployed Youth (Levels 1/2): Colac Skillshare, Vic.
- Numeracy in Industry (Level 1/2): Northern Metropolitan College of TAFE, Vic.
- Numeracy by Telematics Course (Level 2): Adult Literacy Group, Charlton, Vic.
- Return to Study Course for Women - Mathematics (Levels 2/3): Northern Metropolitan College of TAFE, Vic.
- Bridging Mathematics Course (Level 4): Northern Metropolitan College of TAFE, Vic.

Although each course is different, taught by and to different people, there are many similarities in their general style. Each course focuses on the student group rather than purely on the required content.

We have included the Telematics course to illustrate how good practice can be achieved even for long distance teaching through innovations in technology.

Apart from references to the competency statements, levels, strands, and content, each of these course descriptions includes features which add something to our overall repertoire of good practice ideas:

- the use of journals in the Telematics Numeracy course
- the reflective evaluations and use of current events in the Special Needs Numeracy Course
- the use and documentation of the Spiral Approach in the Bridging and Return to Study courses
- the concentration on language development integrated with mathematics learning in the Industry Numeracy Course
- and the use of a theme which has captured students' interest in the Program for Unemployed Youth.

These are all aspects worth reading about and reflecting on whatever the level of the students you are teaching.

THE STRANDS AND LEVELS OF THE ACCREDITATION FRAMEWORK

In mathematics the purpose of the Accreditation Framework is not to dictate exactly what mathematics students should learn, but to ensure that the curriculum falls under the Accreditation Framework guidelines with sufficient breadth of coverage across the strands of mathematics and documented levels of achievement which can be identified by commonly understood terminology. The Accreditation Framework also offers formal recognition of students' mathematical achievements.

The Strands used in the Accreditation Framework are Measurement, Shape (and Space), Data, Number, and Pattern and Relationships. These are described more fully as:

- **Measurement** which relates to understanding the concepts and relevant units of time, mass, temperature, length, area, capacity, angle, and related ratios and rates such as speed. Skills in this category include quantifying these properties by means of estimation, use of appropriate measuring instruments, and by evaluation of standard formulae
- **Shape (and Space)** which relates to naming, describing, and classifying two and three dimensional shapes and objects and to a knowledge of their properties. It also relates to the use of scales, maps, plans and models, and the giving and interpreting of directions
- **Data** which relates to the interpretation and presentation of information in the form of charts, tables and graphs. It involves also the understanding of averages, the analysis of statistical data, and the means of using such data, graphs, and tables to make predictions in political, personal and social contexts
- **Number** which relates to calculation and estimation of numerical quantities with and without calculators, recall of multiplication and addition number facts, understanding and application of fractions, decimals and percentages in meaningful contexts and the confident use of such skills and knowledge in practical situations involving financial dealings, use of measurement and scales, and analysis of statistical data
- **Pattern and Relationships (Algebra)** relates to the study of generalisations, or patterns, existing in collection of objects, numbers or mathematical situations and to the description of these patterns or generalisations using words, symbols or graphs. It also relates to the evaluation of formulae, the creation and solution of equations applicable to particular contexts, and the analysis of connections between related quantities such as population and time, distance and speed.

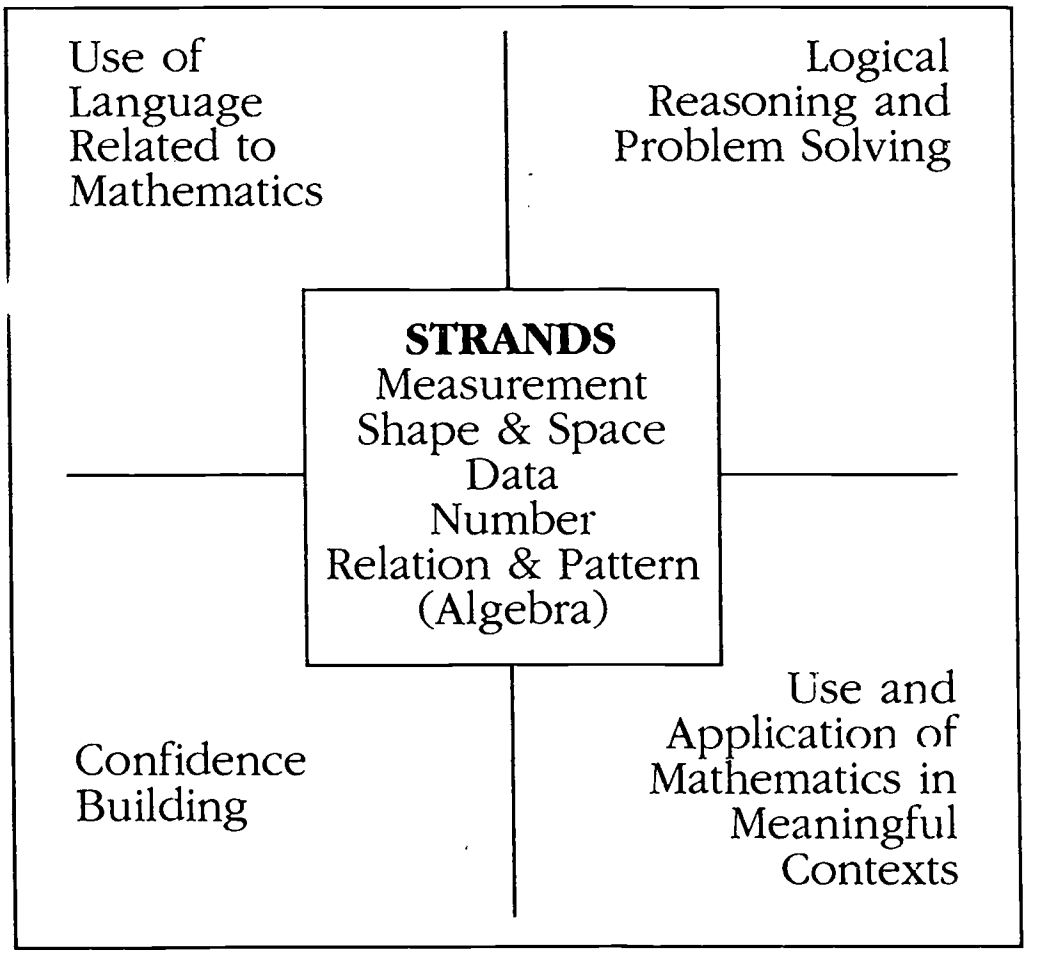
A guide to the **possible** scope of each strand within a given level is provided in the Background Section of the Certificates of General Education for Adults titled **Numerical and Mathematical Concepts - Competencies Arranged According to Levels**. This should not be regarded as a definitive list of 'must do' tasks but a guide from which to select according to the needs of your students.

Neither should the elements of competency or strands be regarded as separate. They were presented under organising headings to ensure that none of the important aspects of mathematical ability was overlooked. However, it is intended that they be viewed as interrelated and overlapping as expressed in the competency statement, and that the skills and knowledge underlying these outcomes should be taught in an integrated way.

At the same time other aspects vital to the effective teaching of mathematics should be kept in mind:

- building students' confidence in their ability to learn and use mathematics,
- encouraging students' development and use of the language associated with the maths they are learning
- presenting all of their maths in relevant and meaningful contexts
- always concentrating on the development of logical reasoning and problem solving skills.

The *Range and Conditions* section of the competency statement attempts to ensure that these are kept in mind whenever tasks are designed. The following diagram will possibly clarify these ideas.



Ideally, each activity or task should involve **all** of the four aspects shown in the corners and an **overlap** of **two or more strands**.

THE LEVELS

Levels 1 to 4 of the Accreditation Framework are officially defined by the Competence Statements on pages of the Certificates of General Education for Adults. Guides to possible specific outcomes at each level are provided in the **Numerical and Mathematical Concepts - Competencies Arranged According to Levels** in the Background section of the document (pp 193-206). These should serve only as a guide from which to select, not a compulsory listing of skills.

Ongoing decisions as to differentiation of levels and adequacy of courses will be made as part of the **moderation process**. To assist in interpretation until then we offer the following less formal descriptions which we hope will give 'a feel' for the four levels.

Levels 1 and 2 were seen as skills associated with two stages of Numeracy maths for everyday use, whether taught in separate numeracy classes or integrated within literacy classes.

Level 1

At the end of Level 1 students have the confidence to deal with simple and familiar tasks. Tasks which are performed are part of the students' normal routine to do with shopping, travelling, cooking, telling time. They have the ability to make sense of their daily personal lives.

People performing at this level would probably tackle only one task at a time such as giving change using real money, looking up a street in a directory, finding a postcode or a telephone number. They may need some help in identifying the sequence of steps in a more complex task such as planning a trip to the cinema, before being able to attempt it.

At this level it is expected the student will use spoken communication rather than written.

Calculations at this level would be performed with concrete materials or with the aid of a calculator.

Measurements of length, time, weight, volume would concentrate on comparisons of bigger, shorter, heavier, etc and be in whole number units or simple fractions such as one half or one quarter units rather than accurate measurements. For example, comparing and ordering distances, heights, weights and capacity of various sized objects, reading time in hours, half hours and quarter hours.

At this level it is important to concentrate on building the confidence of the student to tackle the daily problems of living, for example, tendering the appropriate amount of money when buying a ticket or making a purchase, without fear of embarrassment.

Level 2

At Level 2 students have the confidence to deal with everyday tasks in their entirety, such as checking timetables and estimating time and distance needed to arrive at a destination on time. These are not only tasks which are performed as part of the student's normal routine to do with shopping, travelling, cooking, etc., but they also extend to applications outside their immediate personal

environment such as the workplace and the community (whether first hand or portrayed in the media). At this level we concentrate on students having the ability to make sense of their daily personal and public lives.

People performing at the exit end of this level would probably be able to tackle a series of operations or problems with some confidence of selecting the right method or approach.

At this level it is expected that students will be able to communicate their ideas both verbally and in written form.

Calculations at this exit level would no longer need to be performed with the help of concrete materials, although they would certainly be used during the learning process. The students would be at ease with straightforward calculations both manually or using a calculator. Students would be expected to have a fair knowledge of basic number facts for addition and subtraction. They would have some confidence to estimate quantities 'in their heads'.

Measurements of length, time, weight and volume would be much more accurate and students would use finer units of measurement in the context of everyday life and the workplace.

Students at this level should develop the ability to understand and communicate information from simple graphs used in the media or the workplace.

At Level 2 it is important to concentrate on giving the student the strategies needed to approach problems confidently, to investigate and work through a problem without fearing failure or ridicule.

Level 3 is seen as mathematics beyond the 'everyday' use - the acquisition of early stages of knowledge and methodologies which represent the fundamental building blocks of mathematics. Teachers assisting students at this level would need to be experienced mathematics teachers with an understanding of the needs of adults returning to study.

Level 4 describes mathematics similar in nature to Level 3, but with greater complexity and using more of the body of mathematical knowledge. It requires increased ability to make independent choices of the techniques appropriate to particular problem solving situations.

■ REFERENCES

Barnes, M. (1988) Mathematics: A Barrier for Women? In Caine, B. de Lepervach, M. and Grosz, E. *Crossing Boundaries*, Sydney, Allen and Unwin.

Beazley, K. *Education in Western Australia: Report of the Committee of Inquiry into Education in Western Australia.* Education Department of Western Australia, 1984, p.

Cockcroft, W.H. *"Use of Mathematics by Adults in Daily Life". Mathematics Counts: Report of the Committee of Inquiry into the Teaching of Mathematics in Schools*, Her Majesty's Stationary Office, London, 1982, p.

Willis, S. *Being Numerate: What Counts?* ACER, Hawthorn, Victoria, 1990, p.

Special Needs Numeracy Program

LEVEL 1

This is a Maths course for students with mild intellectual disability

conducted at

Carlton Adult Reading & Writing Program Vic

Teacher and Program Designer
Barbara Mathews

■ PROFILE OF THE GROUP

The class is designed to meet the needs of students who may have a mild intellectual disability or a learning block of some kind and who need intensive practice at basic skills. It is for students who need to work at a very slow pace with special attention being given to their individual needs.

■ THE PROGRAM

The program is made up of four 10 week terms. Enrolment is on-going with students entering or exiting at any point. We try to provide pathways for their learning so that they do not become fixed at any one stage. It is not beneficial for the student to remain in the same program for a long period of time. They need to be challenged to move on to broaden their learning.

■ SELECTION PROCEDURES

Students may be referred through organisations such as Health and Community Services via Community Residential Houses, Commonwealth Employment Service, Specific Learning Difficulties, or other Neighbourhood Houses. Each student is interviewed, assessed and placed in an appropriate class or 1:1 tuition setting.

To be included in the class applicants must have demonstrated that they are capable of being independent learners within a group situation. They need some number skills such as basic number recognition, some understanding of number value, and familiarity with notes and coins. Above all they need to have expressed the desire to build on their knowledge and to have a purpose for their learning. For example, they may want to fill out their own bank form or to be able to shop at the market.

Some applicants may be more suited to teaching on a 1:1 basis rather than in a class setting. However, after some time in the 1:1 situation, they may be ready to join the Special Needs Maths Program.

■ COURSE OBJECTIVES

The course aims to foster within the students learning strategies which will make them more independent and confident. Believing that they become more able to obtain meaning and understanding from the world around them they will gain more control over their lives. Consequently they will see themselves as having a more worthwhile position in society.

I want the students to realise that Mathematics (in many different forms) surrounds them. The course is based on the idea that the development of an understanding of concepts will evolve from the practical experience of manipulating and interpreting numbers. For instance students must **use** money to gain an appreciation of its value. They must **measure** their heights to appreciate centimetres, millimetres and metres. They must think about everyday situations in terms of metrics. Is a 1.5m wave a big or little wave? Would you go swimming there if you read the surf report which said there would be a

1.5m surf? A person's height is recorded as 250cm. Is this possible? Do I cook my cake at 210°C if the recipe tells me to use a moderate oven?

I build on the student's own life experiences which can be used as a stepping off point to future learning. The student must be able to see relevance in their learning. It is far easier to go from the known to the unknown, from the concrete to the abstract.

I try to provide a stimulating learning environment where the student can feel relaxed yet challenged. I want them to enjoy working with numbers and concepts and to become fluent using mathematical language needed for daily living. It is important to realise that some of the students may not be accustomed to thinking for themselves in decision making situations. They need to be encouraged to take risks in their decisions so that they can become more confident and independent in their daily lives.

Although the main focus in the program is an educational one, the social skills developed in the sessions are also valuable. The class provides a social outlet for these students. They enjoy each other's company and are concerned about each member's welfare as well as progress. Students are encouraged to appreciate themselves as worthwhile members in society and to act in a responsible manner towards each other. They do not only stand as individuals but are expected to act within a group. Consequently, I see it as being important that each student view herself/himself as being an integral member of our group. They have an important part to play and it is necessary that they work cooperatively with the group.

■ RELATIONSHIP TO THE COMPETENCY STATEMENTS

This course fits perfectly into the definition of Level 1 Numeracy Competencies – *The student can use and analyse simple data, relation and pattern, number, measurement and shape.* In particular the elements: *1.1 - interpret familiar charts and graphs; 1.3 - using natural (or whole) numbers, practical and everyday fractions and practical and everyday decimal fractions; 1.4 - using personal referents in measurement; 1.5 - classifying shapes; and 1.2 -making connections and looking for patterns in all of the above* (CGE for Adults p87-88).

As stated in the aims the course is geared to assisting the students 'to obtain meaning from the world around them in order to gain more control over their lives'.

Tasks are tackled one at a time with help from the teacher. Real money is used to gain confidence for monetary transactions *(element 1.3).* Real calendars, maps and charts from the newspaper constantly keep activities related to understanding the forms of data used in real life and the mainstream media *(element 1.1).* Often data presentation such as weather maps and graphs which most people take for granted must be used over and over before students feel confident to read them themselves.

For example, when looking at Melbourne's Weather (see page 19) not only are

the charts read, but parts of the article are also examined. The activities are followed up by writing simple sentences about the weather.

Simple calculations are performed on whole numbers (ie. natural numbers) and based around familiar quantities such as measurements, dates, ages, prices of objects, and numbers on cards or dice *(element 1.3, 1.4)*. Also patterns involved in counting (eg. in 2's, 5's, 10's) are investigated using many of these contexts *(element 1.2)*.

Shapes such as circles, squares, triangles are identified as they occur in real situations – buildings, nature, clothing, until students can confidently name the shapes they see *(element 1.5)*.

Most of the communication in the class is verbal using the language of the students and gradually introducing them to new, everyday vocabulary related to the topics.

■ IMPLEMENTATION

I use topical themes which are of high interest value to my students. This means utilising available material in newspapers, magazines and advertisements. As a result the students' exposure to the topic does not come only from the classroom. Literacy plays a very important role in my class and I use a lot of reading material from the environment – junk mail, newspaper and magazine articles, timetables, subscriptions, bills, bank forms and grocery dockets.

I do not alter the texts I use as I believe it is how we use the texts for our level which is more important than the actual level of the text. Students need to be exposed to the material as it appears in 'real life' rather than as a simplified version. I do however, tend to choose clear, concise texts which, the students can effectively use with guidance.

I would like to have more excursions into our local area. However, a few students' lack of mobility and poor eyesight makes this difficult.

Contexts

Contexts used in the course so far are:

- The Olympic Games
- The Melbourne Cup
- Football
- The Elections (State and Federal)
- Melbourne's unusual weather patterns.

A thematic approach allows, and invites, a variety of mathematical skills to be incorporated in interesting ways within topics of interest. Some examples from this course are shown below.

The Olympic Games

Metrics	• Length of the pool
	• Height of high jump
	• Lengths for different track events
Time	• Winning Times
	• Records broken
Approximation & Comparisons	• Holding our own events to compare with the records.
Roman Numerals	• XIV Olympiad
Number Patterns	• Counting by 4's (the years the games are held eg. 1988, 1992, 1996 etc.)
	• Counting by 50's (how many lengths of the 50m pool do they swim in a 500m freestyle?)
Graphs	• of performances
	• medal tally

The Melbourne Cup

Ordinal Number	• Place getters
Metrics	• Time and Distance
Space	• Map reading
	• Patterns in shape and colour
Probability Concepts	• Chance of winning

Other topics students have found interesting have been working with timetables, identifying and recreating shapes and patterns which occur in nature and man-made structures, and preparing shopping lists for special events.

Resources

We have used a variety of instruments and resources such as rulers, compasses (for geometry as well as orienteering) tapes, scissors, measuring containers, scales, clocks, calculators, cards, dice, street directory, timetables and bank forms.

■ COURSE DOCUMENTATION

We have included a sequence of four sessions to show sequential development of a theme as described in the implementation section. With them are included copies of relevant newspaper articles, worksheets and handouts, so that the

flavour of the sessions will be completely clear.

Following these are some examples of a sequence of activities based around a particular major event in the year. The Melbourne Cup has been used to illustrate the idea but the general practice could focus on many topical events such as football finals, The Show, or topical festivals and celebrations which receive media publicity.

All of the detailed sessions and activities are mapped to the relevant elements of competency from the CGE for Adults.

Some of the reading and writing elements of competency have been included to model integration of numeracy and literacy skills. However, the inclusion of the elements and performance criteria should not be seen as samples of assessment items.

■ SESSION STRATEGIES

Although 2 hour sessions may vary from my pre-planned format I begin with a basic framework to my sessions as follows:

A Brief Introductory Game

The purpose of the introductory games or exercises are:

- to bring students together
- to focus their thinking
- to revise a previously taught skill or concept
- to provide practice in automatic response in a way which is enjoyable and acceptable to the students.

Some examples are listed below.

Card games

- Each student is given 3 cards. Who has the highest/lowest total?
- Each student is given 3 or 4 cards. What is the highest/lowest number you can make? eg: from 6, 9 ,3; highest is 963, lowest is 369

Dice games

- Roll the dice 3 times. Total score? Highest number?
- Each student has a dice. First to roll 6, 5, 4, 3, 2, 1 or 1, 2, 3, 4, 5, 6.
- Continue rolling the dice until a 6 is scored
- Continue rolling the dice until a 5 is scored
- Continue rolling the dice until a 4 is scored etc.

What is the number?

- Students work out someone's chosen secret number by asking questions which can only be answered with a Yes or No.

- Is the number greater than 10? Is it odd? Does it have 3 numbers?
- The aim is to find the number with the least number of questions being asked. Ref. *Strength in Numbers* p.GS 35)

Focus Activity 1

The main teaching point is covered here through explanation, discussion and the use of hands-on material if appropriate. There is likely to be an exercise or task to complete individually, with a partner, or in a group, depending on the group structure on the given day. There may be three or more different levels within the group and so tasks and my expectations of the students will vary accordingly.

Break

A break after one hour is essential due to concentration levels.

Focus Activity 2

Sometimes we resume the work from the first half with renewed intensity. However, I usually introduce something different but on the same theme if the students' interest has been captured. We might use the same material to practise different skills and obtain new information thus building on what we did before the break.

On occasions when students have not really engaged with the first focus activity a total shift of emphasis is needed and I bring out a game, puzzle, or practice task from my bag of resources which is always at hand.

Finishing Activity

This is not always necessary, but there are times when I feel the atmosphere needs to be changed or relaxed as students may be becoming confused, frustrated or tired. I believe they must leave the class with a feeling of confidence and purpose and so perhaps a game or a quick puzzle is required to complete the session.

These finishing activities are similar in type to introductory activities.

Student Evaluation

Ideally I like the students to reflect on the session and to critically analyse it. This may be done through quick comments in response to questions such as:

- How did it go today?
- Did you learn anything new?
- What was the best/worst part?
- How can you use what you have learnt today?
- Do you want to do more next week?
- Any ideas for changes?

I feel it is important for the student to be able to talk about what they are doing and so there are times I ask them to write sentences about their work. This shows me if I have been using language they understand. Most students write their own. However, there are a couple of students who will not be comfortable doing this and so I scribe for them.

■ SAMPLE SESSIONS

Four sequential sessions included in the document demonstrate how a theme which was of interest to students – the weather (following a particularly dreadful summer), could be built upon in subsequent classes. Because the classes happen only once a week the students have time to follow up on the material discussed to make their own discoveries. They then arrive the following week with an increased awareness of the topic, such as the ways weather is presented. Thus there is a good foundation to build on the theme and look at other related aspects. There is also time for the teacher to find further activities to expand on themes which have been particularly interesting to the student.

The documented sessions illustrate the following aspects of vital importance when teaching students at this level.

Repetition and Practice

There must be continued repetition and practice of the skills being taught since students at this level will forget new ideas very quickly if they are not constantly reinforced. For example, the introductory activities documented have focussed on large numbers and ordering of numbers in increasing value, recognition of the months of the year and the seasons and all the connected vocabulary.

These session have also repeatedly examined various aspects of data presentation in the form of diagrams, maps, and charts; and the use of symbols and keys in diagrams and maps – different styles of charts and diagrams being used each week.

Building General Knowledge

Since many of these students have rather protected lives, their experience of the world tends to be quite limited. It is therefore important that sessions should build on the students' general knowledge.

For instance, in these sessions the weather, seasons, temperatures and months of the year are discussed and they are later reinforced from the angles of a newspaper article, weather maps, calendars and diaries.

Integrating Literacy and Numeracy

At this stage of learning to use real life items, the skills of ***numeracy*** and ***literacy*** are inevitably interwoven and no attempt is made to separate them. Both aspects are reinforced and practised as appropriate to the context of the sessions.

SESSION 1 - MAIN FOCUS - Melbourne's Weather

Introductory Activity - Phone Numbers

Write down your phone number:

- Add the even numbers.
- Which total is the highest/lowest?
- Re-arrange your phone number. How many new numbers can you make?

(strengthening elements 1.2 - patterns in number, 1.3 – use of natural number, practical and every day fractions)

Focus Activity 1 - Summer Weather

News article on Summer supplied by teacher:

- Discussion – look at the chart. What do you think it means? Identify symbols.

(working towards element 1.1 - interpreting familiar charts and graphs)

Season gets hung out to dry

By Ben Mitchell

VICTORIA has recorded its wettest summer since 1972 and some Melbourne suburbs and country centres have had their highest summer rainfall on record.

A total of 259.2 mm has fallen in Melbourne since the start of December 1992, 105.2 mm above the long-term summer average and 49.2 mm more than last year.

Cheltenham, Oakleigh, Glen Waverley and Springvale recorded their highest rainfall readings, all at least 100 mm above average.

And a record 25 Victorian towns recorded their highest rainfall totals, many tripling their summertime averages. Mildura, usually the driest Victorian centre, had a record 262.8 mm of rain, 201 mm above average.

Temperatures in metropolitan Melbourne were also above average. The average maximum was 26.3 degrees, 1.2 higher than the summertime mean, and the average minimum was 15.9 degrees, more than two degrees above normal.

The highest temperature recorded in Victoria over summer was 43 degrees, at Horsham, Ouyen and Swan Hill, and the lowest minimum was minus eight, at Mount Hotham on 28 December.

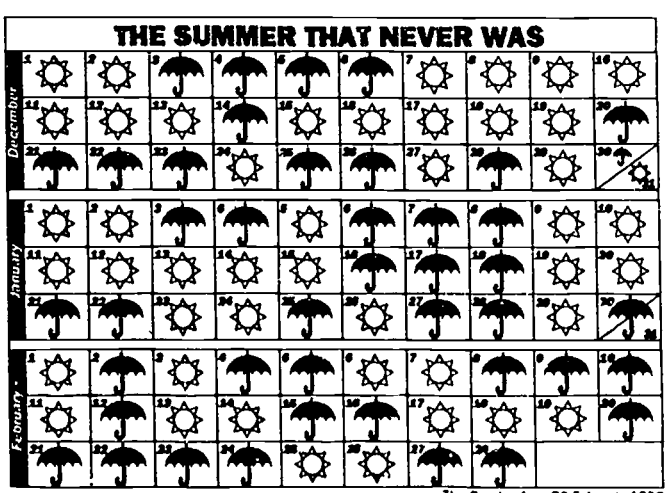
Thunderstorm activity was also well above normal with 73 severe storms recorded since the start of December compared with a summertime mean of about 20.

But despite the doom and gloom, the big wet had little effect on the traditional summer consumables. The three biggest softdrink wholesalers, Pepsico, Coca-Cola and Schweppes, and the major ice-cream manufacturers, all recorded healthy growth on last year's sales.

Ice-cream suppliers recorded poor sales in December, when the weather was poor, and then large sales increases in January and February.

The general manager of the Victorian Surf Life Saving Association, Mr Nigel Taylor, said that, beach attendances were well down on previous years although the January peak was up.

The Melbourne cricket season was also badly interrupted, with the Victorian Cricket Association losing nearly half its district match days to rain.



The Sunday Age, 28 February 1993

- We read the article. I allowed students time to look quickly through it so they could have practice in predicting what information may be found. Some of the better readers like to read parts of the article out aloud while I help the others follow it through.

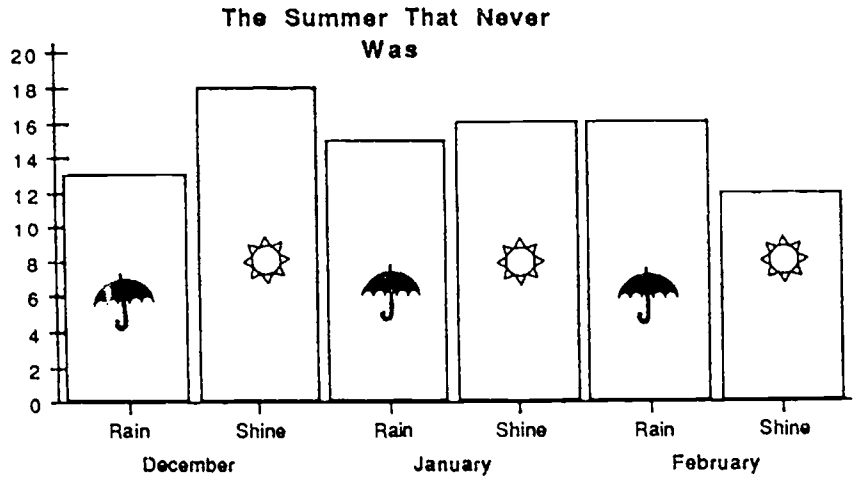
- How have numbers been used? Year, rainfall in mm, temperature, date. *(developing elements 1.3 - use of natural number, practical and everyday fractions and 1.4 - measurement) CGE for Adults, p88.*

- What can you say about Melbourne's Summer this year? Is this normal? Write a sentence.
(developing writing for knowledge, element 1.3 - write several facts about a familiar or personal subject, in simple sentences, using everyday common place language. Although this is a reading and writing for knowledge exercise the students may respond more in the domain of self expression) (CGE for Adults, pp 20, 22).

Break

Focus Activity 2 - Making a wall chart and graph

- How can we show this information on a graph?



A chart like the one above could be used or some kind of bar graph

(working towards element 1.1 - interpret familiar charts and graphs and 1.3 - use of natural number, practical and everyday fractions) CGE for Adults, p88.

Homework

How many different ways can you find out about the daily weather? Try to: listen to the radio for the forecast; watch the water report on TV; find the information in the newspaper.

(reinforcing competence of reading and writing at level 1 - element 1.6 as described by

- *identifying the purpose of the text from graphics and layout;*
- *recall prior knowledge of the subject; CGE for Adults p25).*

SESSION 2 • MAIN FOCUS - *The Weather Report*

Introductory Activity - Matching Times

Game of concentration using time cards match:

- 7.15 - ¼ past 7
- 12.00 - 12 o'clock

(strengthening elements 1.3 - use of natural numbers, practical and every day fractions and 1.4 measurement) CGE for Adults p88.

Focus Activity - Hand-out on Sunday's Weather

(see p23) - this activity continues after the break

- What picture signs do you recognise?
- Are there any the same as from the summer chart?
- What information does the map show?
- What other information is in the rest of the report?

Read the worksheet '*The Weather Map*' (see p24) and discuss questions.

The class worked together answering the worksheet questions orally. They then sorted themselves into two groups. Some worked with me to put their answers in writing whilstä the others went on to write their answers independently. Those who finished began to write their own weather report.

Students gave their forecasts which we were to check next week.

(further development of element 1.1 - interpret familiar charts and graphs)

Homework

During the week students need to note the weather.

Evaluation

What parts of the weather chart can you understand now?

SUNDAY'S WEATHER

THE CITY

Fine. Early cloud clearing to a warm, humid and mostly sunny day. Freshening east to south-east wind. Max. 25, yesterday 29

THREE DAY FORECAST

Tomorrow
Max 30

Tuesday
Low 20s

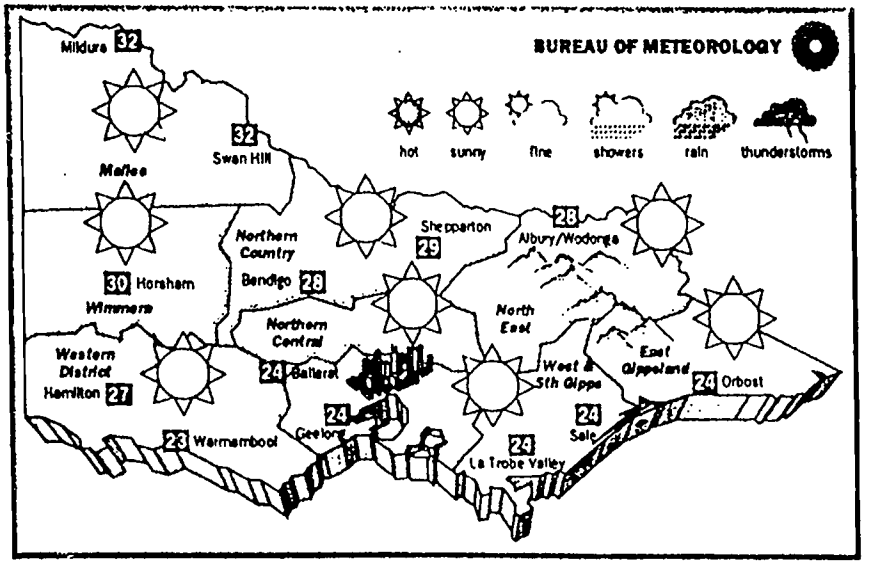
Wednesday
Max 20

VICTORIA

Scattered showers and thunderstorms over the eastern ranges. Morning fog or drizzle patches in the south. A warm and humid day with moderate to fresh east to south-east wind.

THE BAYS

East to south-east wind of 15 to 20 knots reaching 25 knots later in the day. Waves of one metre reaching 1.5 metres later in the day.



THE SURF

Bells Beach: Small waves less than one metre. **Gunnamatta:** Expecting great waves up to 1.5 metres for experienced surfers. **Pt Leo:** Likely to be too small today. **Woolamai:** Excellent conditions with offshore winds around one metre. **Cat Bay:** Too small today.

THE SUN

Rise 6.24 am, set 6.32 pm

THE MOON

Rise 4.20 am, set 5.10 pm.

INTERSTATE

	TODAY	
Adelaide	fine	31
Brisbane	showers	27
Canberra	fine	24
Darwin	storm	32
Hobart	fine	23
Perth	fine	27
Sydney	fine	24

THE TIDES

Williamstown: high water 1.15 am, 1.19 pm; low water 7.30 am, 7.45 pm. **Port Phillip Heads:** high water 10.07 am, 11 pm; low water 3.32 am, 4 pm. **Tooradin:** high water 11.30 am; low water 4.55 am, 5.23 pm. **Geelong:** high water 1.25 am, 1.30 pm; low water 8 am, 8.13 pm. **Western Port:** high water 10.48 am, 11.43 pm; low water 4.19 am, 4.46 pm. **Portland:** high water 12 am, 12.13 pm; low water 6.39 am, 5.57 pm.

WORLD

Athens	clear	18
Auckland	clear	18
Bangkok	clear	34
Beijing	cloudy	12
Cairo	cloudy	17
Christchurch	cloudy	17
Harare	cloudy	27
Hong Kong	cloudy	15
Honolulu	clear	28
London	clear	13
Los Angeles	cloudy	26
Mecca	cloudy	35
New York	cloudy	-02
Paris	cloudy	14
Rome	cloudy	16

THE WEATHER MAP

WORKSHEET

1. What time is sunrise?

2. What time is sunset?

3. Where would it be good to surf?

4. Which city had the highest temperature?

5. Which city had the lowest temperature?

6. When is high tide at Port Phillip Heads?

7. Will I need to water my garden?

8. What are the symbols for:
   - Sunny weather,
   - Rain,
   - Thunderstorms?

9. What sort of weather do you like the best? Draw the symbol and write the temperature.

SESSION 3 • MAIN FOCUS - *The Calendar (Section 1)*

The work on the weather lead onto discussions about the seasons and so I thought it appropriate to introduce work on the calendar.

Introductory Activity - House Prices

Students were each given one cutting of a house for sale from the newspaper.

Questions:

- What is the price of the house?
- Can you find a house that is cheaper?
- Can you find a house that is dearer?
- Who had the most expensive house?
- As a group, arrange the prices in order from most expensive to cheapest.
- Mix them up and now arrange them from the cheapest to the most expensive.

Some students may have difficulty reading the larger numbers. However, because they are dealing with money and rounded figures (eg. $150,000, $90,000, $200,000) they appeared to find it easier than reading numbers out of context. Comments such as "Ooh, that's expensive" and "I'd better win Tattslotto" showed that they enjoyed trying to read these numbers. I feel it is a good way to introduce such numbers.

(developing element 1.3 - use of natural [whole] number, - large numbers) CGE for Adults p 88.

Focus Activity 1 - The Calendar

Handout 'The Calendar' (see p27). The students look at the sheet by themselves.

Questions

- What is the chart about?
- What do the numbers mean?
- What words do you know (underline the words, days, months, seasons)
- What month are we in now?
- When is your birthday?
- How many months until Christmas, the holidays?
- Is this calendar for 1993?

(integrating prior knowledge and the numeracy elements 1.1 - interpreting familiar charts and graphs; 1.4 - measurement [time]; and literacy elements from reading and writing level 1 - element 1.6 - demonstrate meaning has been gained from reading a simple, familiar, practical texts. Relevant performance criteria:

- *identify the text from graphics and layout*

- *recall prior knowledge of the subject*
- *identify each word [some words in this case) CGE for Adults p 25.*

Break

Focus Activity 2 - Looking at Calendars

I have a collection of different calendars ranging from diaries to large calendars of 12 pages. They are not all current which is good for comparing birthdays, Christmas days, etc. from year to year.

Students were allowed time to look through the different calendars, noting similarities and differences.

Re-focusing - All students looked at the handout.

Questions:

- What are the winter months? Colour these an appropriate colour.
- Continue for the other seasons.

Finish the sentences:

- Today's date is . . . . . .
- The month we are in is . . . . . .
- The season we are in is . . . . . .
- The date of the next class will be . . . . . .
- The date of last week's class was . . . . . .
- My favourite date is . . . . . because . . . . . .

Homework

Make a list of all the calendars you see between now and next class.

Evaluation

Did you learn anything new today?

What things can you do better now?

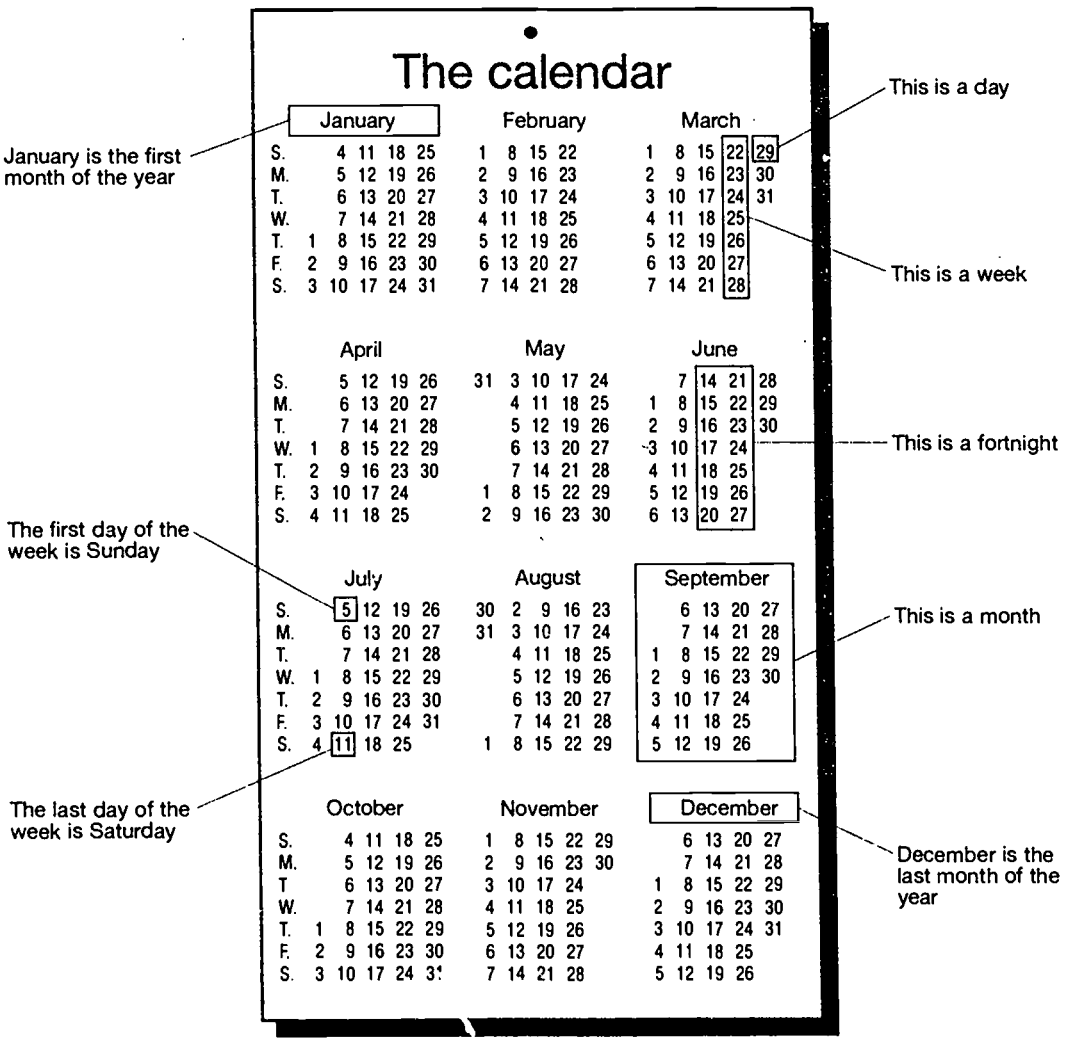
THE CALENDAR

HANDOUT

The seven days of the week are Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday.

The twelve months of the year are January, February, March, April, May, June, July, August, September, October, November, December.

The seasons are Summer - December, January, February; Autumn -March, April, May; Winter - June, July, August; Spring -September, October, November.



SESSION 4 • MAIN FOCUS - *The Calendar (Section 2)*

Introductory Activity - Entering Numbers on a Calculator

Using your calculator show the price of the houses for sale from last week. You may use the advertisements. Show these number on the calculator:

5	clear	7	clear
50	clear	70	clear
500	clear	700	clear
5,000	clear	7,000	clear
50,000	clear	70,000	clear
500,000	clear	700,000	clear

Repeat the number aloud after you have keyed it in.

(strengthening element 1.3 - use natural number [large numbers] and developing familiarity with a calculator)

Focus Activity 1 - The Calendar

Check the lists from homework.

Discussion on where calendars can be found.

Each student chooses a calendar. Look at the month of July.

Questions:

- What day is the 1st of July?
- What day is the 8th of July?
- What day is the 15th of July?
- What day is the 22nd of July?
- What day is the 29th of July?

Can you find these dates easily? What is common?

What day is the 2nd of July?

What date will it be in a week? How many days did you count on?

(further developing numeracy element 1.1 - interpreting familiar charts and graphs and 1.3 - use natural number [ordinal numbers] in the context of measurement [time])

(Also developing further the literacy competency for reading and writing Level 1 -element 1.6 - demonstrate that meaning has been gained from reading a simple, familiar, practical text).

Break

Focus Activity 2 - Worksheet - Calendar Patterns (see p30)

Read together through the questions, allowing time for students to answer them.

The last part of the worksheet will require explanations for the word 'consecutive'.

Most of my students required a lot of assistance with the final part. Some students chose to just look at the calendars rather than continue with the worksheet.

(working towards element 1.2 - patterns in number, integrated with element 1.1 -interpreting familiar charts and graphs)

Finishing Activity - What month am I thinking of?

Clues:

- It is in spring.
- It has 30 days.
- Its first day is on a Tuesday (using handout from last week).

Students take it in turns to give clues for a particular month.

Evaluation

What part did you enjoy the best today?

Can you tell a partner three new things you have learnt about calendars?

Is there anything else you want to know about the calendar?

CALENDAR PATTERNS

WORKSHEET

DECEMBER						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

1. Count the number of Sundays, Mondays, and so on, there are in the month.
2. Do some days occur more times than others?
3. Which ones?
4. Make a list of the Tuesday dates, the Wednesday dates, and Saturdays.
5. Can you find the patterns in these lists?
6. Make a list of the dates for each pair of Fridays and Mondays.
7. Do you find any patterns in this list?
8. Put a rectangle around three consecutive dates on your calendar.

DECEMBER						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

9. Find their sum and compare it to three times the middle number.
10. Try the same with a different three consecutive numbers.

SPECIAL ACTIVITY 1

The following activities provide an example of how a special event can be used as a context to further develop number and spatial skills.

■ MAIN FOCUS - THE MELBOURNE CUP (The week before the cup)

Introductory Activity

Dice Games and Luck

- Throw the dice 3 times. What is your total?
- First person to throw a total of 30
- First person to throw a 6
- Throwing in order - 6, 5, 4, 3, 2, 1
- Who threw these the quickest?
- What number was the hardest to throw?
- How can you be good at this game? (It does not depend on skill. You need to be lucky to be good at this game. Students think this is great because a 'clever' student need not win).

(integrating the idea of probability [luck] with element 1.3 - use of natural number: number recognition and addition practice) CGE for Adults p 88.

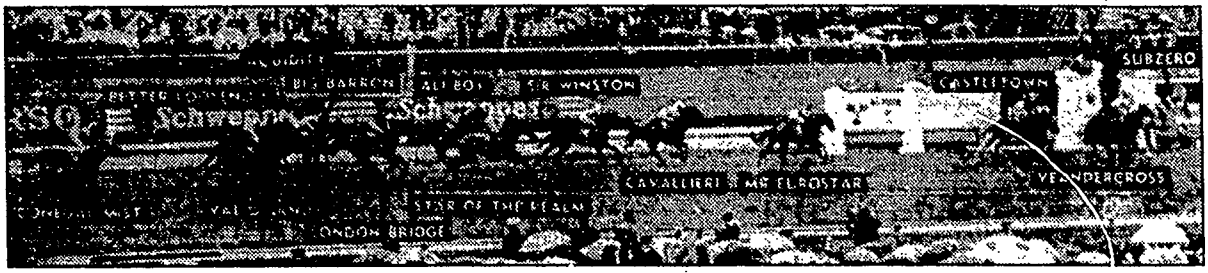
Focus Activity 1 - The Melbourne Cup

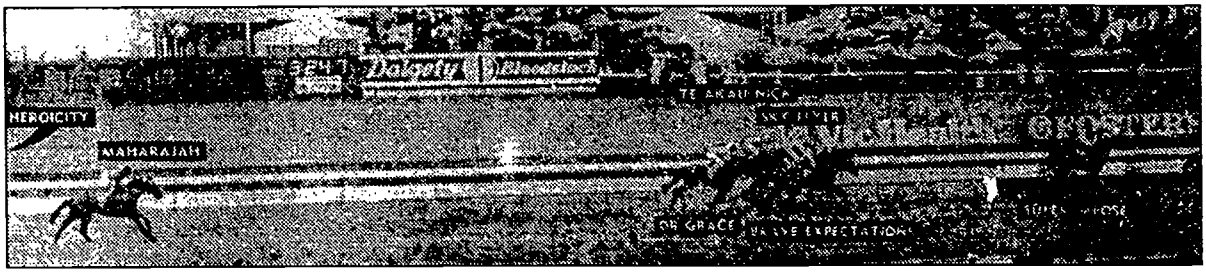
- Throw Where is the Melbourne Cup held?
- Throw Find it on the map (Melways)
- Throw Admission prices. How much would it cost you?
- Throw Transport to the Cup
  - Where does the train depart from?
  - What time?
  - How else can you get there?
- Looking at an example of the racing guide (use real examples of official programs)
  - What information can you find?
  - How many different ways can numbers be used?
  - eg. Race number, time, distance, horse number, prize money.
- Look at the list of the horses to run in the Cup. Predict a **winner** and 2nd **place getters**.

(combination of general knowledge with strands: space and shape - street directory; data - charts and graphs - racing guide, racing program, railway timetables, maps) See Background Works Page 200 of the CGE for Adults for further detailed information.

SPECIAL ACTIVITY 2

■ MAIN FOCUS - THE MELBOURNE CUP (The week after the cup)





Reprinted with permission from the Herald-Sun

Using photograph of the finish from the paper

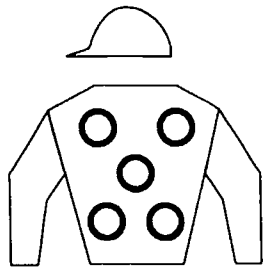
- Ordinal number. Why first, second, third, fourth?
- Match these with the horses as they finished the Cup.
- Who predicted the winner?

15. CAVALLIERI

Using pictures of the racing 'colours'

- Shapes and colours of jockey's clothes.
- Parallel lines, stars, diamonds, circles.
- Design a jacket.
- Role playing of calling the Cup – 1st → 23rd, include winning times and prize money. (If any students were not aware of what a short time it all takes).

(Again strengthening element 1.3 - use of natural number [ordinal number], element 1.5 - classifying shapes, and element 1.4 - measurement [time]) CGE for Adults p88.



24. SIR WINSTON

The Reading and Writing Elements referred to in this document are expanded fully below.

Element 1.3

Writing for Knowledge

Write several facts about a familiar or personal subject.

Performance Criteria:

1. Present 1 or 2 items of familiar information in everyday commonplace language
2. Use third person to convey a tone of formality
3. Use mostly simple sentences in the present tense to convey objective information about features and happenings
4. Produce 1 or 2 descriptive or explanatory sentences
5. Spell with uneven accuracy
6. Use standard grammar unevenly

Range/Conditions:

1. Subject matter related to science, the humanities, technology or other areas of study
2. Use of dictionary of own choice

Element 1.6

Reading for Practical Purposes

Demonstrate that meaning has been gained from reading a simple familiar practical text

Performance Criteria:

1. Identify the purpose of the text from graphics and layout
2. Recall prior knowledge of the subject
3. Identify each word
4. Perform the task described, or determine if more information is needed
5. Express a general opinion on the presentation and the subject matter

Range/Conditions:

At this level, a simple text:

1. will describe familiar procedures in everyday words
2. will emphasise the separate steps in the process in a relatively informal tone
3. may include clearly drawn, suitably placed diagrams
4. will use at least single words or 1-3 short simple sentences
5. will be a rudimentary set of instructions or procedures

Use of a dictionary of choice

Integrated Numeracy/Literacy Program

•

LEVEL 1/2

This is a program for unemployed youth

conducted at

COLAC WORK SKILLS, VIC.

Teacher and Program Designer
Stephanie Sutherland

■ BACKGROUND AND GROUP PROFILE

A number of young men aged 16 plus in the area were refusing to attend their secondary schools any longer because they did not fit in and felt alienated from the programs offered. Some of these were referred to the local adult literacy group. Because of a cooperative relationship between the Adult Literacy Group and Skillshare organizations the students were able to be slotted into a Skillshare class. Other young men of similar age were referred from CES to form a reasonably cohesive group of students between 16 and 20 years of age. All of them had a great need for improving literacy and numeracy skills and were performing at Level 1/2.

■ THE PROGRAM

Funding was for 40 hours total.

The class was held for 10 weeks. Two sessions of two hours duration each were held on one day each week.

■ STARTING THE PROGRAM – DESIGNING THE CURRICULUM

The first two weeks (4 sessions/8 hours) was spent getting to know the participants – their skills, interests and personalities. During this time, I gave them a number of worksheets relating to number, reading, and writing at competency Levels 1 and 2 to reassure myself of their initial assessment.

Experiences during these two initial weeks assisted me to formulate the major objectives for this group and to devise a theme, or context by which to achieve them. Two activities particularly influenced me in these decisions.

First, introducing the students to cooperative problem solving activities highlighted members' lack of confidence and social skills. In spite of my encouragement for all to participate, more dominant and/or capable members were left to find the solution.

More successful was the task of working out the average hours slept over the weekend by each individual, and by the whole group. The weekly results were graphed (eventually for a month). With classes held on a Monday, this exercise was an enjoyable way to share the recent weekend's activities and interests. The task involved the four number processes, converting hours to minutes, simple fractions, using analogue and digital time, comparing the 12 hour clock with 24 hour times. When timetabling activities, word structure was studied briefly. Much language was involved in the discussion. Weekend activities indicated were: speedways, motorbikes, hitchhiking, videos, army-style camp outs and 'staged battles'.

■ COURSE OBJECTIVES

The course was designed with the following major objectives in mind:

- to increase the literacy and numeracy skills of the participants
- to develop and improve the participants' concentration abilities sufficiently

for them to complete set tasks successfully either independently or working in a group

- to foster in participants a sense of responsibility towards their working environment and facilities, and towards each other
- to enhance the capacity of participants to work in a group or team situation by developing the skills of
  - listening to each other
  - giving and receiving appropriate feedback
  - dealing constructively with conflict and
  - assisting others in a sensitive manner.

■ IMPLEMENTATION

Type of Activities

Some members of the group had been in a program the year before and had shown a talent for producing illustrated posters. Others seemed to enjoy decorating, doodling, and using colour. I therefore decided that the course should incorporate graphics skills as much as possible. In this way, those with demonstrated talent could inspire the others and we would be tapping into something that everyone seemed fairly positive about.

Other considerations were the high physical energy level of the participants, a disinclination for sitting still, and an even greater disinclination to read or write. I therefore felt it was necessary to develop a fun centred, activity based program incorporating lots of freedom to move. Activities should, where possible, involve physical movement. Participants should always feel free to walk around the room to help each other, and to get up and use the whiteboard to explain their ideas, rather than being confined to desks as they had been in classrooms, during past schooling.

Also the activities used should be able to be finished quickly to allow for feelings of success, and provide positive feedback immediately. Thus we could begin to counteract the students' past experiences of never finishing or succeeding at previous school tasks. It is always possible to extend activities if students prove to be really interested, or to pick them up again at a later date. It is obvious however when a task is abandoned, and this inevitably indicates to them that they have failed yet again as learners.

Use of a Theme

The theme of 'direction' was selected because I felt that it fitted the requirements. The students would relate to it, it could be highly activity oriented, and the numeracy and literacy concepts and skills at competency Levels 1 and 2 could easily be integrated using this theme.

I hoped that this theme, the activity based approach, and the change of physical atmosphere mentioned above, would break down barriers to learning that these young people had built up during their traditional secondary school experience.

Activities selected were not only to be enjoyable but also to progressively develop skills that were reinforced at every opportunity.

Not all activities were related specifically to the theme. They concentrated on developing automatic response to number facts using three processes – addition, subtraction, and multiplication. Calculators were also used. However, where possible practice at these skills was woven into direction related activities. One example of this was A Trip to The Supermarket, which involved getting there using a map, finding items inside the supermarket using clear directions and then a variety of number skills relevant to costs and metric measures.

Worksheets were used to change the atmosphere and quieten the group down when necessary. For more detail of the Supermarket activity see p55.

Integrating Literacy and Numeracy

Because the same participants attended both the morning and afternoon sessions, I chose to integrate the numeracy and literacy skills. First, to provide flexibility in the day's program, which allowed me to respond better to the students' moods and concentration span. Secondly, by not placing activities into either category, I hoped to avoid the 'mental set' about maths and writing that each participant brought to either.

■ COURSE DOCUMENTATION

We have included a list of the activities done in the first session to give an idea of how the theme was begun. To further clarify the approach several of the successful activities are then detailed. Finally two of the activities are shown in diagrammatic form to illustrate fully how many skills and competencies can be combined in an integrated activity.

Some of the other activities used in subsequent sessions are listed with brief descriptions. These are activities that can easily be found in obtainable reference material. Others, which are new to this course or heavily adapted, are given in greater detail with usable worksheets included.

One activity which did not work is also included as it was a valuable lesson learned and the experience may assist others.

■ RELATIONSHIP TO THE COMPETENCY STATEMENTS

Activities were pitched towards the following competencies:

Numeracy Competency Level 1 - The student can use and analyse simple data, relation and pattern, number, measurement and shape. With particular focus on the elements

- *1.1 Interpret familiar charts and graphs*
- *1.3 Use natural number, practical and everyday fractions and practical and everyday decimal fractions*
- *1.4 Use personal referents in measurement*

1.5 Classify shapes - (CGE for Adults pp 87,88)

and also elements of competency at levels 2:

2.1 Interpret data and organize it into tables and charts

2.3 Use natural number, and common fraction/decimal fraction/ percentage equivalents

2.4 Use estimation and calculation with shape and direction (CGE for Adults pp 87,88)

Reading and Writing - Level 1 & 2

Elements 1.2 & 2.2 Writing for Practical Purposes (CGE for Adults pp 21,31)

1.6 & 2.6 Reading for Practical Purposes (CGE for Adults pp 25,35)

Oral Communication - Levels 1 & 2 (CGE for Adults pp 68,71)

Activities were selected which could incorporate as many of these as possible.

■ THE SESSIONS

The first session aimed to establish the theme of 'direction' and an enjoyable relaxed atmosphere. The initial activities centred on the need for using 'direction' vocabulary and practice in doing so.

Further sessions aimed to develop and consolidate the concepts and skills used in the initial direction related activities. However, many other skills were also incorporated to develop further literacy and numeracy skills such as

1. Other activities that weren't directly related to the theme.
2. Developing automatic response to number facts using 3 processes - addition, subtraction, and multiplication, estimation, use of calculators, working out perimeters.
3. However, where possible these were woven into direction related activities. e.g. see below the Trip to the Supermarket.

■ FIRST SESSIONS:

These included the following activities:

Obstacle Course

a) Blindfolded before entering a darkened room participants are requested to find a seat and sit down. Discussion focus is on the need for directions to arrive safely and efficiently at a destination.

b) A simple obstacle course is planned for each blindfolded participant in turn who is directed to safely complete the course by others.

c) Discussion creates a whiteboard list of 'direction' words - e.g. straight, behind, right, left.

Building Towers

Equipment: coloured blocks or 'duplo'.

One partner constructs a model which is hidden from the other using 6 blocks. The second person then builds the same model according to verbal instructions given by the model maker (no hand gestures allowed). Turns are then reversed. This activity can be developed with the endless variations offered by the Duplo material: plans of the 3-D model can be drawn and given to be built; direction words are continually added to the whiteboard list as they occur.

Finding Direction Words

Ref: Writing to Inform

A worksheet in which students find and circle direction words in a series of sentences.

For example:

- Walk to your left and stop next to the carton near the table (3)
- You will find the writing paper on the top shelf behind my desk near the crayons (3)
- To find the police station you must drive straight for one block. Turn right at the traffic lights. The police station is on the next corner beside the Post Office. (3)

The numbers in brackets indicate the number of words to be found.

Drawing the Design Described

Ref. Writing to Inform

As with the Building Towers activity, one person draws a design and uses only words to describe it to the other who tries to reproduce it.

Design includes shapes - circles, rectangles etc.

position - vertical, left, above etc.

Draw Own Design using geometric shapes.

Ref. Writing to Inform

In a list, **write** your directions - one line for each step. Instructions are shared around the group.

Discussion focus: to recognize the importance of clear, ordered instructions, using specific direction words.

The above activities took the first 3 x 2 hour sessions. They contributed to the development of the following competencies.

Numeracy - Space and Shape - Level 1 & 2 (CGE for Adults pp 200,201)

Reading and Writing - Level 1 & 2 - element 2.2 (CGE for Adults p31)

Oracy - element 1.2 - oracy for practical purposes (CGE for Adults p63)

■ DETAILS OF SOME SUCCESSFUL ACTIVITIES

The documented activities are listed in the order they were conducted as it represents a development of skills and order of difficulty.

Directions Using Points of the Compass

Games

The following games lead to discussion of compass points, use of protractor to measure 180°/90° and simple fractions 1/2, 1/4, 3/4. They establish the language of direction and angles eg: N, S, E, W, NE, NW etc. They also reinforce the importance of the starting point when giving directions.

They reinforce the competencies of Numeracy: Element 2.4 - use estimation and calculation with shape and direction, and element 1.3 - use natural number (CGE for Adults p 88,90)

Dollar Scramble - board game. (see diagram on page 42)

Players: 2 - 4

Equipment: Dollar Scramble Board
Score Sheet
4 different coloured counters
2 die

(a) one dice with numbers 1 to 6

(b) one dice with 2 blank sides, and N,S,E,W, on the remaining 4 sides (a wooden cube can be drawn on to act as this dice).

The dice with numbers indicated how many lines the player can move.

The dice with the direction (N,S,E,W) indicated which direction the player can move. A blank side allows the player to move in any direction.

Instructions: Start from the Bank

To start the game, a 6 must be thrown.

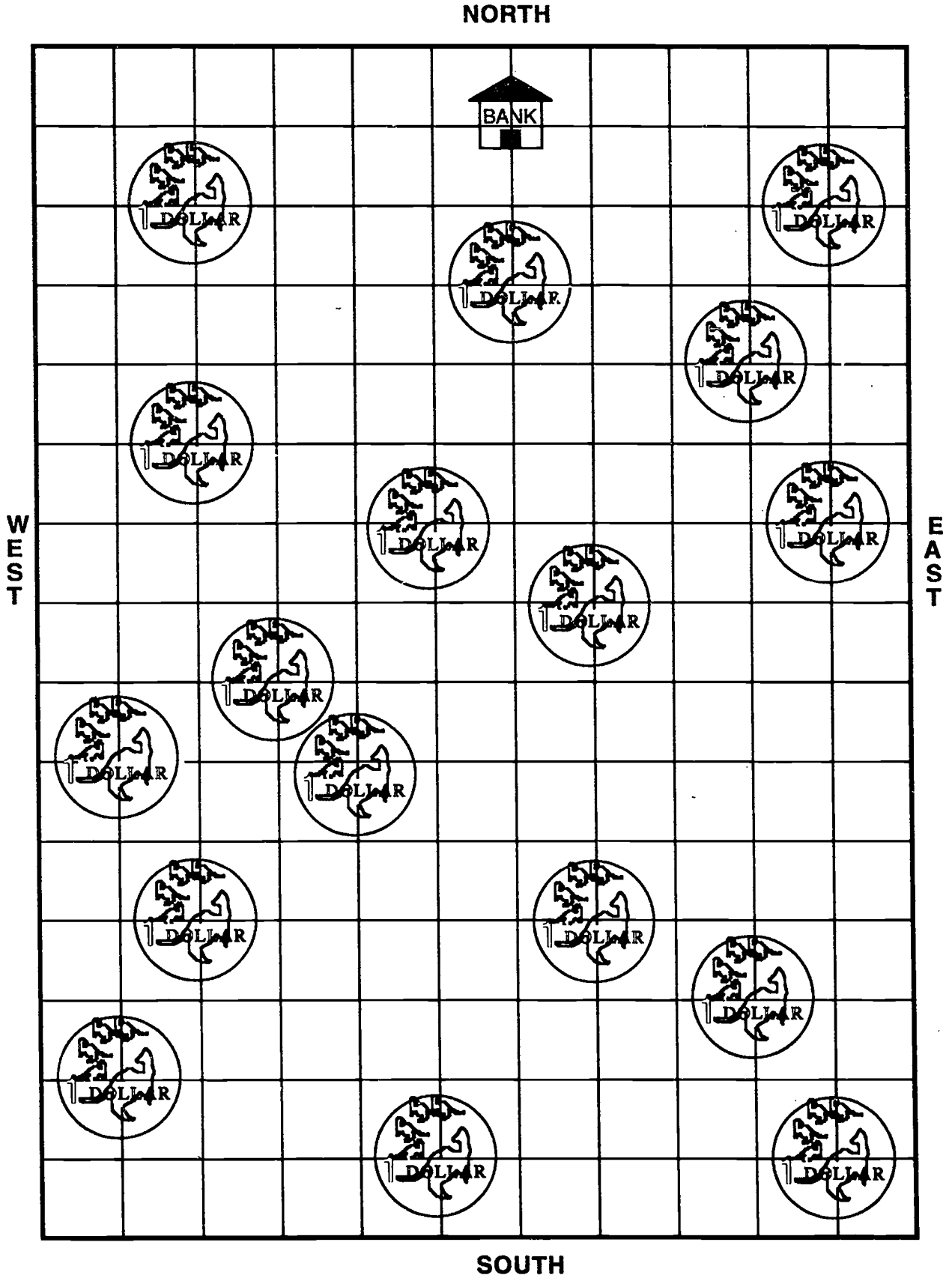
The directional dice is also thrown to indicate the direction the move must be made. If a player is unable to move, a turn is missed.

If a player takes a turn, and end up on top of another player, then the player who has just had the turn returns to the bank. Any dollar coins captured still count.

If a 6 is thrown, the player gets another turn.

Each time a player **passes over** or **lands on** a dollar coin, one point is scored. A progressive total is kept. The winner is the first player to collect $10 (10 points).

DOLLAR SCRAMBLE



Catch the Rabbit - board game (see diagram on page 44)

(any appropriate context could be chosen and an appropriate board drawn eg: catching fish, butterflies, orchids, treasure)

Players: 2 - 4

Equipment: Catch the Rabbit Board
Score sheet
4 different coloured counters
2 die

(a) 1 dice with numbers 1 to 6

(b) 1 dice with 2 blank sides, and NW, SW, SE, and NE on the remaining 4 sides.

The dice with NW, SW, SE, and NE indicated which direction the player can move. A blank side allowed the player to move in any direction.

Instructions: Start from the Burrow

A six must be thrown to start the game.

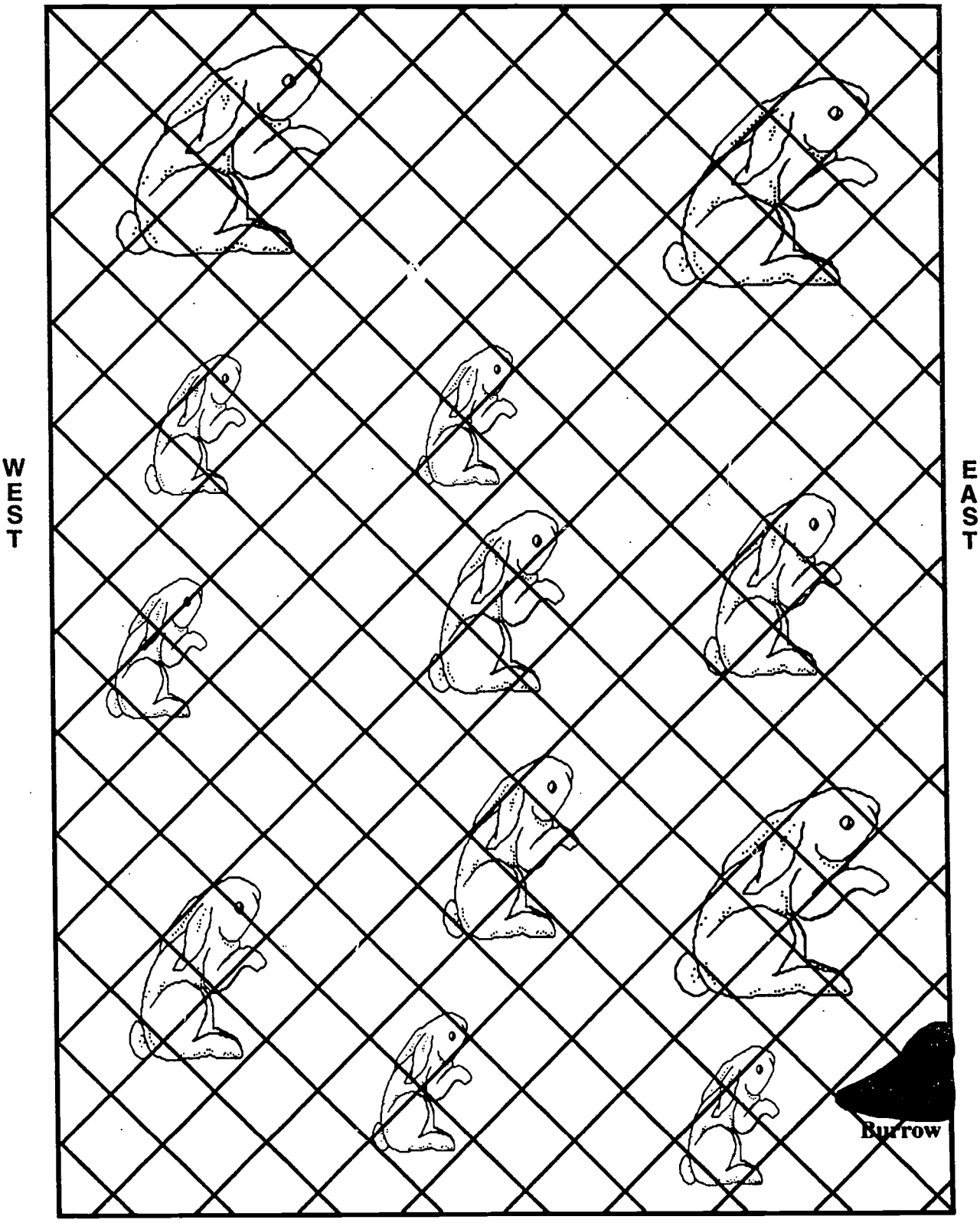
The directional dice indicated in which direction the player may move. If a player is unable to move, a turn is missed.

If a player lands on top of another player, the player returns to the Burrow. Any rabbits caught, still count in the progressive total.

If a 6 is thrown, the player gets another turn. Each time a player 'passes over' or 'lands on' a rabbit, one point is scored.

The winner is the first person to catch 10 rabbits.

CATCH THE RABBIT



Activities

Other activities which follow these and reinforce the skills are:

Australian Directions

Using a map of Australia, questions are asked: *What direction is Brisbane from Melbourne?* etc.

OR A plane route is given. Leaving from each place, in what direction is the plane now flying?

Flying Over Australia

This activity is my personal adaptation of an original idea seen some time ago. An airline map from a travel agency is easily obtainable.

A map of Australia with the plane routes of major airlines marked is given to participants, who have to select the most appropriate ending or answer to sentences or questions such as:

1. The main terminals in Australia are in
   (a) the inland centres
   (b) the dots on the maps
   (c) the capital cities
   (d) the individual states
2. Name the most southerly located terminal in Australia.
   (a) Thursday Island
   (b) Launceston
   (c) Hobart
   (d) Brisbane

To check their answers, participants were given the correct answers, colour coded, yet with each sentence cut into words. The individual words had to be reassembled correctly. The master sheet for reassembly of the correct answers to these and other questions is included on pages 47 and 48. Each answer was identified by a different colour or symbol which corresponded with the original question. Then each sentence was cut into words jumbled and secured with a paper clip (it could also be stored in an envelope). Each participant had his own collection of answers and then conducted his own word matching exercise. Individual words were isolated and read aloud to the tutor, with difficult words noted for attention later with the participant concerned. Use of capital letter and full stops were also identified.

I had intended to use the words to an activity based on DATA – sorting words into groups of 2-letter words, 3-letter words etc. and tabulating their frequency - but group concentration flagged and interest waned towards those myriad slips of paper after the initial activity.

Popular Plane Routes

From the map, participants also had to draw conclusions about the distribution of population and patterns of travel within Australia, make comparisons and make decisions about which airline or airlines it would be necessary to fly with to reach a particular destination.

These two activities also reinforce Reading and Writing Elements 1.6 Reading for Practical Purposes (CGE for Adults p25) and the latter - Numeracy - Element 2.1 - Interpret data and organize it into tables and charts (CGE for Adults p88).

The	main	terminals
in	Australia	are
in the	capital	cities
The	most	
southerly	located	
airport	in	Australia
is	Hobart.	
The	most	centrally
located	city	in the
airline	network	is
Alice	Springs	

The longest non-stop flight is from Perth to Brisbane

Perth does not provide a direct flight to Alice Springs

Travelling from Cairns to Ayers Rock you have to change planes at Alice Springs

Use of Grid References and Scales

Other activities used to provide practice at use of grid references, the measurement of cms and direct scale and to revise direction were:

Games

Rainbow Logic *Ref (Family Math)*

A game played in pairs, using 3 x 3 or 4 x 4 squares with the required amount of coloured counters. It follows the 'Mastermind' principle, with one partner trying to discover the pattern of positioning triomino and later tetromino shapes devised by the other. Questions asked could be: eg: In the first column, second row, is the colour red?

After explanation, the group handled this quite well and quickly extended to using the 4 x 4 cards.

Battleships

Grid references given for a battleship route. Drawn on a handout - 6 x 6 grid sheet. Two different coloured dice are thrown to plot the co-ordinates of the attacking battleship. If it crosses the route of the first battleship at any point, it scores a direct hit and 5 points.

Because these two activities involve the use of grids as in graphs they develop Numeracy - element 2.1 - interpret data and organize it into tables and charts (graphs) (CGE for Adults p.90).

Also the use of geometric shapes and grids reinforces Space and Shape - level 2 (CGE for Adults p.200).

Hitchhiking - *(adapted from an original idea from Jan Healy, Colac.)*

Each pair needed a large road map of Victoria, a dice and two rulers. Compass directions were revised.

Location of home town with directions to neighbouring towns were discussed.

Each pair was given a place in Victoria far away from the hometown of Colac, such as Lakes Entrance.

Using the map index and knowledge of alphabetical order, the place with its associated grid references was located.

From the designated place, the pair, each with a counter has to model the hitchhike trip home on the throw of a dice.

The number thrown is equivalent to the number of centimetres you are allowed to travel in a homeward direction.

If no contact point with another town is made, you have to miss a turn. First one home is the winner.

Direction was discussed whilst play was in progress. 'Names of towns visited were copied down.

See page 51 for analysis of skills and competencies involved.

Numeracy - *element 2.3 - use natural number....*

2.4 - use estimation and calculation with ....direction (CGE for Adults p 90)

Measurement - Strand Level 1 (measuring to nearest cm)

Data - Strand Level 2 - (use of tables and charts) CGE for Adults p 201

Literacy - *Reading and Writing - element 1.6 Reading for Practical Purposes (p.25)*

Reading and Writing - Writing for Practical Purposes - (p 21)

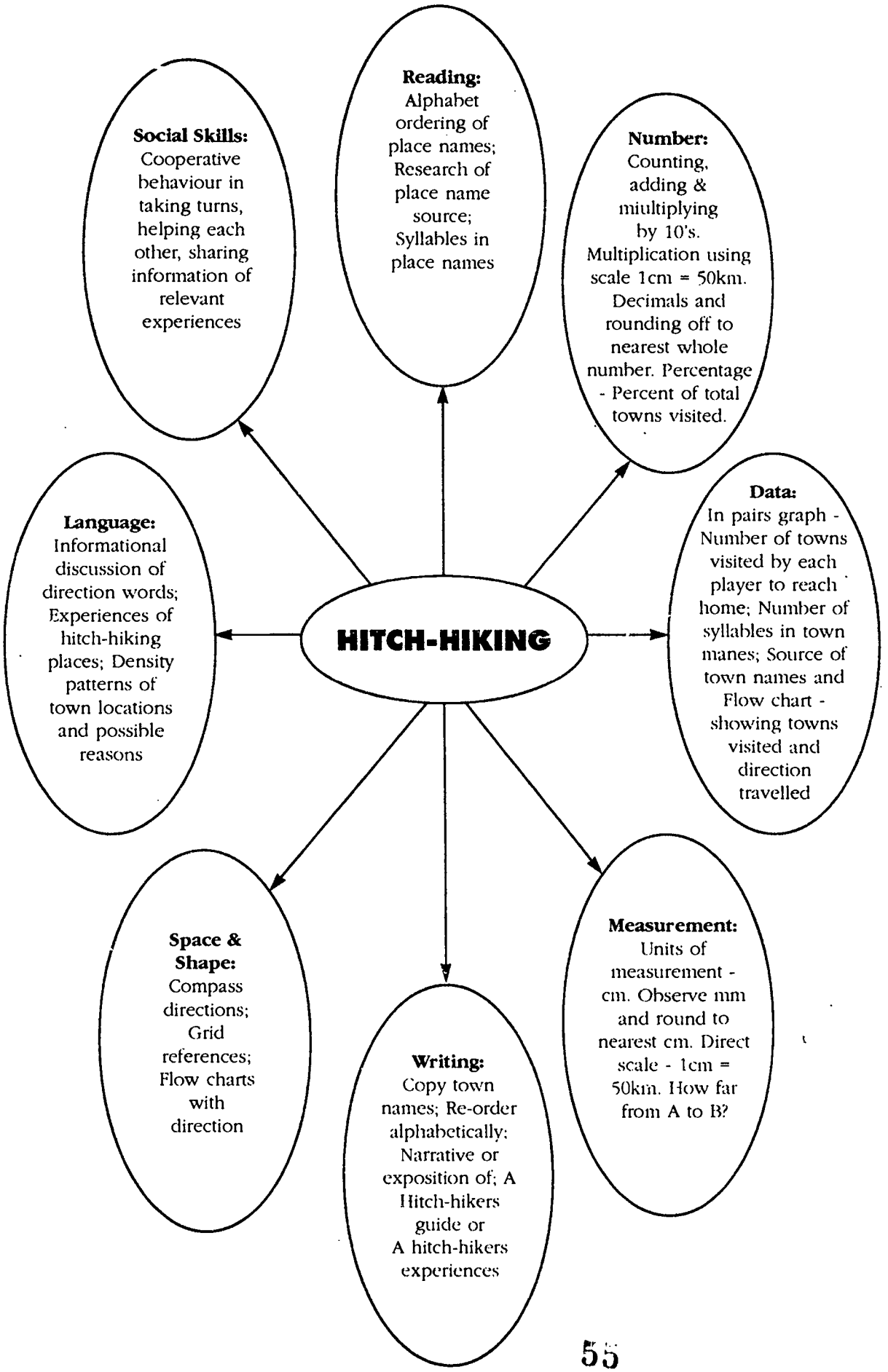
Oral Communication -

element 2.1 - Oracy for Self Expression - (CGE for Adults p 68)

element 2.2 - Oracy for Practical Purposes (p 69)

element 2.3 - Oracy for Knowledge (p 70)

element 2.4 - Oracy for Public Debate (p 71)


HITCH-HIKING
Reading: Alphabet ordering of place names; Research of place name source; Syllables in place names
Social Skills: Cooperative behaviour in taking turns, helping each other, sharing information of relevant experiences
Number: Counting, adding & miultiplying by 10's. Multiplication using scale 1cm = 50km. Decimals and rounding off to nearest whole number. Percentage - Percent of total towns visited.
Language: Informational discussion of direction words; Experiences of hitch-hiking places; Density patterns of town locations and possible reasons
Data: In pairs graph - Number of towns visited by each player to reach home; Number of syllables in town manes; Source of town names and Flow chart - showing towns visited and direction travelled
Space & Shape: Compass directions; Grid references; Flow charts with direction
Writing: Copy town names; Re-order alphabetically; Narrative or exposition of; A Hitch-hikers guide or A hitch-hikers experiences
Measurement: Units of measurement - cm. Observe mm and round to nearest cm. Direct scale - 1cm = 50km. How far from A to B?

Activities

Hometown Map

Each participant had a few copies of their local town map to practise verbal directions using precise terms (eg: northerly direction) to 3 or 4 chosen points some distance away from the Workskills Centre.

Partners marked the route as instructions were given.

Maps were also used for Data Collection, by creating a table which recorded the features of the town highlighted on the map eg schools, conveniences, BBQ's, Caravan Parks etc. The results, how many of each were passed, were collected together and displayed on a communal bar graph using a scale of 1 for each item.

Numeracy - Element 2.1 - Interpret data and organize it into tables and charts.

Space and Shape strand level 2 (CGE for Adults p 201)

Literacy - Element 2.2 - Oracy for Practical Purposes, p 69

Logical Order of Directions

Ref Following Directions

Sentences compiling a list of directions have to be rearranged so that they make sense. Cross out sentences which are irrelevant to the topic.

An example:

Situation:

You have sprained your ankle playing football and have to use crutches. A mate from out of town has volunteered to drive you to the doctor's for a check-up. You will need to give him instructions.

With the aid of your town map, reorder the instructions so they make sense. Cross out any unnecessary instruction. For this purpose, your home is marked with an X.

Have you tried that new peppermint-choc icecream?
Go out the driveway of my house and turn left.
You can set your watch by the train.
Turn right at the first intersection past Carr St.
Keep going east until we reach the T intersection.
Pass the ice cream factory on your left.
Gosh, my ankle hurts.

Travel north across the railway line.
Cross Hart Street and there's the hospital on the right hand side.
Thanks for the ride.
Go north along Scott Street, then turn right at Connor Street.

This activity can be adapted to any set of instructions eg: how to change a flat tyre, how to clean your teeth etc.

Reading and Writing -
Element 2.6 - Reading for Practical Purposes p 35
Element 2.2 - Writing for Practical Purposes p 31

Imaginary Get-away Stories *Ref. Activities to Improve Writing Skills.*

Each participant has a map of a suburb with main features marked on it. The central business area shows banks, newsagents, etc. Some of the students devised the idea that they were bank robbers and planned a get - away route. While they gave an excited account, the rest of us were the police attempting to follow them on our own maps. Everyone wanted a turn, so the maps became a colourful mess of lines trying to follow each 'get-away'.

Oral Communications - Elements 2.1 - 2.4 pages 68-71

Following Instructions

Reading Directions

Ref. Following Directions

Simple fun exercise to stress the importance of reading all directions before starting. The last direction negates all previous directions.

Reading and Writing - *Elements 1.6 (p 25) and 2.6 (p 31)*
Reading for Practical Purposes

Reading Directions and Following a Diagram

Ref. Following Directions

a) 1 - fold design - referring to axis of symmetry

b) Multi fold design

c) Invent own multi-fold design. Participants write and illustrate how to do it. Others try the inventions.

Equipment: scissors, textas, coloured squares of paper.

Reading for Practical Purposes - Elements 1.6, 2.6

Numeracy - Space and Shape stream - Level 2 (CGE for Adults p 200)

More Directions

Hidden Direction Words

Direction words are hidden in a 'wonderword' type puzzle, - diagonal, left to right, right to left, up and down. List words were then studied further, eg: Find other words which have 'up' in them. Find other words which have 'ight' in them etc. Dictionaries, magazines, newspapers were all a useful source.

I had proposed to do further work on the compass and extending into measuring angles and related activities. With assistance from Outdoor Education texts, the final goal was to be an orienteering activity planned and catered for by the boys which hopefully would have encouraged some different forms of report writing and a willingness to attempt more difficult tasks in the fields of numeracy and literacy.

Compass Introduction

Ref. Following Directions

a) Using a Watch as a Compass

Handout: Students had to follow directions from a central point in the local park. Students were to note directions to various landmarks.

Numeracy - Element 2.4 - Use estimation and calculation with....direction (CGE for Adults p 90)

SUPERMARKET SESSIONS

■ THE TRIP TO THE SUPERMARKET

This session began one afternoon after a lunchtime discussion about the advantages and disadvantages of buying lunch (coke, snack bar, chips, cigarettes, etc.) from the corner milkbar compared with the nearby supermarket, especially when participants were on a limited income. Some points which arose included price versus convenience and multiple packs/economy size packs versus single items. The challenge presented itself: how well did they know supermarket prices of mainly generic brands, allowing for the variations of weekly discounts? In spite of differing household responsibilities for grocery shopping, most boys were confident about their estimations. So a list of ten grocery items was compiled, along with their respective price estimations. The list was revealing about their priorities, experience and daring! Budget planning and health/nutrition units could have been developed as well. However, the following format evolved within the framework of the general course theme of - Direction.

Aims

The supermarket topic was to provide a meaningful context whereby each participant had the opportunity:

1. to compose one or two sentences that direct members from the Skillshare Centre to the supermarket.

   Reading and Writing - element 1.2 - Writing for Practical Purposes p.21

2. to spell familiar words (milk, chips, etc) in a shopping list format

   element 2.1 - Writing for Practical Purposes, p.21

3. to utilize a memory technique based on visualization or categorization to recall a shopping list of 10 items.

4. to recognize familiar words, brand names, aisle headings and street names

   Reading and Writing - element 1.6, Reading for Practical Purposes, p 25

5. to read a simple set of directions

   Reading and Writing - element 1.6, Reading for Practical Purposes, p 25

6. to use prior knowledge of the local supermarket to discuss best route, shopping list, location of goods and general layout of supermarket

   Oral Communication, elements 1.1, 1.2, 1.3, pages 62 - 64

7. to interact cooperatively in pairs to complete the task of locating goods, recording prices, drawing floorplan and making polite requests for assistance from supermarket staff.

   Oral Communication, elements 1.1, 1.2, 1.3, pages 62 - 64

8. to estimate prices (to the nearest dollar) of goods, based on experience

   Number, Level 1 & 2, pages 200, 201

9. to estimate distance and walking time from Skillshare Centre to supermarket

10. to use language of comparison eg. more/less than 1 km; more/less than 5 minutes; cheaper/more expensive

    Measurement, Level 1, page 200

11. to recognize units of measurement for different types and sizes of goods, e.g. ml, l, g, kg

    Measurement, Level 1 & 2, pages 200 - 201

12. to draw a simple floorplan of supermarket with aisle headings, using a number key to show location of shopping list items.

    Space & Shape, Level 2, page 201

13. to use and follow directions using everyday terms of position eg. left/right, up/down, first/last, high/low, near/far.

    Space & Shape, Level 1, page 200

14. to compare a shopping list of estimated prices with actual prices (more/less)

    Number, Level 1, page 200

15. to estimate the total cost of both shopping lists.

    Number, Level 2, page 201

16. to check the accuracy of estimation, noting the difference between costs, estimated and actual, using a calculator.

    Number, Level 2, page 201

Procedure

1. Writing the shopping list with estimated prices

A list of 10 items was compiled, with assistance from everyone in the group regarding spelling and price estimates. In order to know how much money would be required, the total cost was estimated and then checked with the calculator.

2. Memory strategies

The value of the shopping list as a part of budget practices was discussed briefly. The question was posed: 'What if you forgot the shopping list, how would you remember what to buy?'

(a) Categorisation Method

The students suggested categorising items into smaller groups based on type of goods, frozen foods/non frozen, initial letter, etc. This method was explored but not found helpful for the group list. Too many sub-groups!

(b) Location Method

One student imagined his flat and 'visually' walked through each room, placing each item in its respective place. This proved reasonably successful.

(c) Mnemonic Method

I suggested this method which uses both sound and visualization. The name of an object must rhyme with its corresponding number. (eg 1 - nun, 2 - shoe, 3 - tree, 4 - door, 5 - hive,etc) So the first number on the list, cigarettes, could be visualized with the nun. The more outlandish the image the more memorable the item to be remembered. This was a lot of fun with the students vying with each other for the most humorous suggestion.

Because it required more time, effort and concentration and it already had the benefit of familiarity with the two previous methods, the mnemonic method was the most successful technique. The following week would measure the degree of success when participants had to write the list from memory.

3. Directions to the Supermarket

Participants collaborated to draw a map of the whiteboard showing the location of the Skillshare Centre and the supermarket. North was ascertained with a compass.

Various routes were discussed using landmarks and 'direction' vocabulary. Estimations of 'walking' time and distance helped the group to decide on the most efficient route.

Each participant then wrote his own set of directions. In turn, each writer read aloud his directions and another class member marked the route on the whiteboard map. The group offered suggestions for improvement.

An improvised floorplan of the supermarket was discussed and drawn on the

whiteboard to provide an example. Aisle headings were suggested and a number key was used to show the predicted location of items.

End of afternoon session. The next component began the following week with 2 x 2 hour sessions.

4. Visit to the Supermarket

A review of the directions to the supermarket was conducted. Two sentences from the previous week with missing 'direction' words (right, Hess Street,etc) were on the whiteboard. Participants, in turn, wrote words from a list to correctly complete the sentences. The shopping list was reviewed. It was written from memory after recalling the images visualized using the mnemonic method. The handout of the shopping list was then examined noting estimated prices and quantities. The students were to work in pairs.

The time of departure from the Skillshare Centre was noted with one student responsible for recording the time of arrival at the supermarket. Needless to say, he was first to arrive and the hapless tutor was last! The notion of averaging when estimating walking time was overlooked by myself!

At the supermarket, the pairs were instructed to draw a rough layout plan with aisle headings, before locating the shopping list items. Items were then found with prices and location noted. There were varying degrees of efficiency in performing this task - perhaps a function of the individual's familiarity with the supermarket and the list items. Some participants were determined to price their regular brands, rather than the cheapest. This was allowed, provided the choice was recorded.

This activity took the morning session of two hours.

5. Supermarket Follow Up - Report and Analysis of the Activity

In pairs, the estimated and actual price lists were compared, with higher prices underlined. The students weren't satisfied with comparing prices to the nearest dollar because their estimates were reasonably accurate in most cases. I had underestimated their experience and the knowledge displayed by one particular student.

According to their level of confidence, the students used two methods to find the difference between prices: 1. formal subtraction and 2. complementary addition. Calculators were used to check the answers and the totals of both lists.

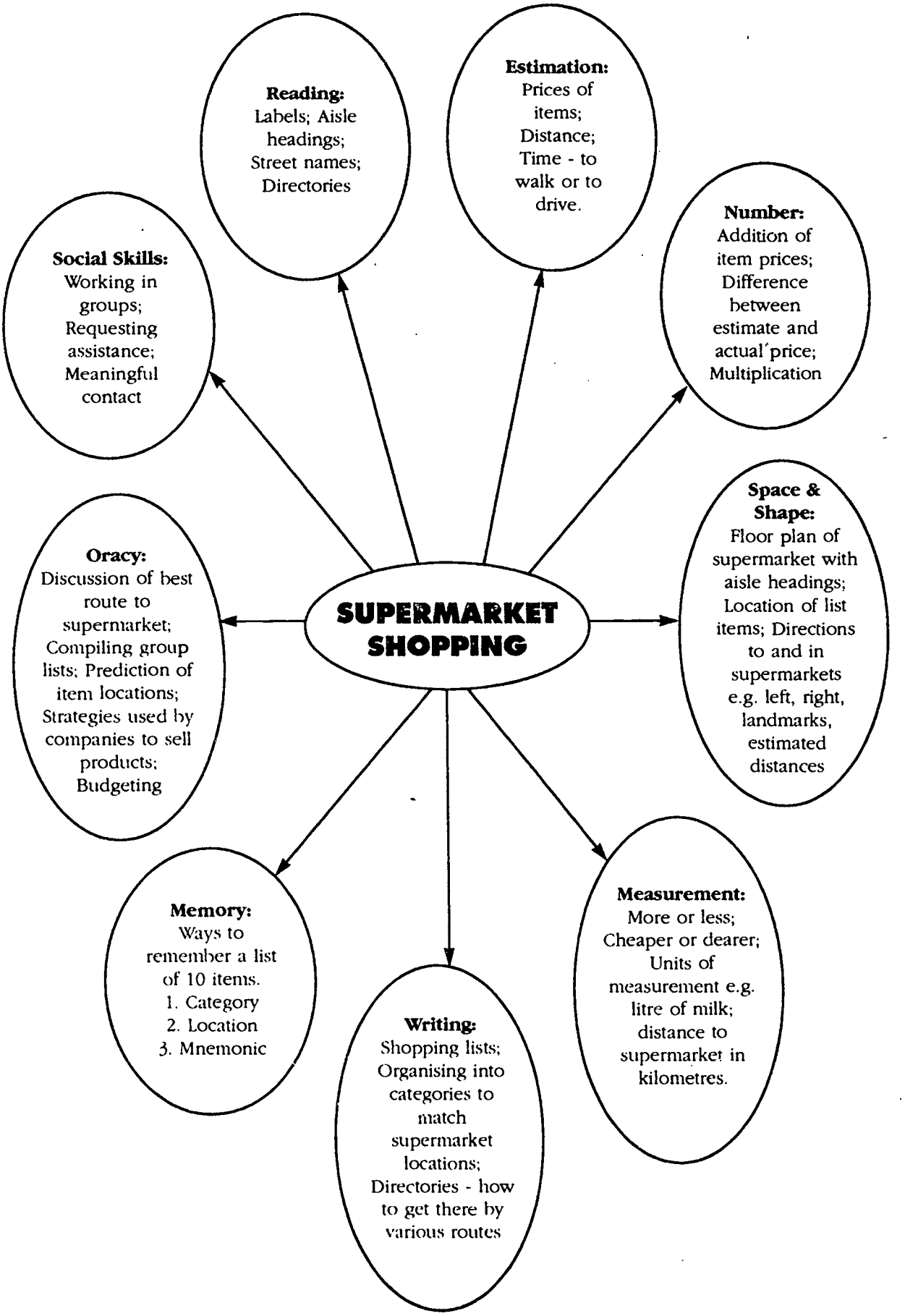
On large sheets of newsprint, each pair prepared a supermarket floor plan, not drawn to scale, with a number key locating each item. Drawing the layout required cooperative decisions concerning the organisation of space and information. One pair resented the task perhaps because its level of difficulty exposed them to failure. I assume this when they readily cooperated to make stick on labels for the aisle headings to be used by the other pairs.

Informal discussion also took place concerning the marketing strategies of supermarkets: e.g . locating items on middle shelves, at the back of the store, at checkouts; at the end of aisles, according to logic (frozen food in fridges), etc. At this juncture, time ran out. Generally, I like to finish with a whole group game that is either connected with the topic (e.g. I went to the supermarket and bought 1 litre of milk; I went to the supermarket and bought 1 litre of milk and 1 dozen eggs, etc or a game that reviews the skills practised in the session (e.g .a modified version of the TV game - Supermarket Sweep).

Overall, this series of activities was enjoyable and successful in fulfilling the initial aims. The participants had practised skills in many areas of literacy and numeracy. They were generally successful in performing the set task. The topic allowed them physical activity, group support and interaction, and a chance to show the depth of their skills and knowledge in a familiar environment outside of the 'classroom'.

SUPERMARKET SHOPPING

Item	Estimated Price	Actual Price
1 pkt Horizon cigarettes	6.00	5.85
1 slab VB	23.00	23.95
1 pkt condoms	2.70	3.40
1 lge frozen pizza	1.80	2.15
1 pkt frozen hamburgers	4.00	3.85
500 gm cornflakes	1.29	1.29
150 gm coffee	2.50	3.50
2 litres milk	2.00	1.90
1 jumbo sandwich loaf	1.49	1.50
1.5 kg sugar	3.00	1.90
TOTAL		


SUPERMARKET SHOPPING
Reading: Labels; Aisle headings; Street names; Directories
Estimation: Prices of items; Distance; Time - to walk or to drive.
Social Skills: Working in groups; Requesting assistance; Meaningful contact
Number: Addition of item prices; Difference between estimate and actual price; Multiplication
Oracy: Discussion of best route to supermarket; Compiling group lists; Prediction of item locations; Strategies used by companies to sell products; Budgeting
Space & Shape: Floor plan of supermarket with aisle headings; Location of list items; Directions to and in supermarkets e.g. left, right, landmarks, estimated distances
Memory: Ways to remember a list of 10 items. 1. Category 2. Location 3. Mnemonic
Writing: Shopping lists; Organising into categories to match supermarket locations; Directories - how to get there by various routes
Measurement: More or less; Cheaper or dearer; Units of measurement e.g. litre of milk; distance to supermarket in kilometres.

■ AN ACTIVITY THAT FAILED

The flying over Australia seemed to lead naturally to thoughts of holidays we had all been on. A great opportunity to fire them off into some practical research into planning a holiday to a destination of their choice – all those numeracy/literacy/artistic skills involved! Or so I thought. The original discussion included places where they had been on holiday or where they would like to take a holiday. They were then to pick a destination and plan out the trip. After some time-wasting and half-hearted efforts, it was judged too hard and 'too much like school' – my mistake, so I didn't pursue it any further.

This was an important lesson for me to learn and it is interesting to examine why this particular activity did not work for these students. What did 'too much like school' and 'too hard' actually mean? There was nothing involved that was any more difficult than other tasks they had been undertaking. The students, on further pressing said (although not in these words) it felt like one of those never-ending school assignments – irrelevant to their needs and interests, and too long and open ended. This reconfirmed initial instincts to keep activities short or, possible to complete in a short space of time, at this early stage of their reaquaintance with learning. It also emphasized the importance of keeping together as a group at this stage – not splitting off as individuals for any extended period. Although I knew that eventually these students would have to do things by themselves I decided that this was more likely to occur for a real task, or research on something of genuine interest at a time relevant to them, not for a contrived activity.

■ EVALUATION

Evaluation, in general terms, can perhaps be measured by their good attendance and a desire to play some of the games during their lunch break. In fact their enjoyment and the importance of the program to their lives was demonstrated on a day I couldn't attend. The participants were very reluctant to go home and stayed together at the centre for most of the day, even though no staff were able to give them further activities to do. It seemed to mean a great deal to them to have somewhere to go on a Monday when the rest of the world went off to work.

Further evidence of the success of the program was, unfortunately, its termination. The program came to an unexpected finish when most of the group were accepted for a full-time TAFE course with literacy support. This prevented the grand finale of a full-day orienteering exercise taking place. However, it demonstrated that one of the major aims had been achieved – the students now had a new attitude to education and were willing to have another go by making a commitment to a full-time course.

REFERENCES

Some useful references for the activities I have used come from the following texts. Other activities have been gleaned from colleagues and S.D. workshops.

Baker, Michael G. *Critical Thinking Activities to Improve Writing Skills - Whereabouts*, Hawker Brownlow Education, Australia, 1989.

Pirie, Jennifer, and Pirie, Alex, *Following Directions*, Curriculum Associates Inc. Hawker Brownlow Education, Australia, 1991.

Rogers, Kathleen A., *Writing to Inform*, Hawker Brownlow Education, Australia, 1989.

The above texts contain fully reproducible worksheets.

Stenmark, Jean Kerr, Thompson, Virginia and Cossey, Ruth. *Family Math*, Lawrence Hall of Science, University of California, Berkeley, U.S.A. 1986.

Industry Numeracy Program

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LEVEL 1/2

This program is conducted in industry settings by the Applied Science and Mathematics Department of Northern Metropolitan College of TAFE, Vic.

Teacher and Program Designer:
Sheila Fitzgerald

■ BACKGROUND

Our TAFE College was asked to deliver a maths program to some of the process workers in a local factory. The purpose of the training was to enable all production staff to carry out and record the graphing and measuring required for the Statistical Process Control, or Quality Control, used by the company. This Quality Control was currently being done by highly trained staff. However, in line with popular trends to improve productivity, the company wished to pass greater responsibility for, and understanding of, these tasks on to their production line staff.

This means that employees needed to learn to use complex measuring instruments which involved accurate reading of decimal scales. These readings then had to be averaged and plotted on quality control charts also with complex decimal scales.

We conducted a series of maths assessments based around the skill areas we had identified as being appropriate for the company's requirements. The assessments were conducted orally and designed to be presented in as non-threatening a manner as possible. Many of the employees had already completed a literacy assessment and so were not really concerned about the interview process. After analysis of the interviews we were asked to suggest possible maths groupings for training.

At this time, we had in-depth discussions with the company to establish their expectations for assessment, future training goals and anything else specific to the program.

Our assessments showed that the workers were spread throughout varied levels of maths competency. However, we were able to establish three groups which not only satisfied the company's needs in terms of the number of participants in each group, and the distribution of these people across the various areas within the production structure, but also the mathematics required by the participants.

The group assessed to be at Level 3 of the CGE for Adults or above had no problems with the concepts needed for Statistical Process Control and their training was completed in 12 hours. It involved a brief revision of some mathematics and a detailed examination of graphing and its purpose in an industrial setting.

However, the other two groups, who were below Level 3, required far more extensive training and a far greater time commitment.

This document will discuss in detail the Level 1 and 2 course which has now been successfully completed with the maths abilities of the production staff greatly improved as a result.

■ GROUP PROFILE: LEVEL 1 AND 2

The nine people in the group were of mixed age and ethnic origin, only one had English as a first language. The others had various levels of English. Some had already completed a language course conducted by our College.

Their maths skills ranged from those who could not reliably subtract or divide to those who had many of the required maths skills, but to whom language was a significant problem. A number of the students had only limited schooling in their own country. However, they were able to function extremely well with money and had few difficulties completing the tasks currently required of them in their jobs.

■ THE PROGRAM

We were able to conduct 50 hours of classes. It was decided that the classes would be two and a half hours long and would run over twenty weeks.

The areas of work to be covered were:

Whole number calculations
Decimals
Introductory fractions
Metric measurement and conversions
Percentages
Graphs and their applications
Calculator use
Mathematical language

The aims for the course were much broader than only teaching mathematical skills. The program had a very strong language focus and the students were encouraged to develop all aspects of reading, writing and speaking English.

■ IMPLEMENTATION

The company has a well established training area which we were able to use. It provided an area where the participants could not be observed by fellow workers and had facilities for making tea and coffee. These were both important factors in setting up a relaxed mood in the classes.

The individual lessons were structured around a number of main activities, four or five per lesson. They had a central theme or themes and were used to not only cover the *'lesson topics'* but also to involve the students in much broader areas of mathematics.

We spent a considerable amount of time exploring the maths that the students knew in their own language and had not been able to translate into English.

We used many *'cooperative logic'* activities as a part of the program to foster language development, promote group cohesion and team work. This is a major issue within many work place reforms. Activities of this type are excellent in developing confidence and give great scope for the introduction of new subject areas.

If students showed interest in a particular subject, even one not directly related to the program, we tried to include it in some way. Drawing on their own interests helped to relieve their anxieties about studying mathematics again and made the course more relevant to their own lives. For example, early in the course we did work on 24 hour time and its uses. This was done because one of the students wanted to meet a plane from overseas and another student found operating the video timer difficult. This approach helped students decide that the course was for them, as well as the company. This shift in attitude was a vital step in the success of the program.

■ RELATIONSHIP TO THE COMPETENCY STATEMENTS

We consider that the competencies required by the industry were, on the whole, those put at Level 2 of the CGE for Adults Framework, p.90. The course activities however, in many instances, crossed the boundaries of competencies described in Levels 1 and 2,(CGE for Adults pp.87 - 90) and occasionally touched those of Level 3. (CGE for Adults p.92) Further details are provided below and in the detailed course documentation.

Language encouraged during the course was everyday English. Stress was put on the recognition and use of words linked to mathematical concepts and operations, and on the symbols used to denote these. The non English speaking backgrounds of the client group made this one of the major objectives of the course. Frequent practice at verbalisation and communication using such language was encouraged through the type of activities used.

The problems involved ranged from those which were personally familiar – relating to real situations in students' lives, such as calculations they need for shopping, banking, or routinely at work *(Level 1 CGE for Adults p 87-88)* – to written problems which also relate to everyday situations but which were perhaps beyond the direct experience of individuals in the class *(Level 2 CGE for Adults p 90).*

Calculation standards required by the end of the course were Level 2: using a range of methods and requiring recall of number facts, (see Background Works p.201). However, during the course many students performed for some time at Level 1 standard: using hands on materials to model and assist their understanding of the process (CGE for Adults p.200) until they became more confident to use the abstract calculation methods required for Level 2 *(element 2.2 - develop and use.....number.....relationships, element 2.3 - use natural number and common fraction/decimal fraction/percentage equivalents - CGE for Adults p.90). A range of formal and in the head methods was encouraged (see performance criteria - Level 2 CGE for Adults p 90).*

Calculations were initially performed using whole numbers but later extended to decimals in the contexts of money and measurement (element 2.3).

The use of decimal measuring devices in the industry meant that considerable attention needed to be given to decimal place value in relation to reading scales, plotting graphs and metric conversions. This meant moving into the Level 3 number competencies *(element 3.3 - use appropriate methods of calculating with natural numbers, fractions, decimal fractions, percentages).*

The two strands of number and measurement were continually treated together in practical contexts. Beginning with estimation of whole number measurements *(element 1.4, - use personal referents in measurement)*, and progressing through the reading of simple measuring devices *(Level 1 - CGE for Adults p.200)* to more complex work based tasks of reading gauges and other relevant measuring devices *(Level 2 - CGE for Adults p. 201)*.

Fractions were seen necessary at two Levels. First, Level 1, as a necessary part of the language development; the common usage of simple fractions such as a half and a quarter *(element 1.3 - use... practical and everyday fractions)*. Secondly as a conceptual foundation for the understanding of decimal place value and percentage. The conceptual development also included the notion of equivalence for simple, common fractions *(element 2.3 - use common fraction/decimal/percentage equivalents - CGE for Adults p.90)*. Some students progressed as far as Level 3, adding and subtracting fractions *(element 3.3, use appropriate methods of calculation with.... fractions...CGE for Adults p.92)*, but only as extension work.

Percentages were dealt with similarly: at a conceptual level and in conjunction with graphical work and pie charts *(element 2.1 - interpret data and organize it into tables and charts -CGE for Adults p.90)*. The level of performance probably remained at Level 2, since calculations, such as those of percentage waste, were contrived to be easily done in the head rather than with formal calculations. Calculators were also used for percentage work in real situations, with in the head estimations used for checking whether results are reasonable.

The strand or element of competency relating to space, shape and direction was developed during the course in a variety of situations. The opportunity for the Level 1 classification of shapes and use of spatial language *(element 1.5 - classify shapes - CGE for Adults p.88, Background Notes - Space and Shape - p.201)* was provided in problem solving contexts in the early weeks of the course using matchstick puzzles and developed later to descriptions of attributes *(Level 2 Space and Shape - p. 201)*. The use of maps and simple scales was examined in conjunction with time calculations, reading timetables, and giving directions to describe routes from one location to another *(element 2.4 use estimation and calculation with shape and direction - CGE for Adults p.90)*. The concepts of perimeter and area, possibly seen as Level 3 *(element 3.5 - use estimation and calculation with perimeter area, volume, relationships of common shapes)* were dealt with in relation to spatial problem solving activities (see week 4). However, the language aspect of these was stressed rather than mathematical calculations and the treatment was brief, so it probably remained in the Level 2 range *(element 2.2 - develop and use.... measurement and shape relationships -CGE for Adults p.90)*.

COURSE DOCUMENTATION

The materials provided to detail this course give a breakdown of the program session by session. For each session a diagram is provided which shows:

- the teacher's specific aims for that particular class - *written at the top of each page;*
- the activities used to achieve them - *written in the shaded boxes;*
- the skills being developed in each task - *in the oval shapes of the diagram;*
- explanatory information about the session and the significant issues it raised for the students - *underneath the diagram;* and
- references to resources which give details about the activities - *at the bottom of the page.*

In using the diagram we have tried to show at a glance the skills and knowledge being learnt or practised in each of the activities, and how the tasks overlap and reinforce each other to develop those skills. We have also tried to highlight the diverse nature of these skills, covering not only the strands of mathematics, but many language and literacy skills as well.

More than one topic was generally covered in each session, except when students specifically requested that we concentrate on one area. In many cases an activity apparently unrelated to the other activities in the session was used to prepare students for the future introduction of that material in detail; such as an early look at graphs to finish off a session which concentrated on percentage concepts and calculations. This technique often gave students the language and confidence to proceed quite quickly with the topic when it was reintroduced in later weeks.

For example, in Session 4 the main aim of the lesson was to work with decimal numbers and processes of addition and subtraction. However, measurement was also introduced in readiness for much more detailed work in this area later. The students were able to use simple measuring instruments like rulers, tapes and workplace digital micrometers to measure many aspects of the size of a variety of objects. This section of the session allowed discussions of measurement, accuracy of measurement, units and measuring technique to take place in a very natural way. It enabled the students to write decimal measurements and established quite a lot of language about measurement for future sessions.

In order to relate in more detail to the Competency Statements we have divided the sessions into 4 major blocks: Sessions 1 - 7; Sessions 8 - 11; Sessions 12 - 17; and Sessions 18 - 20.

Each of these blocks, whilst integrating a number of elements, is seen to have a particular focus. The focus and the particular elements of competency to which the block relates are described in a separate page following each of the blocks.

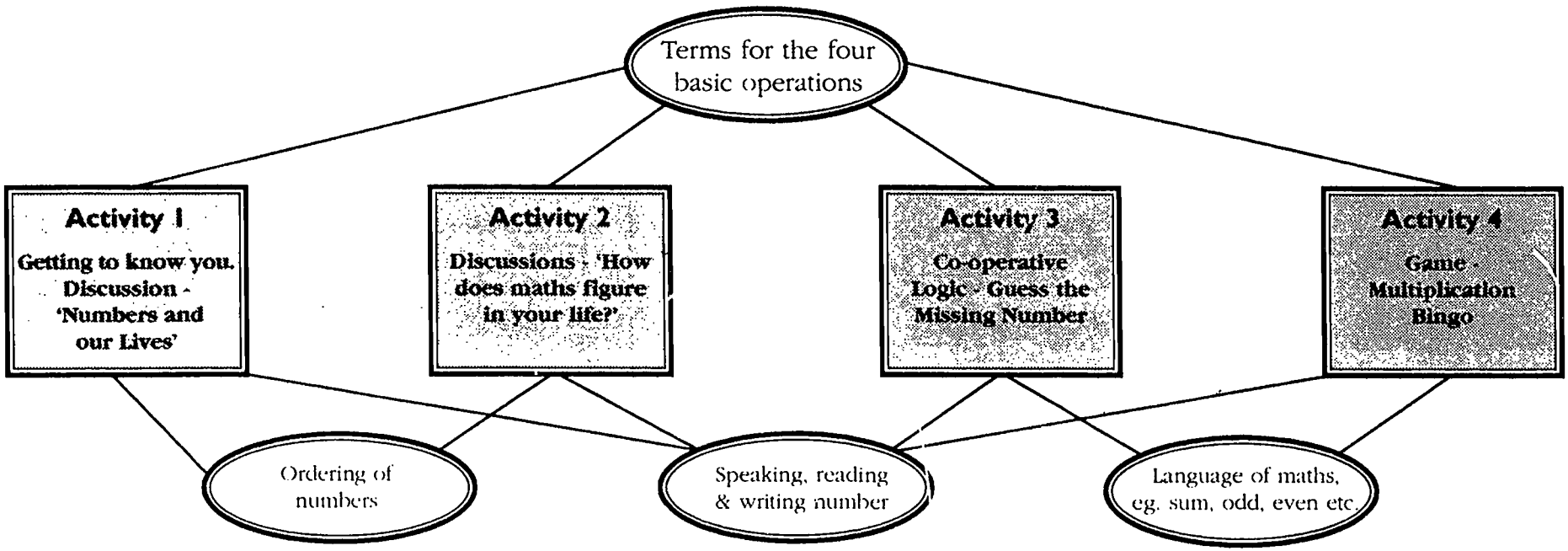
A bibliography is also provided at the end of the course description.

SESSION 1

2.5 hours duration

The aims of this session were to:

1. To assess the current number skills of the group.
2. Introduce the English words for maths symbols.
3. Discuss maths terms and relate them to the first language of the participants.
4. Interest the participants in maths using materials which are different from their past maths experiences.



The lesson tasks all overlap and offer opportunities for students to actively participate in all areas. They are designed to build group cohesion, communication and confidence. Activity 1 & 2 also demonstrate the relevance of maths to the participants' personal lives. An overall aim for the program is the development of language by the participants, hence the material being used involves many class discussions and creates opportunities for individuals to talk to each other about the mathematics.

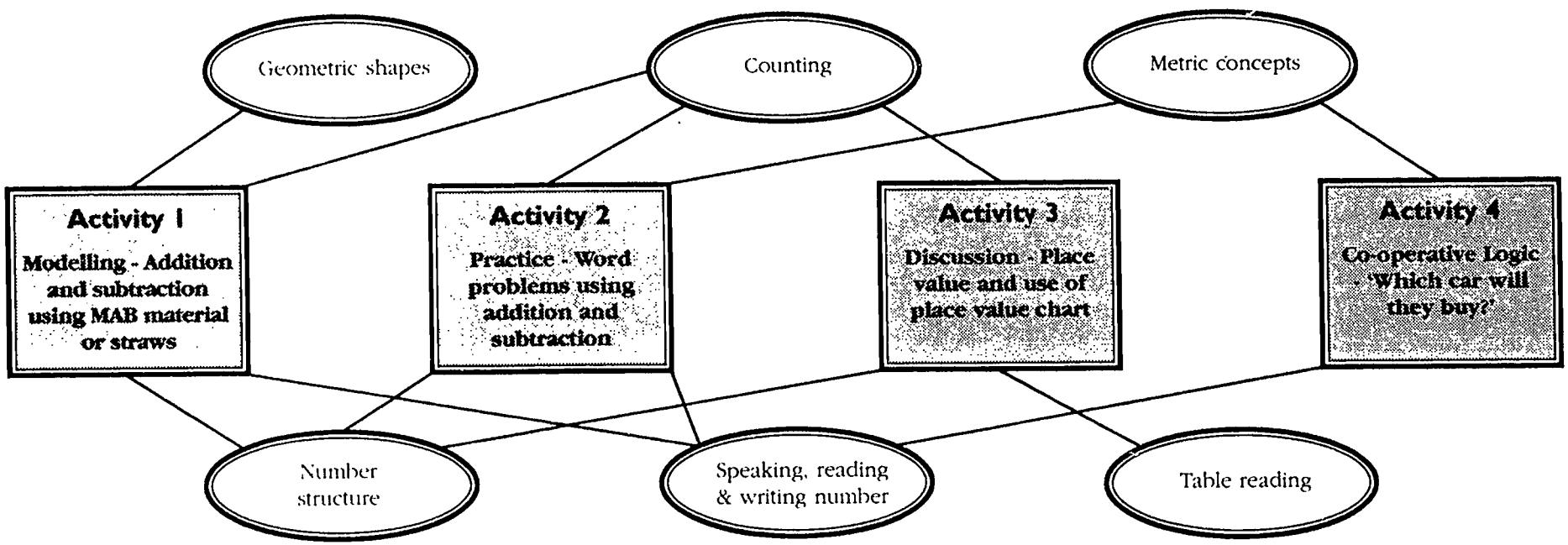
Refs *Activities all from Strength in Numbers* - Getting Started.

SESSION 2

2.5 hours duration

Aims of this session were to:

1. Continue with the students' mathematical language development.
2. Introduce the concept of Place Value.
3. Develop students skills in addition and subtraction.



The lesson tasks still have the same overall language objectives and similar concepts are reinforced in more than one task. However, the tasks are also used to develop apparently unrelated themes. These introductions help students feel familiar with the concept and language when the topic is brought up for full explanation later. Chart reading is an important requirement for industry and the extensive use of the Place Value Chart is an early introduction to this process. The cooperative logic activity is designed to use numbers in an everyday practical context. The introduction of concepts like addition and subtraction through the use of concrete materials was very important. The rate at which the level of difficulty of the work progressed depended on the individual students. At the time when some students went on to do word problems with addition and subtraction others worked on addition and subtraction number facts or further examples wholly using the concrete materials.

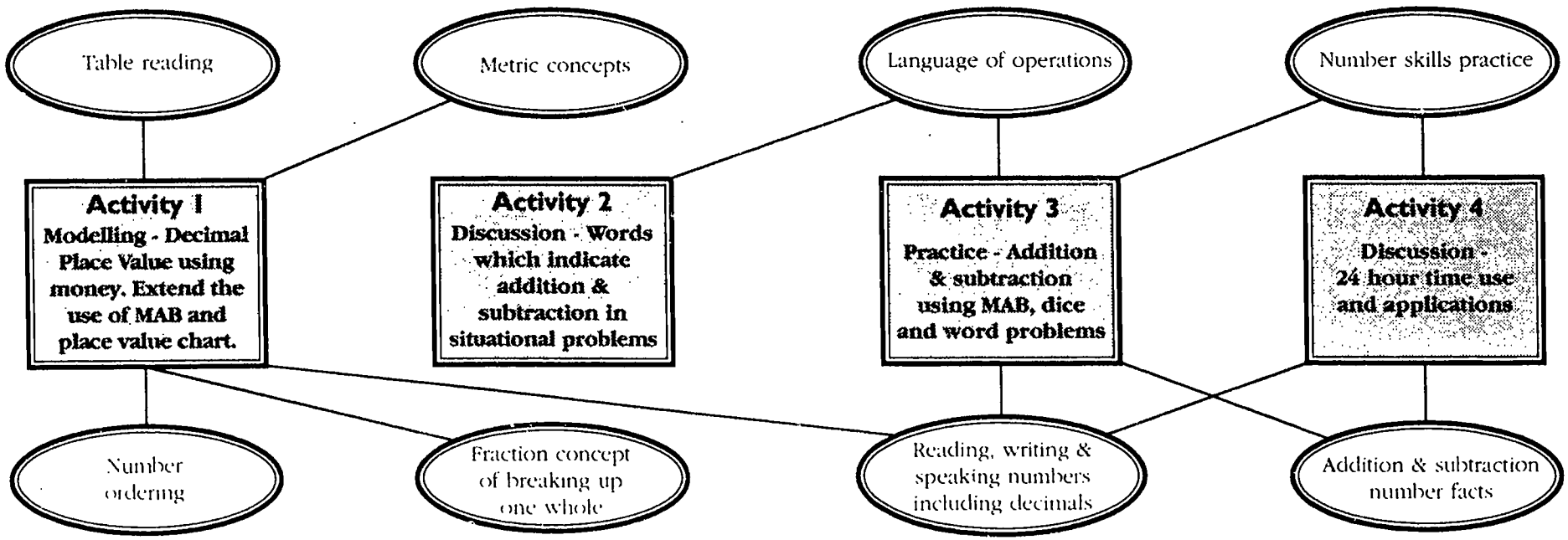
Refs *Activity 1, 2 and 3 from Strength in Numbers* - Addition and Subtraction. *Activity 4 from Strength in Numbers* - Getting Started.

SESSION 3

2.5 hours duration

Aims of this session were to:

1. Discussion to extend place value to include decimals.
2. Consolidate students addition and subtraction skills using M.A.Ba. materials.
3. Continue language development with written addition and subtraction problems.
4. Discuss 24 hour time. (Specific request from one of the students.)



This lesson involved a great deal of oral work for the students as well as use of concrete aids like money and a large clock face. The individuals within the group were showing a need for different levels of practice in addition and subtraction, some focussed on learning number facts and problems without using MAB support. A number of the students had very little understanding of the concept of subtracting and so needed extensive practice. Other students focussed on the more complex word problems which involved considerable discussion about language use and interpretation.

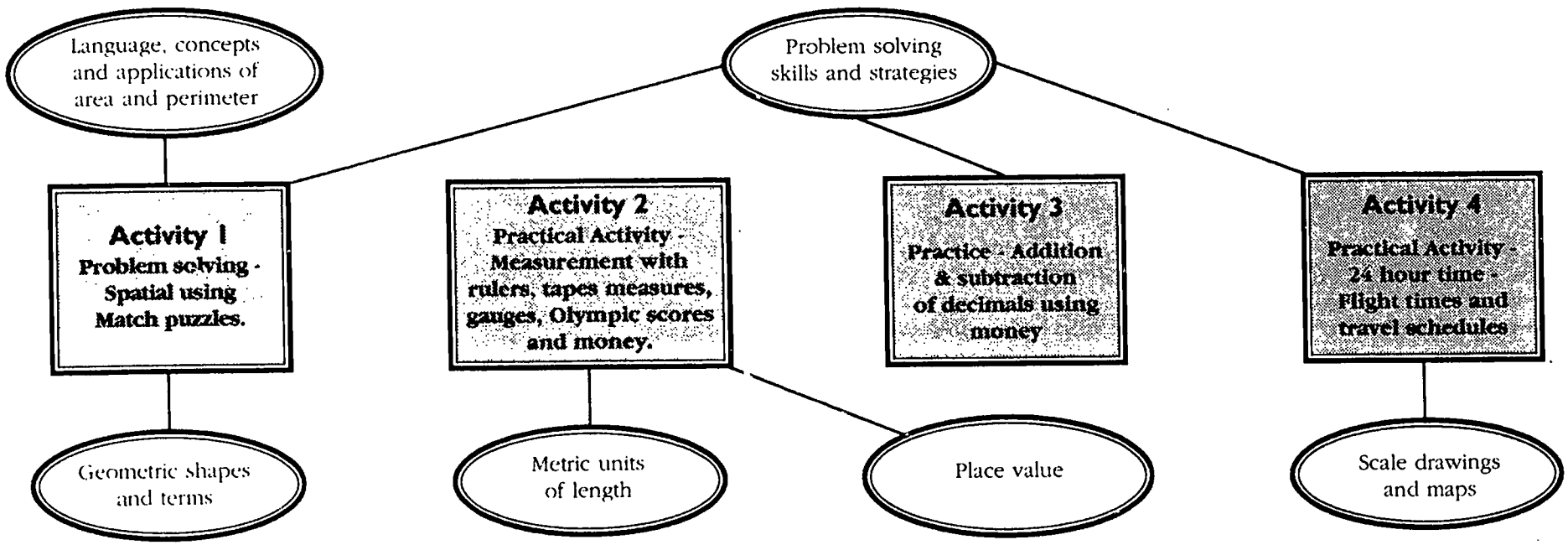
Activity 2 uses the problems included in *Strength in Numbers* AS39 - AS50. We discussed a number of selected problems and examined fully what it was in the examples that gave the clues as to whether they had to add or subtract. This was a necessary activity in terms of language development.

SESSION 4

2.5 hours duration

Aims of this session were to:

1. Extend from place value of decimals to ordering of decimals.
2. Introduce decimal addition and subtraction using practical money situations.
3. Provide practice with 24 hour time using real applications.
4. Introduce geometric concepts through problem solving.



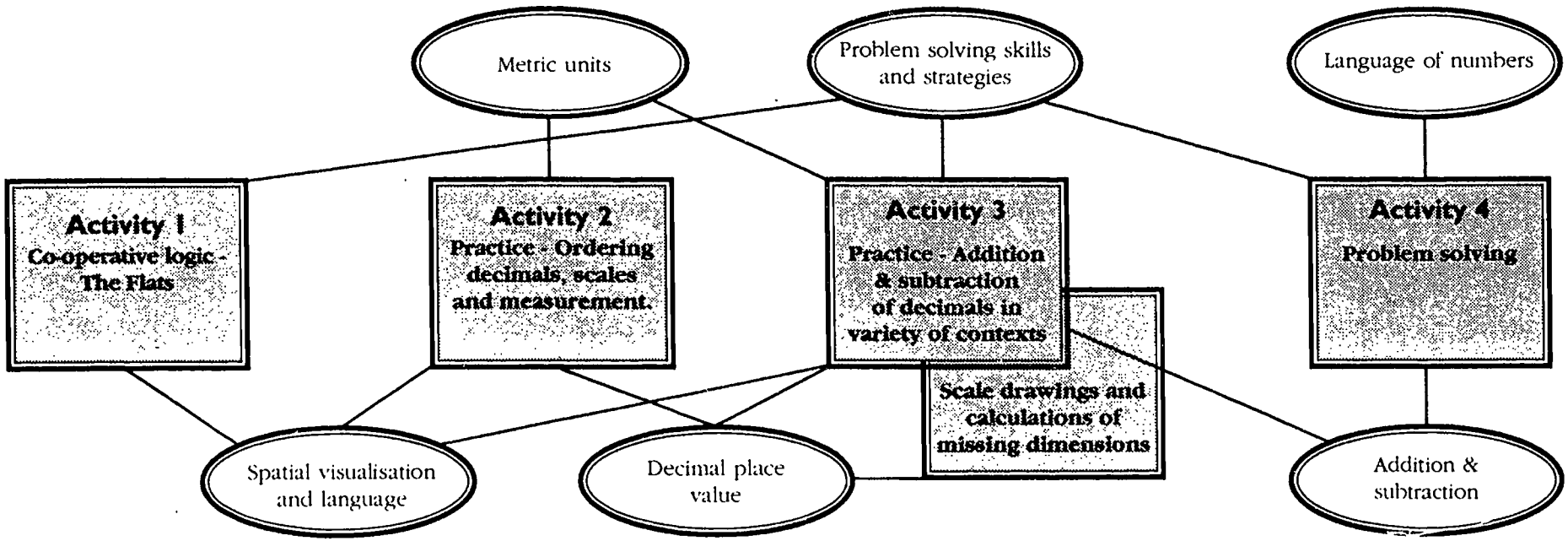
The emphasis on decimal scales and ordering is necessary for the tasks these employees will be required to carry out at work; measuring and plotting points on a line graph with a decimal scale are to be future job requirements. Participants were therefore given early practice at measuring lengths of 2D and 3D shapes using a variety of everyday tools, writing them as decimals and ranking these in terms of size. This lead to interesting discussions on accuracy of measurements.

SESSION 5

2.5 hours duration

Aims of this session were to:

1. Continue with decimal ordering and addition/subtraction of decimals using practical money situations.
2. Give further practice on number skills with decimals.
3. Develop students' spatial language through problem solving.



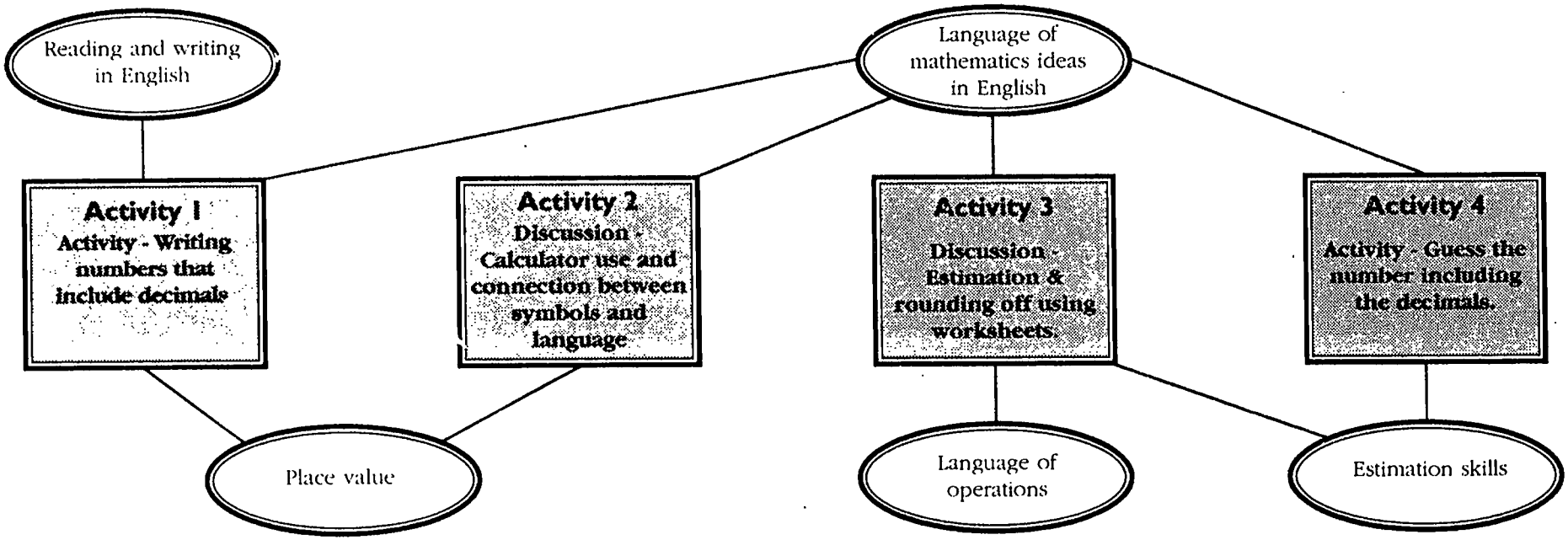
During this lesson many of the participants expressed the desire to consolidate their addition and subtraction skills. They wanted to practise them for quite an extended amount of time. Many of them felt close to mastering subtraction, a skill which had eluded them previously, and wanted to keep going with it without the introduction of new topics. This produced, from my point of view, quite a limited lesson but it was in response to the students' request. Other students needed some extension activities starting at this time and so they worked on items of their own choice from the problem solving materials, number crosswords and the scale drawing mentioned above.

SESSION 6

2.5 hours duration

Aims of this session were to:

1. Reinforce the concept of decimal applications.
2. Introduce the concepts of estimation and rounding off (with addition and subtraction only at this stage)
3. Introduce the use of a calculator.



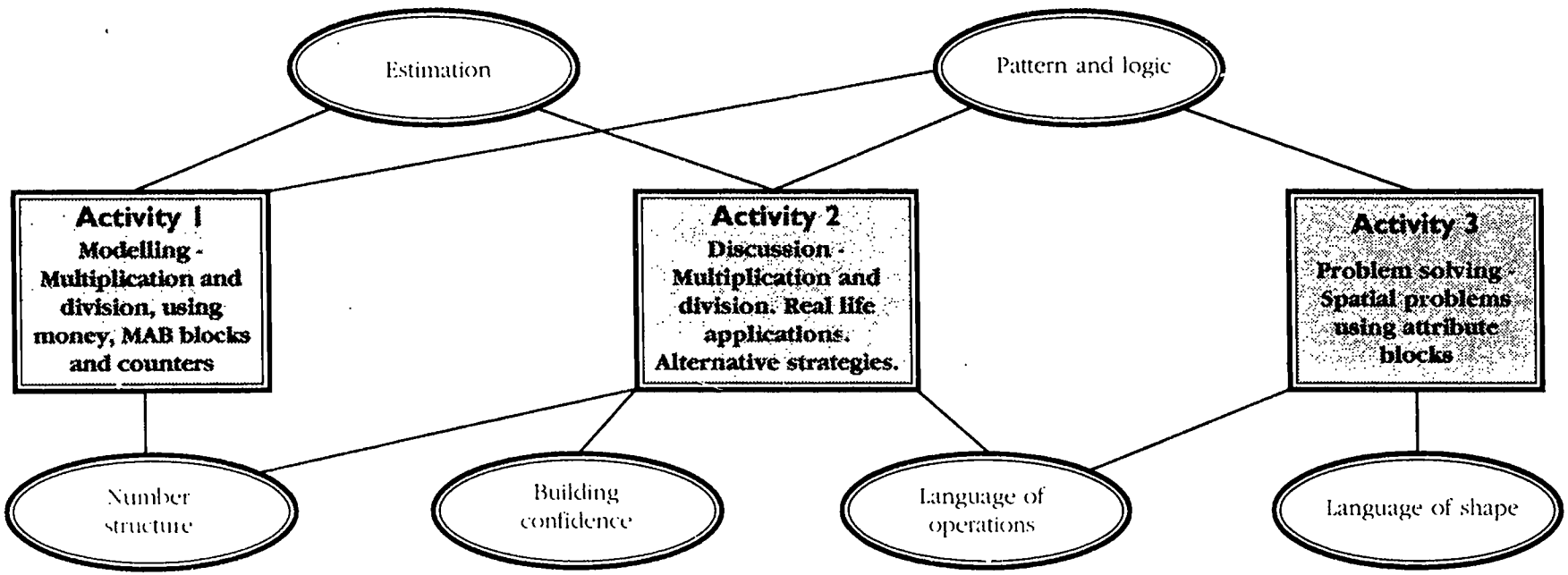
This session had a strong language focus for both numbers and as related to the function buttons of a calculator. Further revision of English terms for processes was necessary. Many of the students had never used a calculator before and using one was a challenge for them. The concept of estimation is one that most of the students understood from real life situations. However they were reluctant to practise it with number calculations in a classroom situation. This concept was reinforced by using the "ABC" of calculators: A - Approximation, B - Buttons, C - Check. Refs: *Strength in Numbers*

SESSION 7

2.5 hours duration

Aims of this session were to:

1. Introduce multiplication and division concepts.
2. Provide practice with these procedures.
3. Continue earlier discussions on shapes and their properties.



The 'acting out' of the processes of multiplication and division initially using money and demonstrating the way it is often necessary to break money into smaller denominations to share it out evenly really helped students when used in conjunction with MAB blocks. The students found it helpful to discuss the sort of strategies they use in their real lives. The reinforcement of these strategies not being wrong gave them a lot of confidence. The students were convinced that there was only one way to carry out a process in maths and that the idea that every alternative they came up with would be wrong was an important issue to address.

RELATIONSHIP TO THE COMPETENCY STATEMENTS

■ SESSIONS 1 TO 7

In these sessions the focus is largely on developing Level 2 numbers skills, including operations with whole numbers and decimals; estimation; and calculator skills. (see element 2.2 below)

The contexts used integrate the strands of Measurement, and Space and Shape. (see element 2.4 below)

COMPETENCY LEVEL 2

CGE for Adults p89, 90

The student can use and analyse everyday data, relation and pattern, number, measurement and shape.

Elements

2.1 Interpret data and organise it into tables and charts

2.2 Develop and use data, number, measurement and shape relationships

2.3 Use natural number and common fraction/decimal fraction/ percentage equivalents

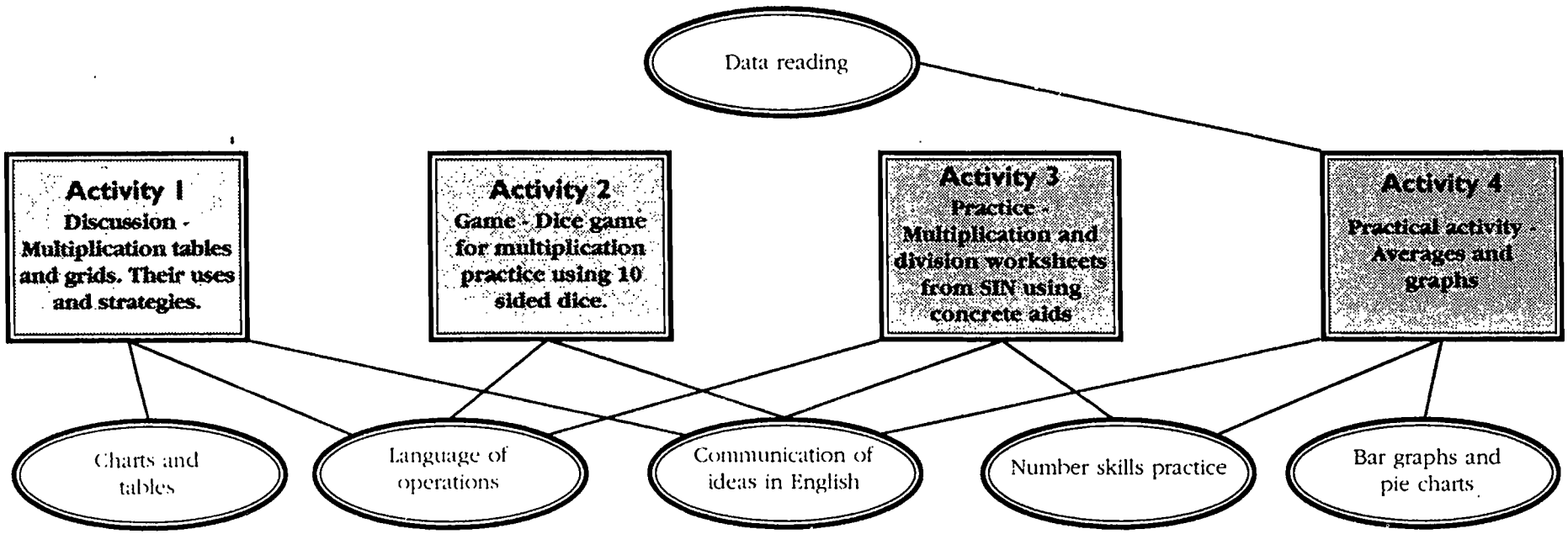
2.4 Use estimation and calculation with shape and direction

SESSION 8

2.5 hours duration

Aims of this session were to:

1. Provide continued practice with multiplication and division.
2. .Provide opportunities to apply these skills in worded problem situations.
3. Introduce methods of learning multiplication tables.
4. Introduce the concept of average and explore its relevance to the work situation.



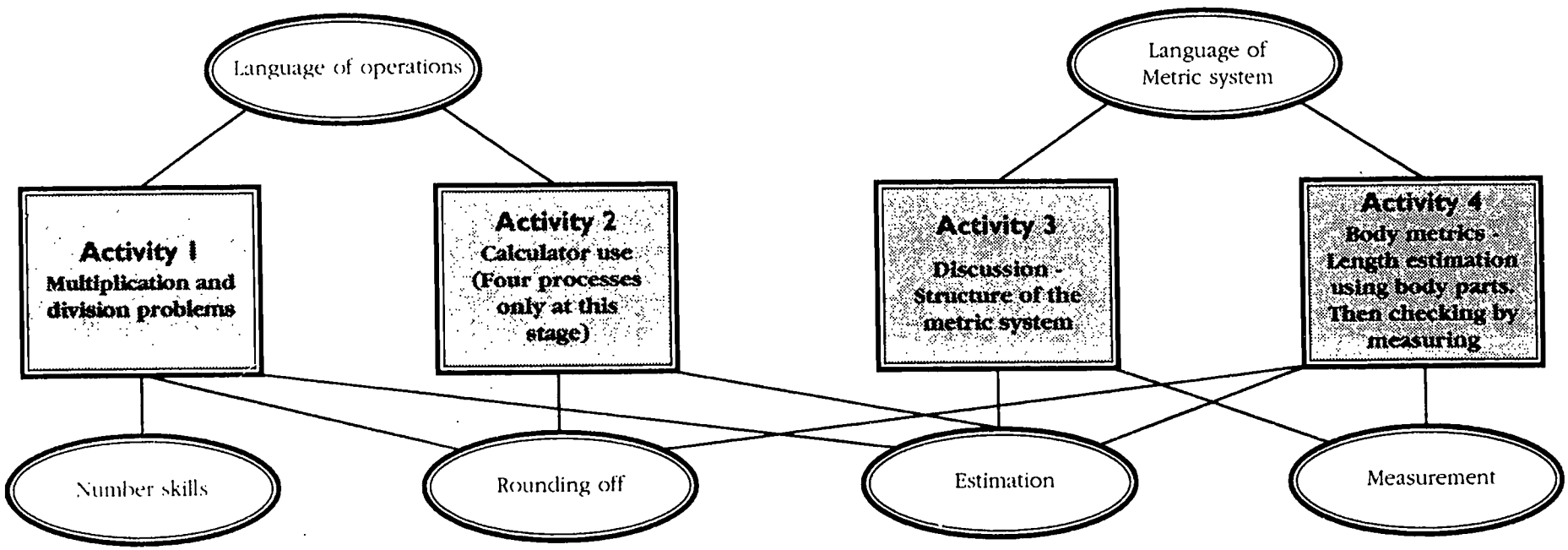
For many of the students in the group, division was a process they had never been taught and they had no strategies for doing it. The use of concrete material was vital to their confidence and the development of this skill. The workplace required all staff to be able to plot averages from a number of readings on to a line graph. To develop an understanding of the process this group started with the calculation of averages and then finally examined the task on the company's graphing sheets. The initial averages we calculated used plastics discs in cups. The students were asked to calculate the average number of discs in 2, 3 or 4 cups. The group discussed other applications of average such as average contents of a packet, average temperatures, etc.

SESSION 9

2.5 hours duration

Aims of this session were to:

1. Provide continued practice at multiplication and division including some decimals.
2. Introduce calculators to check answers introduce the concept of estimation in calculations
3. Formally introduce the language of the metric system and the relationships between units..
4. Develop estimation skills with metric units of length.



All students had now really strengthened their calculation skills with the four processes and they accepted the introduction of calculators as a checking tool only. A few students in this group had never used a calculator before and the language required was difficult for them. The concept of estimation and calculator use was new for everyone and quite difficult for some therefore a lot of time was needed to encourage them to use estimation rather than merely trust the calculator answers. The group was very divided in terms of experience with and understanding of the metric system. Some had a lot of prior knowledge but lacked English language, others had little understanding. Discussion helped them to share their strengths.

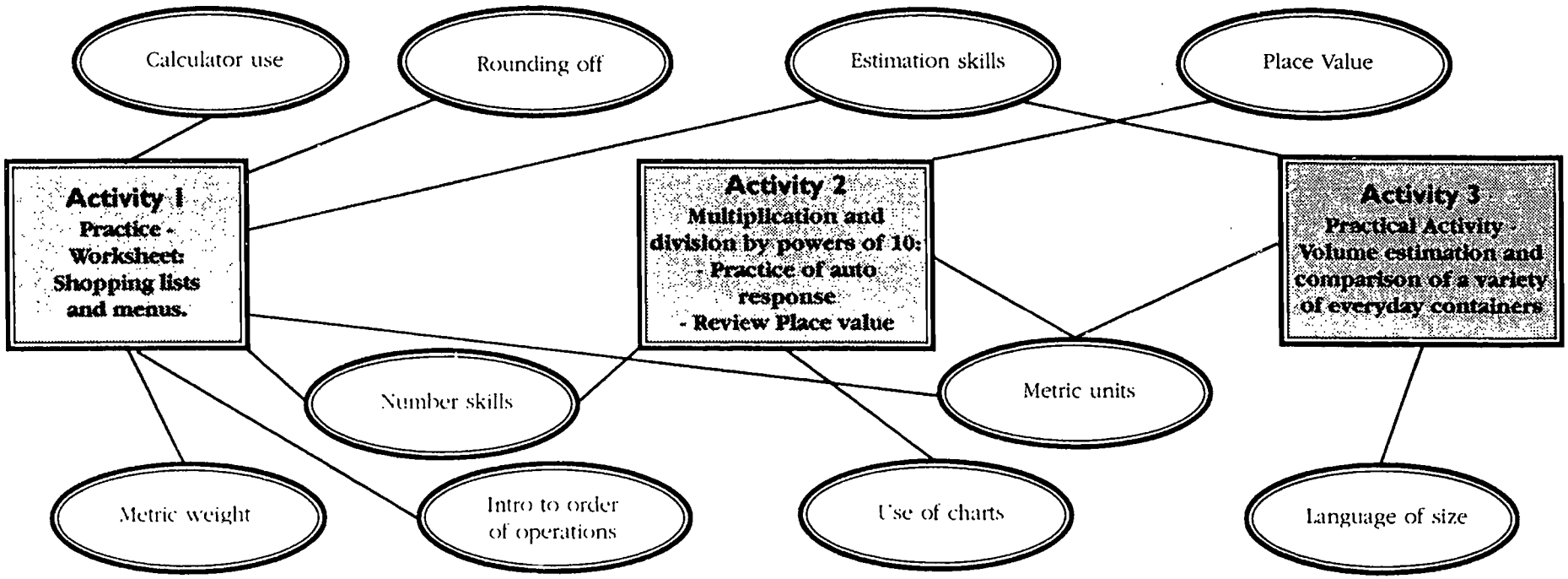
Refs Activities 1 & 2 - *Strength in Numbers* - Money & Metrics. Activity 4 - *Mathematics a New Beginning* p.GS 35

SESSION 10

2.5 hours duration

Aims of this session were to:

1. Introduce the memory function of the calculator.
2. Extend the use of estimation, and rounding off calculations.
3. Introduce strategies for multiplication and division by powers of 10.
4. Provide a practical activity involving the estimation of the capacity of containers in metric units.



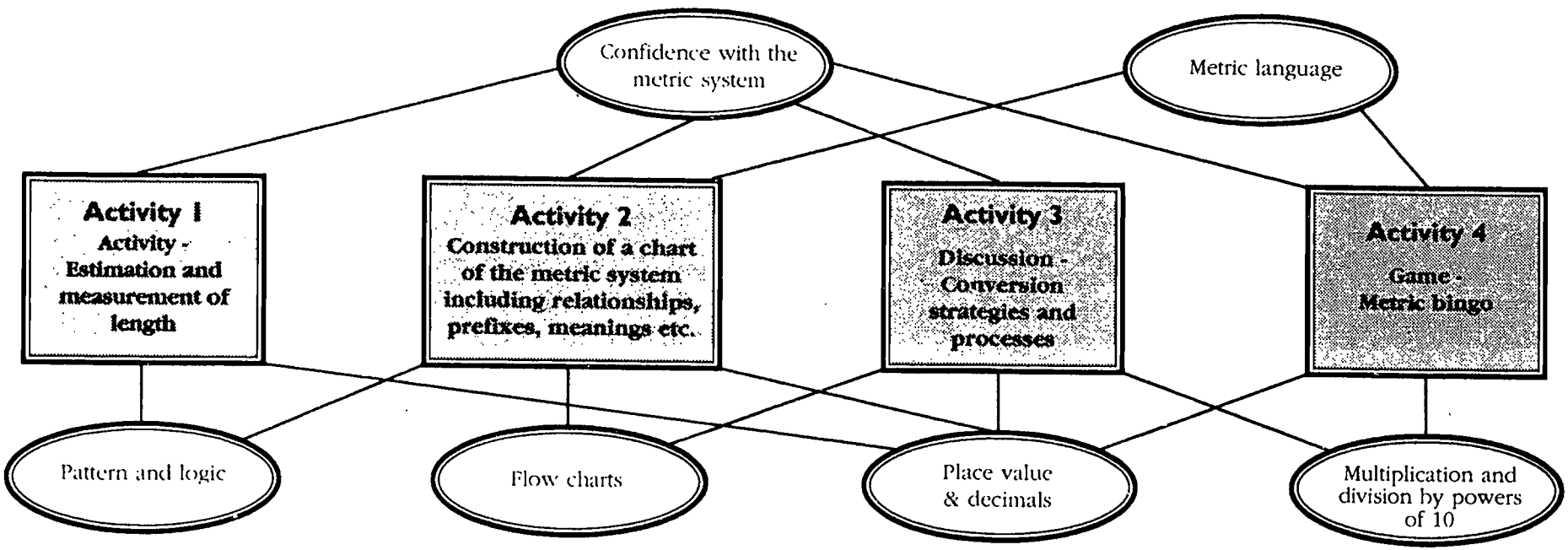
The students understood the principle of rounding off from their everyday lives. An extension of this was to round off to the nearest 10 or 100, or to a fixed number of decimal places. The activity on the capacity of various containers stimulated lots of discussion including advertising techniques and the strategies manufacturers use to disguise the capacity of a container. This was an excellent language activity and was also a challenge to those students who had a good understanding of the metric system. Refs: *Activity 3 - Maths: A New Beginning* p. M23-25

SESSION 11

2.5 hours duration

Aims of this session were to:

1. Review the metric system
2. Provide practice in converting one metric unit to another.
3. Continue the development of estimation skills in calculations and measurement.
4. Consolidate students' confidence in assessing the 'correctness' of an answer.



The students really lacked confidence when converting metric units so we spent a considerable amount of time on this. We worked through the system and its patterns many times. Giving each student strategies they could use was vital. They were each confused by slightly different parts of the process. The more concrete examples used the better, especially where a measurement was taken in one unit of measurement and then converted to a different unit. In activity 1 physical objects, those mentioned in Activity 2 (session 4) could be re-used and extended with the volume shapes from the previous session.

RELATIONSHIP TO THE COMPETENCY STATEMENTS

■ SESSIONS 8 TO 11

The focus of these three sessions is largely on developing measurement skills at Level 2, ranging from personal measurements and estimation, to carrying out metric conversions.

Elements 2.1 and 2.4 are also developed using charts, grids and graphs. Element 2.2 is integrated when looking at patterns in the use of metric prefixes and using the emerging pattern of zeros to teach multiplication and division by 10s, 100s etc.

COMPETENCY LEVEL 2

CGE for Adults p89, 90

The student can use and analyse everyday data, relation and pattern, number, measurement and shape.

Elements

2.1 Interpret data and organise it into tables and charts

2.2 Develop and use data, number, measurement and shape relationships

2.3 Use natural number and common fraction/decimal fraction/ percentage equivalents

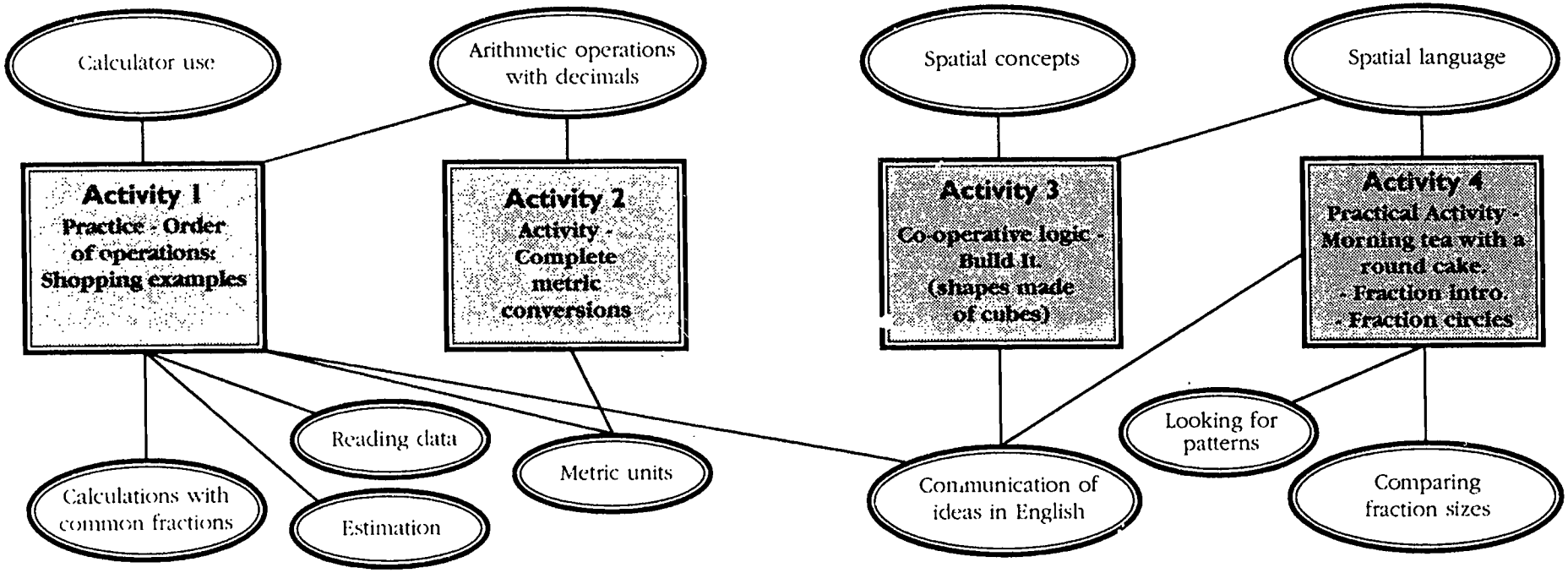
2.4 Use estimation and calculation with shape and direction

SESSION 12

2.5 hours duration

Aims of this session were to:

1. Provide continued practice at metric conversions.
2. Practise problem solving strategies.
3. Introduce the use of the correct 'order of operations' including applications to calculator use.
4. Allow for concrete exploration of fraction concepts.



This lesson was the final consolidation of the metric conversion processes. All the students had greatly improved in this area. This topic also supported work we had done on estimation and strengthened students' use of multiplication and division by powers of 10. Fractions had been one of the areas the students had expressed concern about, and introducing it with food was a great ice-breaker. The introduction to order of operations using shopping examples was intended to draw upon the students' own automatic skills in the handling of money. In the case of buying multiples of one item it is instinctive that the multiplication is done before adding on further items of a different price. An important aspect of order of operations is that students understand it is a part of all calculations and not simply an isolated issue in this lesson.

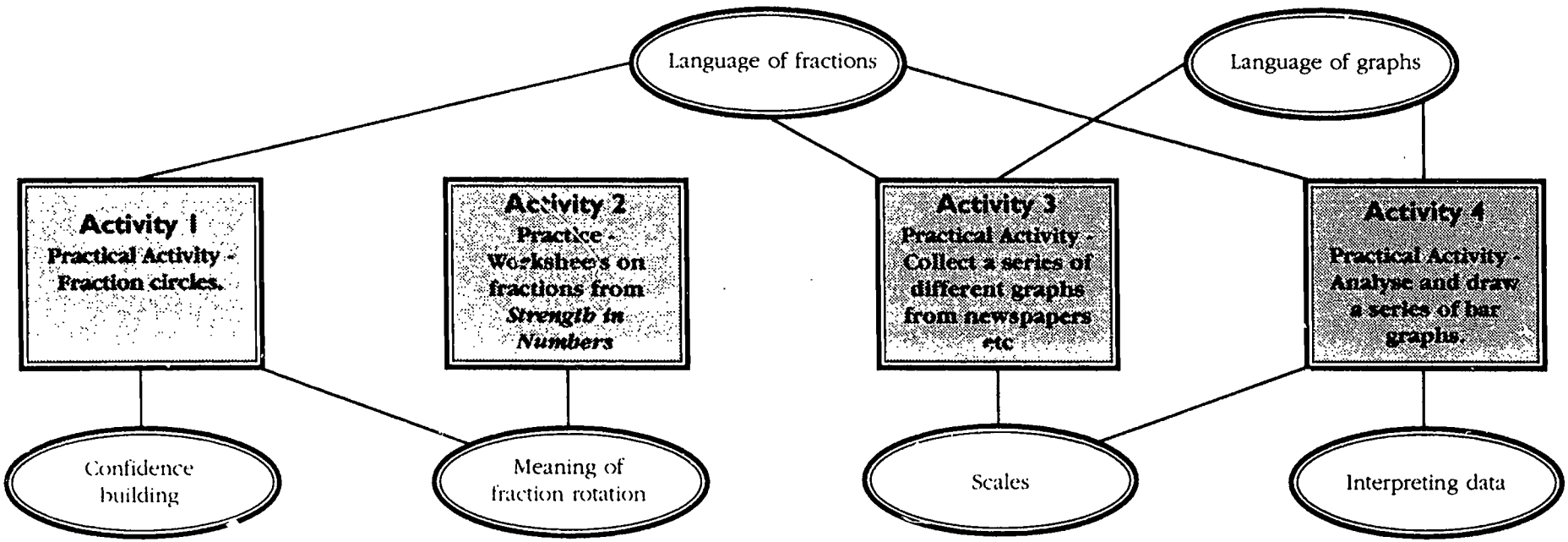
Refs: *Mathematics: A New Beginning*

SESSION 13

2.5 hours duration

Aims of this session were to:

1. Extend fraction concepts using fraction circles.
2. Introduce graphing as a way of presenting data.
3. Revise bar graphs by looking at examples from the media and by drawing class examples.
4. Provide practice in the use of fraction concepts.



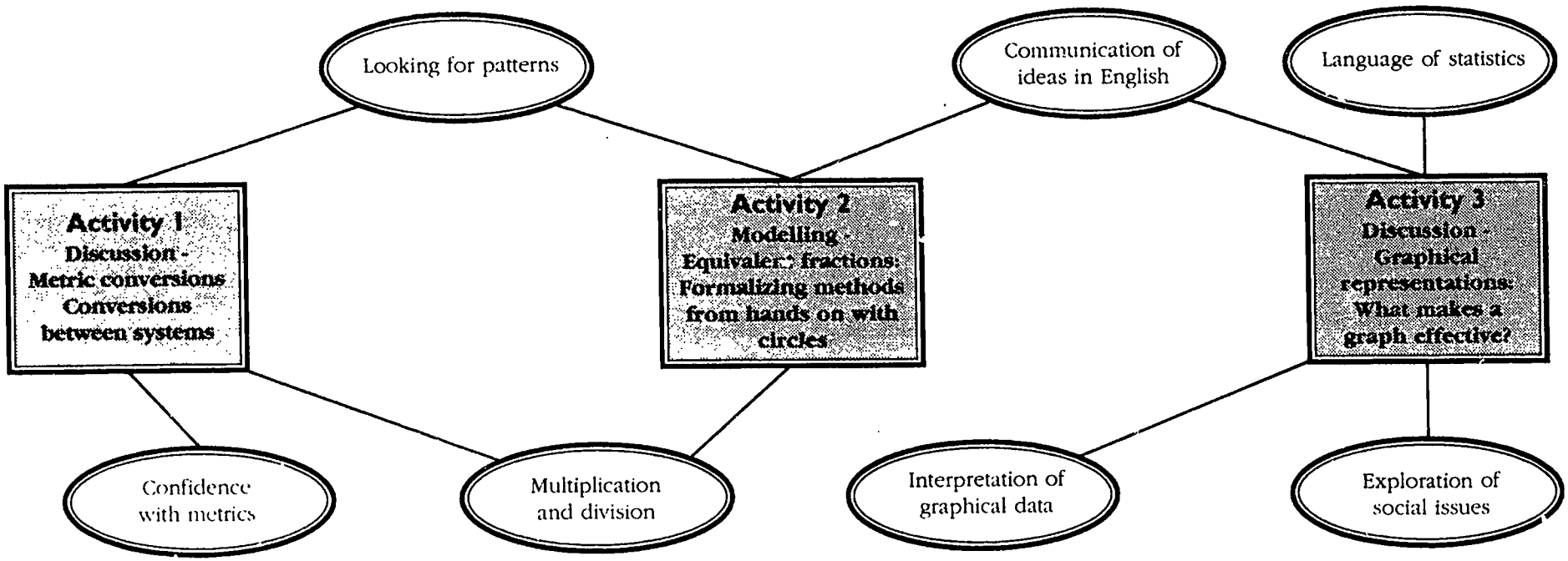
The use of concrete aids for fractions was vital for these students, the type of examples used e.g. measurements within cooking, time in the worksheets and measuring allowed the confidence of the group to build up. The initial fraction examples used were ½, ⅓, ¼ which are both simple and familiar. There was a great need to build up the language around fractions. The fraction worksheets in *Strength in Numbers* provide a wide range for students of differing abilities. The graphing activity was to continue building the group's skills with graphs because the workplace required the students to be able to draw line graphs and to read the trends they showed. This required an extensive review of graphs. A huge number of graphing examples are available in the media so I took a variety of newspapers and magazines into class and got the students to look for the graphs. They initiated a lot of discussion about issues and the effectiveness of graphs. In this lesson the focus was on bar graphs but many other graphs were classified by type. The range of students' experience with fractions was diverse. This was accommodated for by allowing them to progress at their own rate through the materials in *Strength in Numbers* while extension work was possible for other by using the materials in *Mathematics: A New Beginning*

SESSION 14

2.5 hours duration

Aims of this session were to:

1. Review metric conversions and some imperial to metric relationships.
2. Introduce and compare equivalent fractions.
3. Discuss the graphs collected by students in terms of information presented, effectiveness and accuracy of the graphs.



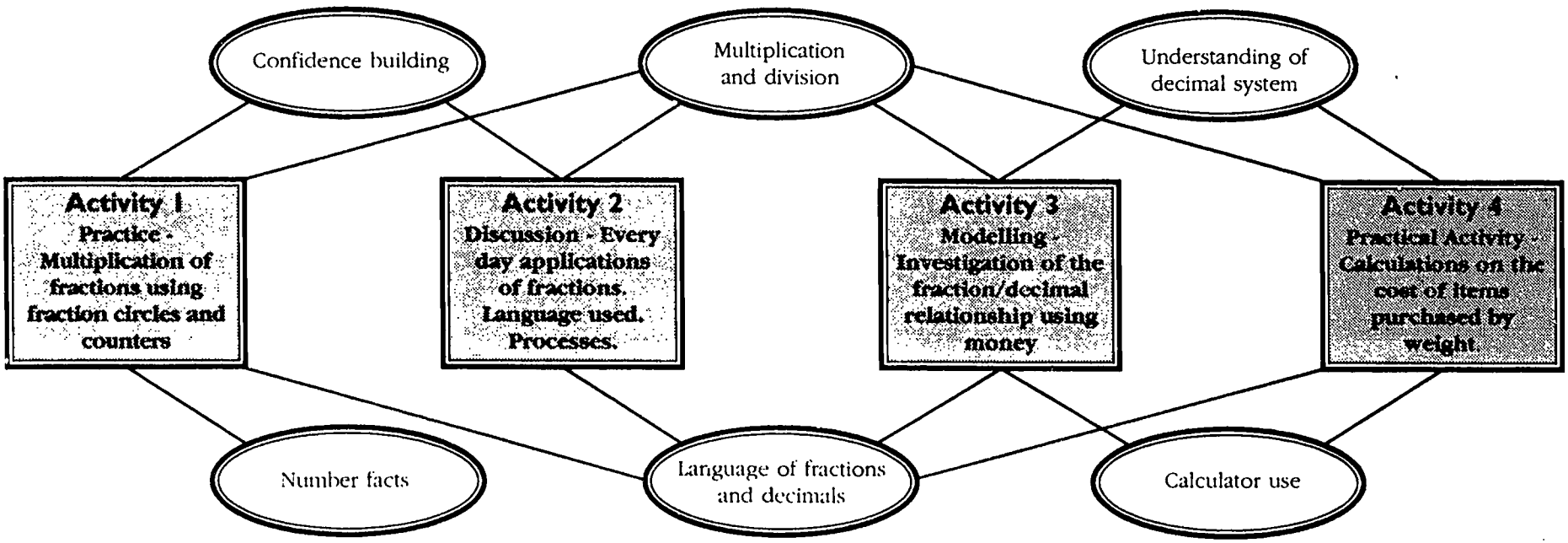
The students collected a number of different graphs from magazines and newspapers over the week. They found some excellent examples which led to a good discussion on the effectiveness of graphs and scales. A group of students wanted to return to metric conversions and to explore some metric and imperial relationships. Common equivalents such as 1kg roughly equalling 2.2 lbs. were discussed. Equivalent fractions work in activity 2 varied considerably from student to student. Some students concentrated on common fractions while others progressed to adding and subtracting fractions from *Mathematics: A New Beginning*.

SESSION 15

2.5 hours duration

Aims of this session were to:

1. Use hands on material to investigate the concepts of fractions of whole numbers e.g. ¼ of 12 and multiplication of fractions.
2. Introduce calculations of the above type using both written and oral questions.
3. Examine decimal and fraction equivalents.
4. Look at ways of calculating the cost of an item in light of fraction decimal equivalents e.g. ½ kg costs the price divided by 2. This is the same as 0.5kg costs the price per kg x 0.5.



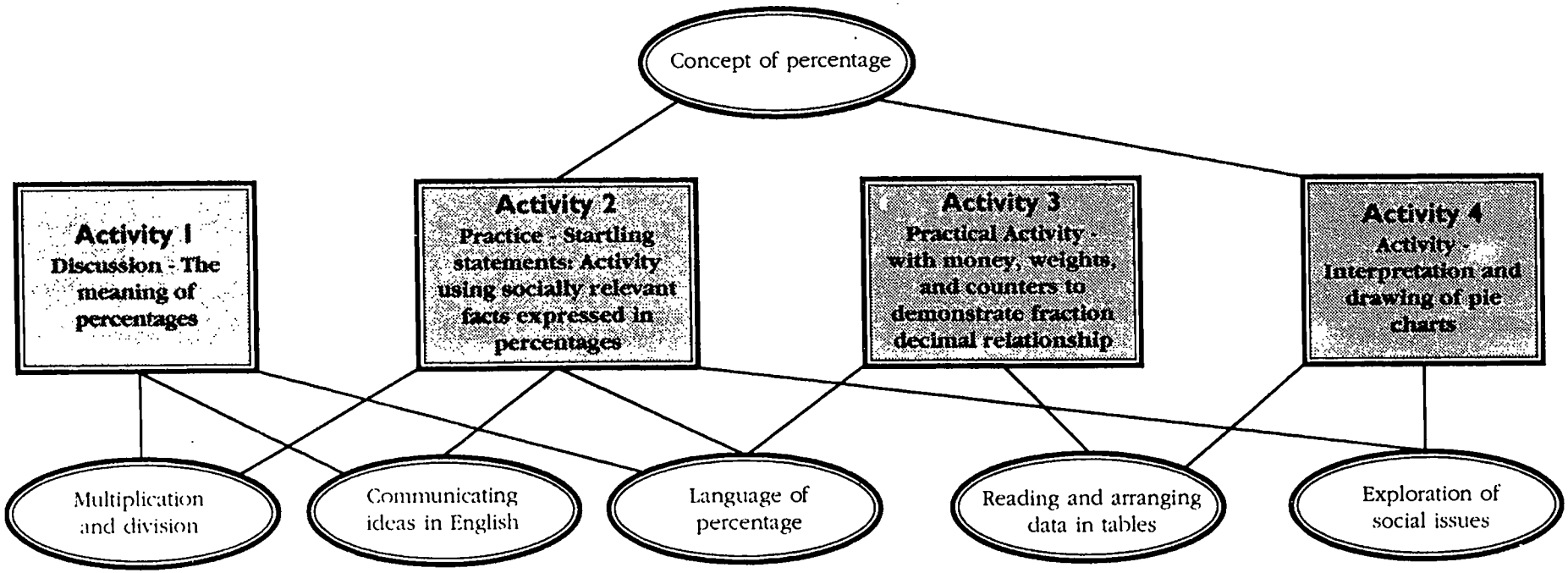
A thorough discussion on each of the above areas helped to convince the students that they already had skills and that many of them carried them out automatically. The ideas were made clearer and easier by progressing from the familiar idea of half of a whole number to something like three quarters of a whole. A fraction of a fraction was also introduced but with only very specific examples using common fractions e.g. half of a half, half of a quarter. Decimal and fraction equivalents were also introduced using familiar money situations such as half a dollar is 50 cents or 0.5, a quarter is 0.25 etc. Calculations of costs were taken from *Headway Maths 4* p.10-11.

SESSION 16

2.5 hours duration

Aims of this session were to:

1. Introduce the concept and meaning of percentage.
2. Investigate fractions, decimals and percentage relationships using familiar and practical situations.
3. Introduce pie charts by looking at some examples and by students drawing their own using calibrated circles (angle calculations not needed).



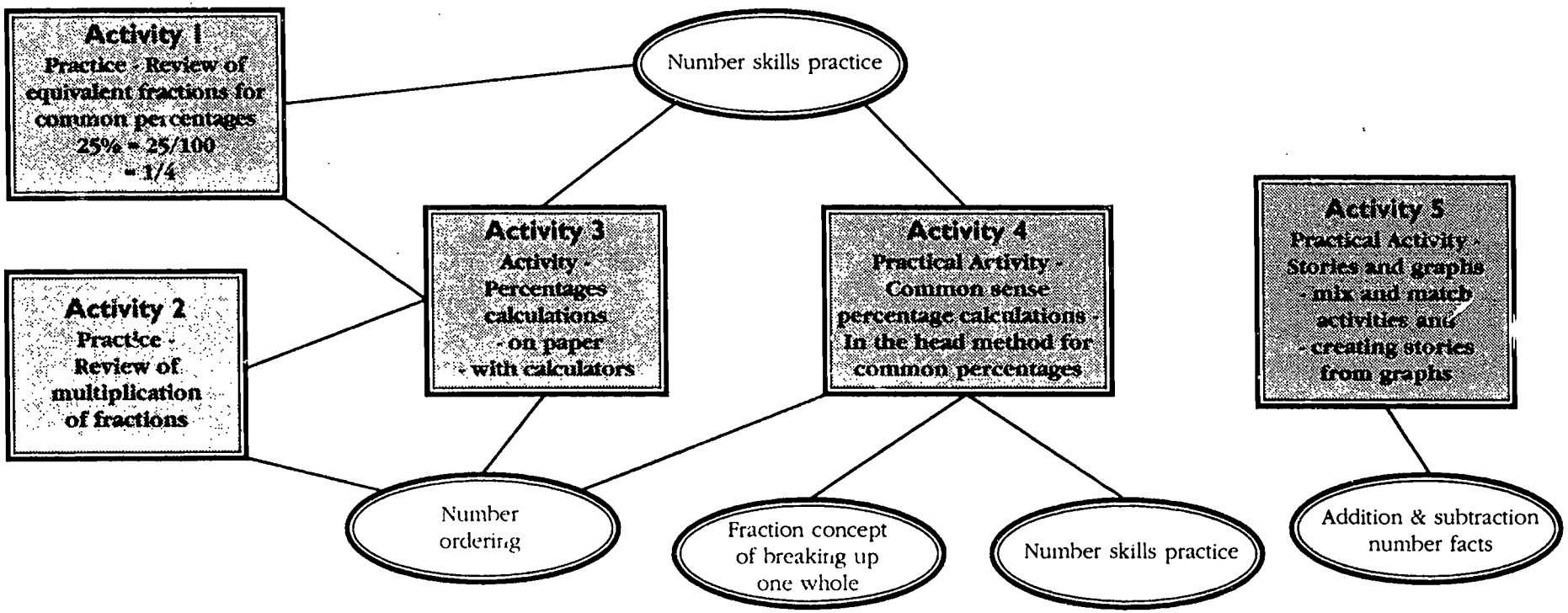
Many of the students had an understanding of percentages as being 'out of 100' and could make some approximations. These strengths were reinforced to build foundations for exact calculations in later sessions. The examples used were simple and familiar fractions such as 1/2, 1/4, 1/5, 1/10 where the students were able to see both the decimal and percentage relationships. Hands on materials were used to make the connections, students were asked questions like: give half of the counters away, and give 50% away, etc. We started using 100 items and then varying amounts. A data chart was made to show the relationships

SESSION 17

2.5 hours duration

Aims of this session were to:

1. Introduce the calculation of percentages: informal as 'in the head'; on paper; and with calculators.
2. Examine and discuss line graphs and their meanings.



An ability to interpret and draw line graphs is necessary for these students. Being able to understand that the shape of the line means something is an important issue. The reading of various axes is important for the interpretation necessary for graphs. The graphs used in the work-place are quite sophisticated data charts with decimal scales. The percentages were calculations the students felt were important to learn, they knew that there were many applications of percentages in their everyday lives as well as at work. The activity on common sense percentage calculations related to examples like 10%, 20 %, 25%, 50% and 75% to try to encourage students to make these calculations without a calculator or pen and paper.

RELATIONSHIP TO THE COMPETENCY STATEMENTS

■ SESSIONS 12 TO 17

These sessions combine the development of several elements. Particular focus is on element 2.3 because of the introduction of fractions/fraction-decimal relationships and percentage concepts, combined with the graphical aspects of element 2.1.

The Measurement and Space and Shape strands are integrated into these sessions in the context of calculations and problem solving. Element 2.2 is reinforced in the analysis of costs of quantities using rates such as price per kg.

No formal assessment was used in this course but at this stage of the course assessment tasks combining many of the aspects covered would be appropriate to determine a Level 2 competence.

COMPETENCY LEVEL 2

CGE for Adults p 89, 90

The student can use and analyse everyday data, relation and pattern, number, measurement and shape.

Elements

2.1 Interpret data and organise it into tables and charts

2.2 Develop and use data, number, measurement and shape relationships

2.3 Use natural number and common fraction/decimal fraction/ percentage equivalents

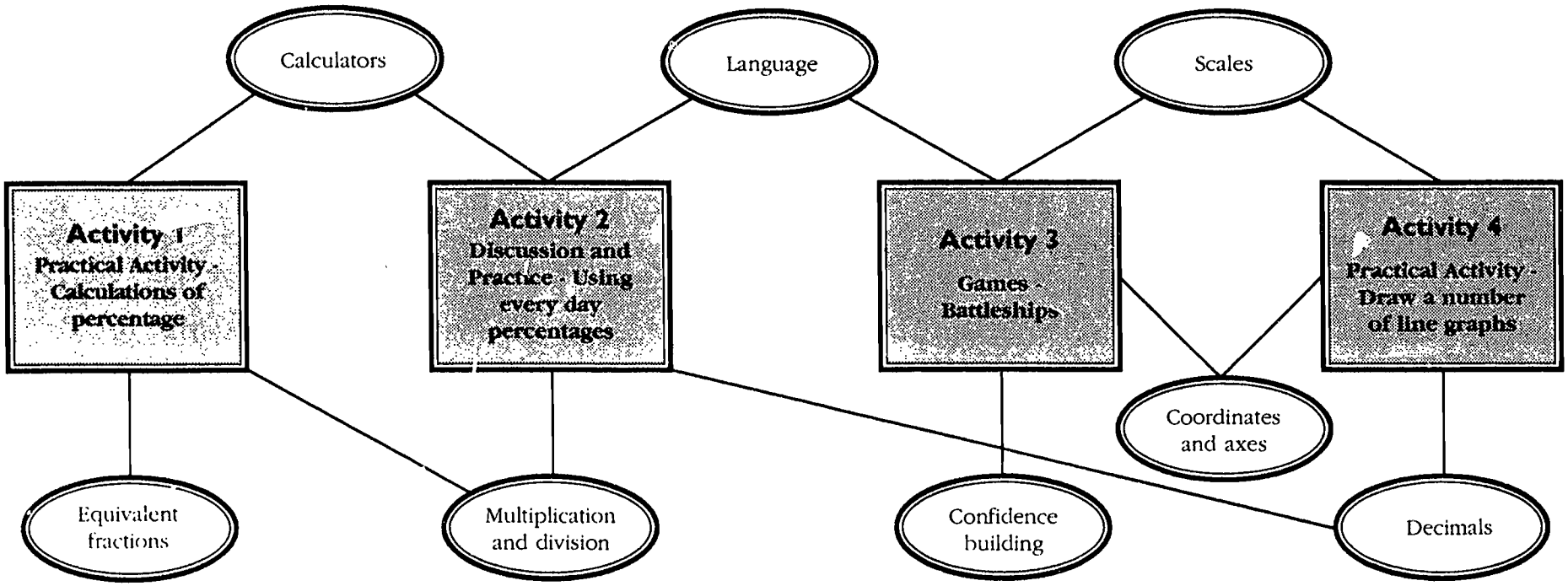
2.4 Use estimation and calculation with shape and direction

SESSION 18

2.5 hours duration

Aims of this session were to:

1. Continue students' calculation of percentage, to include expressing fractions as a percentage.
2. Discuss the many applications of percentages, e.g. tax, super, leave loading etc.
3. Provide practice drawing of line graphs for work and other familiar situations.



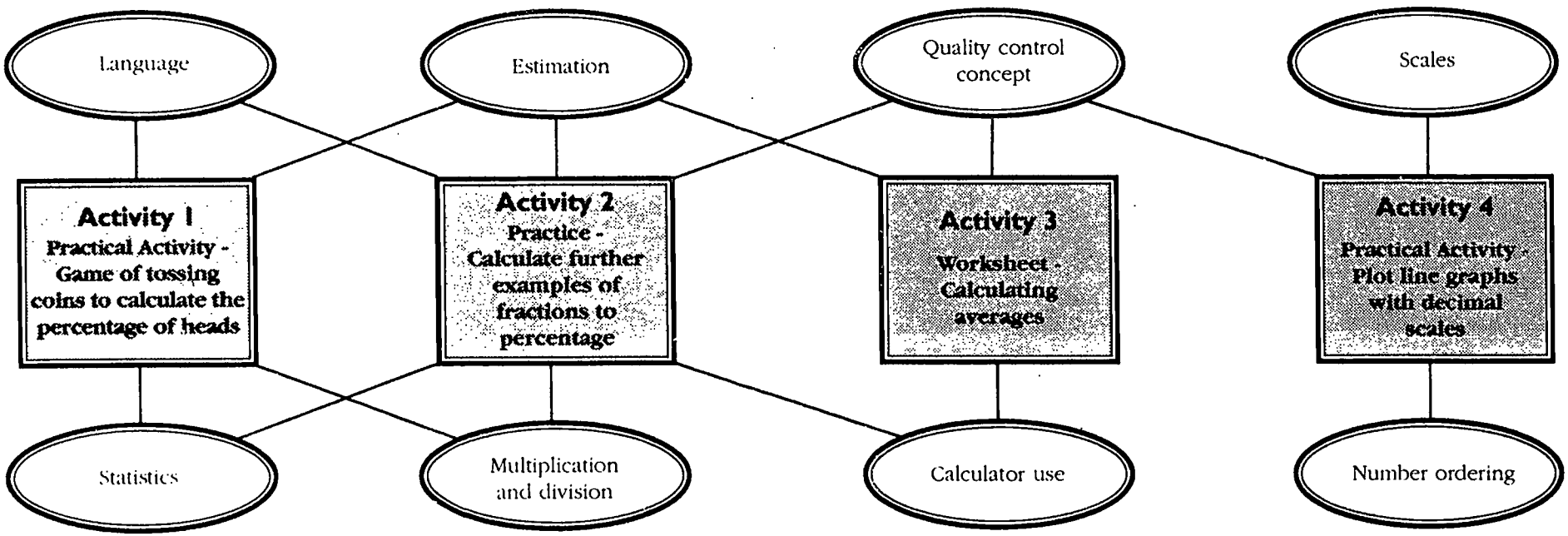
We concentrated on every day and work-place percentages as the industry is interested in percentage increase of productivity, rejects etc. and the students wanted clarification of these issues. We also continued working with and without calculators to reinforce all of the fraction, decimal and percentage relationships. We plotted a variety of line graphs related to weather conditions and monthly road accident statistics, video rental statistics and practical examples using the extension of a spring with weights attached. The students had to record the data as well as plot it. We also plotted the students' scores on subsequent throws of a pair of dice. These students need to develop an understanding of trends in graphs and do not need to concentrate on relationships a graph may show.

SESSION 19

2.5 hours duration

Aims of this session were to:

1. Discuss the quality control applications of graphing.
2. Calculating averages and expressing them in terms of x.
3. Introduce quality control graphs, line graphs with upper and lower limits, and provide practical plotting practice.
4. Practise and reinforce the students' skills at converting fractions to percentages and relate it to work applications, e.g. percentage of rejects.



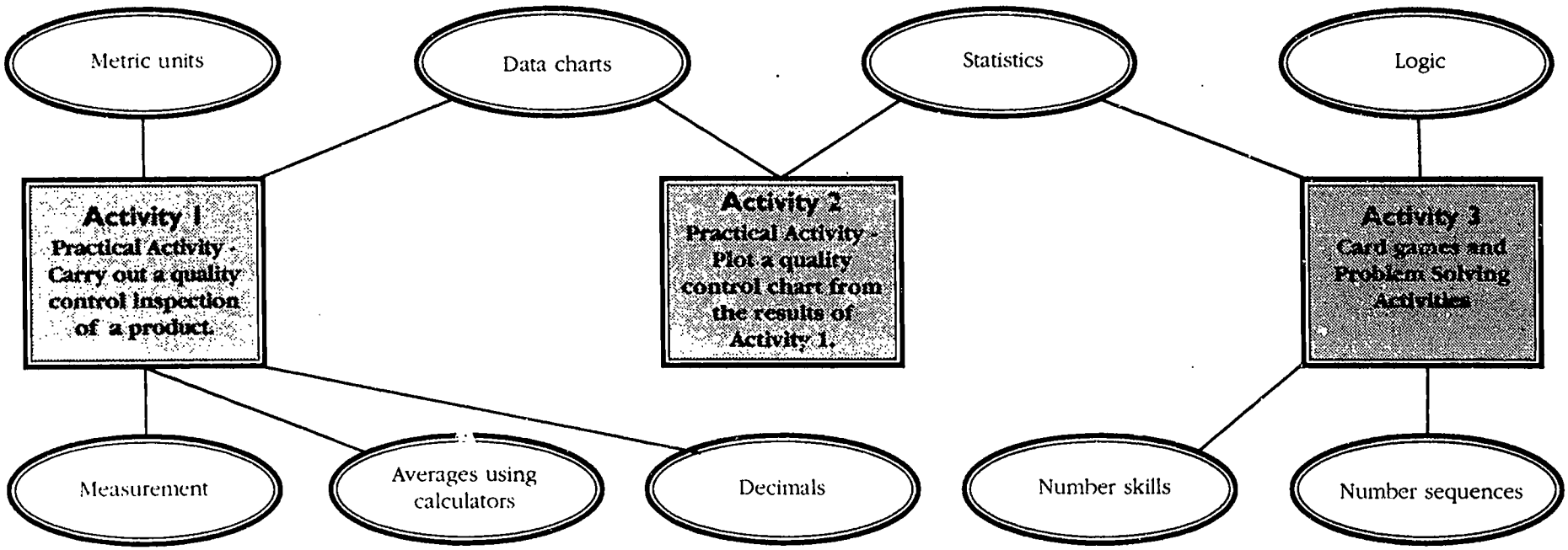
This lesson brought together many of the company's needs in mathematics and enabled the group to focus on many of the tasks we had carried out earlier and their relationship to work. The students were confident in drawing the graphs and describing the trends. We spent a lot of time discussing quality control and its implications for the company and themselves. In activity 1 students had a number of coins which they threw and were asked to work out the percentage of heads. Over the activity the numbers of coins used by the group was changed. This activity was good for converting fractions to percentages. This activity was then related to percentage faults and averages, both of which workers need to understand.

SESSION 20

2.5 hours duration

Aims of this session were to:

1. Review any work requested by students that had been previously covered during the course.
2. Practise using micrometers to measure the thickness of a variety of the company's products.
3. Consolidate skills at plotting line graphs and quality control charts.
4. Review past topics using games.



This lesson involved the completion of the quality control process using a completely practical experience and making the corresponding quality control chart. The students felt they needed to go over some of the metric measurement work as well as percentages. However, to make this last lesson a positive experience for the students we used games and problem solving activities to re-visit topics. The students were amazed at the amount of new knowledge and skills they were now using which reinforced how much they had gained from previous classes.

RELATIONSHIP TO THE COMPETENCY STATEMENTS

■ SESSIONS 18 TO 20

As well as further reinforcing all elements of Level 2, these sessions introduce some statistical concepts and procedures which are part of 3.1.

COMPETENCY LEVEL 2
CGE for Adults p89, 90

The student can use and analyse everyday data, relation and pattern, number, measurement and shape.

Elements

2.1 Interpret data and organise it into tables and charts

2.2 Develop and use data, number, measurement and shape relationships

2.3 Use natural number and common fraction/decimal fraction/ percentage equivalents

2.4 Use estimation and calculation with shape and direction

COMPETENCY LEVEL 3

The student can use and analyse and adapt a range of everyday and some complex data, relation and pattern, number, measurement and shape.

Element

3.1 Interpret, organise and analyse data

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Numeracy by Telematics

LEVEL 2

This is a distance mode course connecting two country centres.

It was conducted by
Charlton Adult Literacy Group, Vic.

Teacher and Program designer:
Kath Morton

■ BACKGROUND

Flexible modes of delivery, in particular, audio conferencing and audio-graphics, have made possible interactive tuition between students in two or more locations. This means classes can be offered to students who live in small communities where previously they were unavailable because enrolment numbers were insufficient to meet minimum requirements for funding. These arrangements also benefit those with other barriers to participation, such as disability or family commitments. Cost of travel to participants can also be a barrier.

In Charlton and Wedderburn, two small country towns in the Loddon Mallee region, small student numbers meant that ALBE group provision in numeracy was not viable separately at either centre. The creative solution – two small groups of students were linked by telematics (audiographics) to make one viable group. The teacher, Kath Morton, was based at Charlton with one group of students, while the other students at Wedderburn had the support of Rosemary, a trained literacy tutor.

The emphasis in this document is on a Maths class conducted in 1992. In 1993 a basic Numeracy class is being conducted by audioconferencing, backed up by fax machines. Students are linked up from four locations - Pyramid Hill, Maryborough, Wedderburn, and Charlton. There will also be some references to this Maths On The Line program in this document.

■ THE MECHANICS OF THE TELEMATICS DELIVERY

Audio conferencing joins two or more locations into a common telephone network which lasts for the duration of a particular session or event.

Audiographics (or audiographic conferencing) occurs when the telephone link is enhanced by the addition of a computer link. In the Charlton-Wedderburn program the on-line costs for the audiographic of telematics links were equivalent to the cost of two local calls for the duration of the lesson.

Max-Fac Audio facilities located at the Charlton and Wedderburn Secondary Colleges were used for the programme.

A duct system (a loud speaker with hand-held microphones for participants) facilitated the audio link.

Macintosh computer, linked via modems and using electronic classroom software, created an interactive whiteboard. The teacher could prepare in advance some 'screens' under a 'Prepare a Lesson' menu. These could be questions to be worked on, diagrams to assist in the lesson, or activities which the students would do during the lesson. After preparation, they would be stored on disk, and called up as required during the lesson.

Fax (Facsimile) machines were used to transmit hard copy.

■ SETTING UP THE CHARLTON - WEDDERBURN PROGRAM

Staff Development

Kath had attended a two and a half day DEBIT (Distance Education By Interactive Telematics) conference some months earlier. In preparation for this class, Kath, the Wedderburn tutor, and the students participated in two local training days at Wedderburn. The initial training sessions combined with Kath's energy and enthusiasm to make a success of teaching adults using a different medium. Kath found a useful resource in the Telematics Manual (Ministry of Education and Training) by Neil Elliot. She adapted the format suggested in the manual and designed a 'Proposed Weekly Lesson Procedure' which was posted in a prominent place at each class site. Students were also given a copy.

Advertising

Advertising was done through the local ALBE (Adult Literacy and Basic Education) structure: local groups; regional newsletter; local Learning Centre; and Neighbourhood Houses; using letterboxing, posters in shop windows and on Community notice boards; also through the local primary schools via their newsletters.

Group Profile

The group was all female, between the ages of thirty and late fifties; one woman had a mild intellectual disability. Some had 'missed out' on maths during their school days, others had interrupted schooling. Some of the students had left school very early, for a variety of reasons. One woman joined the group because she had commenced a TAFE course in Book-keeping and realised the need to brush up on her maths skills.

■ NEGOTIATING THE CURRICULUM

Relationship to the Competency Statements

The original course plan was drawn up after the initial, face to face, meeting of all the students. This meeting began with an activity designed to encourage students to discuss their feelings about maths, share their past experiences and problems and identify skills which they felt needed improving. Because students in this group were not very forthcoming with the latter, teacher prompts were necessary. Questions such as: ***Can you use a calculator? How do you feel about fractions?*** encouraged further discussion and requests.

From the conversations it appeared that the skills the group were interested in were all at Level 1 or 2 of the maths competencies (CGE for Adults pp 87 - 90). Trying to include each of the elements of the maths competencies into the initial plan meant including : estimations in height and length of familiar objects, measurements of domestic items, and use of comparative language to describe these lengths *(elements 1.4 use personal referents in measurement, p.88, 2.4 use estimation and calculation with shape and direction, p.90)*; recognising common fractions such as a half, a third, or a quarter as they appeared in domestic situations *(element 1.3 use everyday fractions....p.88)*; practice at

using calculators for the four basic operations *(elements 1.3, 2.3 use natural number..... and practical and everyday decimal fractions pp 88,90)*; preparing and reading simple tables such as transport timetables; and giving directions with the aid of a straightforward map *(element 2.4)*.

It would also be necessary to make sure some problem solving techniques were included throughout the course: discussion of strategies such as 'guess and check', 'acting out the problem', and 'looking for patterns' would be ideal for this group. *(Competency: The student can use and analyse.... relation and pattern.....p89)*

If students are amenable and accepting it is quite easy to include all elements of the competency statements into the outline. If not, then some elements can be woven incidentally into other topics. For example, when students wanted help with budgeting (as did the students in the 'On the Line' group) it was possible to introduce pie charts and bar graphs in order to compare different types of expenses *(element 2.1 interpret data and organize it into tables and charts p.90)*. Students appreciated this type of visual presentation when it was relevant to the subject which interested them.

The theme of shopping was suggested as a useful mechanism to tie together all of the chosen topics. Students agreed readily to this as it was something common to all of them, and a way that skills could be practised regularly.

■ INITIAL PLAN: THEME - SHOPPING

- Use of the calculator
- Common metric units (estimation and use)
- Fractions (common)
- 'In the head' calculations
- Shapes and names
- Problem solving related to shopping
- Giving directions

Negotiation continued throughout the course. Other requests came up and as a group they discussed the issue of adding something. For instance, after working on ***use of the calculator*** and ***common metric units*** one student wanted to learn long division as she had never mastered it at school. Fortunately, everyone agreed so the group proceeded to learn long division. The teacher was aware that this is no longer a relevant skill in the calculator age, the use of rounding off and estimation to back up the use of a calculator being preferable. However, sometimes it is necessary to make compromises to gain student confidence, and in this case the removal of that old block was very important to the student.

■ LESSON FORMAT

With reference to the Telematics Manual a proposed structure or format for each weekly session was designed. This proposed format was posted in a prominent place at each site in addition to each student having their own copy.

Proposed Weekly Lesson Format

1. Greeting and welcome
2. Roll call
3. Administration - notices to students and tutors
4. Introductory activity
5. Homework review

BREAK

6. New work
7. Practice
8. Setting of homework
9. Evaluation - verbal
10. Farewell - sign off, disconnection.

■ WEEKLY LESSON FORMAT - MORE DETAILS

Introductory Activities

These were short activities which students did at the beginning of the session, some as individuals, some as pairs, and occasionally as whole on-site groups.

After everyone had worked on the activity, the group discussed it together with students from both sites participating.

An introductory activity

- could be a short memory exercise; on the third week it was numbering the handouts from weeks one and two, and becoming familiar with the 3.1, 3.2 system;
- it could be a revision e.g. on calculator memory several weeks after teaching it;
- sometimes it would be cooperative problem solving - always enjoyed;
- maybe understanding/checking the phone bill, SEC bill, maximum and minimum temperature.

After trying many of these opening activities it seemed that, at this level, those which worked best were practical activities involving pairs such as measuring activities, cutting out fraction shapes, or filling in tables. Perhaps this was because they tended to focus students' attention very quickly on tasks which were manageable and provided feelings of success. These opening activities were selected from across the spectrum of maths so that each element or strand was included:

- *fraction shapes - part of number elements 1.3 and 2.3 (pp. 88 & 90)*
- *tables - part of data element 1.1 and 2.1 (pp. 88 & 90)*
- *measuring activitiees - part of the measturement strand (see Background Works pp. 200,201 or element 2.4 p.90)*
- *other shape puzzles built on the space and shape aspect (Background Works, pp.200,201 or element 1.5 and 2.4 p.89,90)*

■ JOURNAL ENTRY

Kath had heard the use of mathematical journals suggested at a staff development activity and decided to give it a try with this group.

There were two reasons for this. First, she wanted the students to express themselves in words, and for this writing to be done weekly. Secondly she hoped that the exercise of keeping a journal would help boost students' confidence in their existing maths skills.

The journal idea was introduced using this handout:

Journal Writing - for each of us

- Write each week a short article of no more than 100 words about Maths in your life - Maths in this course and outside it, too.
- You could write about noughts and crosses, cooking, craftwork, sport. (Be sure you tell about the Maths involved in your writing);
- or about patterns in nature, (in construction);
- or about your feelings in learning or teaching maths.

Kath and Rosemary both wrote journal entries each week. These provided models to demonstrate their expectations of the students. The entries were all read out during the lesson each week.

Examples of student writings include:

- I took $10 with me to the Coonover Bridge Hall. I paid $4 for lunch, bought a plant for $1.00, a C.W.A. card for 40 cents and 5 cents for 'Penny Friendship'. I had $4.55 left.
- Dad took 20 suckers to the pig market. He got $25 for each one, a total of $500. After paying all the fees he came home with $434.90.
- As the treasurer of our Neighbourhood House I work out our co-ordinator's pay. She works 5 hours per week at $14 per hour plus 23% loading. I do all the calculations.

- We required supper for 60 people for our old-time Musical Evening. We allowed each person 2 sandwiches, 2 sausage rolls, 1 piece of slice and 1 small cake. We used 60 slices of bread, 120 sausage rolls, 5 dozen slices and 5 dozen cakes. We added 3 dozen scones for good measure.

Other examples covered: calculating the amount of carpet needed for a student's floor, working out now many grapefruit needed to cater for a number of people, deciding on the amount of cordial to buy for a Neighbourhood House gathering, calculating how much curtain material was necessary for a particular window, and the costing of petrol for a trip to the city.

■ MATHS DIARY

Midway through the course, to vary the approach, the journal entry became a `Maths Diary' entry. The entries would still describe mathematical tasks that students performed incidentally during the course of their normal daily activities, as with the previous journal entries, but this time they would analyse further what skills were involved. Some examples are shown below.

MATHS DIARY

Task	Maths Skills Involved
Deciding when to leave home to keep an appointment.	Map reading Estimation of distance and speeds Division
Shopping for weekend visitors and preparing food.	Estimation of quantities Estimation of costs Following instructions in recipes Managing time
Packing the family Esky	Counting Choosing appropriate shapes for plastic containers Fitting shapes into Esky
Tiling the kitchen	Measuring Fitting shapes Multiplication,division,addition to work out quantities and costs
Food needs for school holiday bus trip	Estimation of quantities per person Multiplication Estimation of times for travel

Each week all the participants would read their entries, analysing the skills involved. The emphasis was on a clear, logical explanation of how they solved the problem and the sequence of steps taken.

Students managed to do this surprisingly well. Often there were more skills used than individual students realised and these were picked up together at the class. This indicated to me that students were performing at Level 2 Competency in many aspects of their lives and that we could work on the gaps by building on current strengths and setting up situations for sharing students skills and methods with one another. Sometimes it highlighted areas of need so that in future classes the group could concentrate on these skills.

The process proved very helpful in developing the students' mathematical language: verbalising the operations carried out in calculations, keeping to the point, correct use of concepts such as estimation, and speaking and writing the names of common fractions.

One student was unable to express herself in writing at all without help. She could, however, talk about her tasks. By giving her some help between classes she was able to write her own sentences to read out during the lesson.

Sometimes a student's entry would pose a problem for them, and the group would tackle it together.

Activities of this nature assist in modelling the performance criteria of module 2:

- *Recognise that mathematics in involved in the activity.*
- *Identify mathematics for use.*

They develop a consciousness that maths is involved in everyday activities. In turn this develops students' confidence in their ability to learn even more mathematics. CGE for Adults p.90.

■ SOME SUCCESSFUL LESSONS

Metric Length

A lesson that worked well was becoming familiar with metric length. (Most students had grown up in 'pre-metric' days). Kath had prepared screens with questions - students had brought tape measures. They worked in pairs, at each site, and when the measurements were all taken, together the students completed the prepared table .

OUR MEASUREMENTS

Name	Stride	Height	Arm span	Foot length	Hand span
Margaret					
Rosemary					
Bonnie					
Jill					
Pam					
Kath					
Georgina					

After assembling that data students were given questions to answer individually. These were on a prepared screen (see below) and were adapted from ***Strength In Numbers*** page GS 39.

Working towards: element 1.4 - use personal referents in measure ment; and element 2.1 - interpret data and organize it into tables and charts; element 1.3 use of natural number. CGE for Adults pp. 88-90.

Prepared screen:

1. What is the difference in height between the tallest and the shortest person?
2. How far would we stretch if we all lay head to foot on the floor in a line?
3. What measurement is 10 cms greater than your height?
4. How much longer is Rosemary's stride than Pam's?
5. If everyone stood side by side with arms outstretched, how far would we stretch?

Weight and Volume

Similar activities were done with **mass** and **volume**. First, estimating, then measuring accurately using common measuring equipment. Containers such as milk cartons, ice cream tubs, (written volumes covered over with white out or sticky paper) can be compared by filling with liquid and then using a measuring jug for actual accurate volume measurement.

This may sound difficult, coordinating two sites. However, with an enthusiastic, cooperative leader at the second site and as long as commonly available products and containers are agreed upon, it should be quite simple.

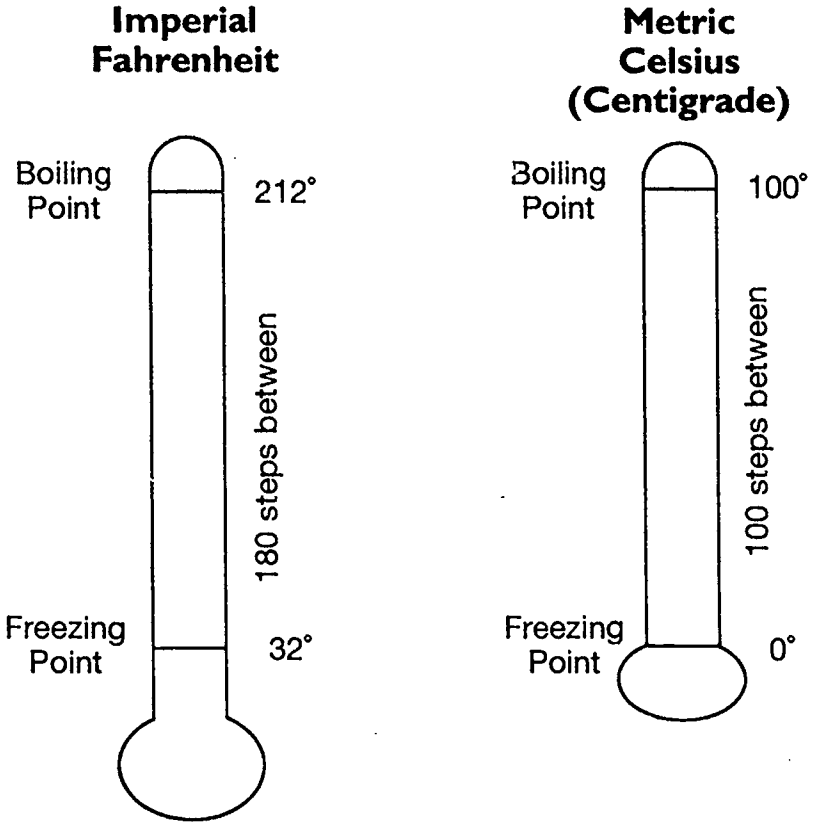
Working towards measurement level 2 - see background works p.201 of the CGE for Adults Document.

Temperatures

Following discussion on winter temperatures one student requested an explanation of the connection between Celsius and Fahrenheit. The diagrams below were used to help her understand the link. Calculators were then used to practise conversions.

Integrating measurement at level 2, number at level 2 and relationship in measurement (element 2.2 develop and use data, number, measurement and shape relationships) CGE for Adults p.90.

A student for whom this was too difficult worked on basic shopping exercises from **Strength In Numbers** page MM 13.



To convert from Fahrenheit to Celsius: subtract 32 then calculate five ninths $\left\{ \times \frac{5}{9} \right\}$	To convert from Celsius to Fahrenheit: calculate nine fifths $\left\{ \times \frac{9}{5} \right\}$ then add 32

Fractions

When it came to fractions (common) several circles were sent to the students to cut - they then worked out the best way of getting ½ and what the '2' stood for, and the '1' etc. Kath found a lot of the fraction material in *Strength in Numbers* helpful and suitable, and the more advanced pupils enjoyed fraction problems from Maths A New Beginning – either done individually, or as a group.

Developing element 2.3 - common fraction/decimal fraction/percentage equivalents. CGE for Adults p.90.

Percentages

Percentages had not initially been listed as a topic, but the class moved on to it from fractions, as it became clear that in everyday life percentages presented some difficulty. Some of the students could manage common, whole number percentages, but once 12 ½% or 33 ⅓% were introduced there was difficulty.

Further developing element 2.3 - common fraction/decimal fraction/ percentage equivalents, CGE for Adults p.90.

Giving Directions

As part of the course, the teacher brought her students together for a face to face class mid-term. She prepared a plan and written directions to locate the venue which she sent to the students before the class. One of the students had trouble following the instructions and thought the map was not really clear enough. This provided an excellent opportunity for discussion during the class. All of the students assessed the teacher's instructions and discussed suitable language to use. Then for the following week's homework the students prepared a plan and written directions to find their homes.

Strengthening element 2.4 - Use estimation and calculation with space and direction, CGE for Adults p.90.

■ SPECIFIC ASPECTS OF TELEMATICS DELIVERY

Establishing a rapport

The lack of face-to-face contact in a telematics class means that establishing a rapport between the teacher and the students who are remote from each other is a challenge. Face-to-face meetings occurred prior to the commencement of this program for the two initial training days. In retrospect Kath felt that she could have made more use of these days. Some ice-breaker activities and discussion of student goals would have been useful in assisting to establish rapport. At the end of the program the group met for a maths 'party' - games and supper. Another face-to-face gathering mid-way through the program would also have been useful.

Strategies to Encourage Interaction

In telematics classes when students cannot see each other it can be difficult for them to grasp the concept of belonging to the larger group and spontaneous interaction between group members will not happen readily. In this class situation the students responded well to the others at their site but needed encouragement to interact with those at the remote site. This was compounded by the fact that there were insufficient microphones and so people shared.

Kath found that she had to take a lot of care with her questioning techniques and that students usually had to be addressed by name before they would respond.

Technical Problems

One difficulty in using a Duct audio system is that the loudest sound takes the line so that this was rather limiting when students were involved in animated discussions such as during problem solving activities. Kath found this out when she asked the entire group to read together. When students worked in pairs or small groups with students at their site the microphones had to be pushed further away to prevent distractions at the other site. Disconnecting whilst doing activities was definitely not considered, because of the difficulties entailed in regaining connections.

There were times when the computer link could not be made. This meant that Kath needed to be very flexible with her lesson plan. Often valuable class time was taken in trying to make the link and students would voluntarily forego their break to make up the lost class time. If Kath planned to use prepared screens during the lesson and the link was not made this posed another problem. Had the facsimile machines been accessible during class time it would have been easier to improvise.

Access to Facilities and Equipment

While the local schools provided access to appropriate equipment there were some problems associated with using school facilities after normal school hours. Some of the problems were:

- the telematics expert from the school staff was often not available to assist when there were technical difficulties
- facsimile machines were not easily accessible
- heating/cooling was not operating.

Working Without Visuals

One little hint received in training was for the teacher. In preparing instruction for activities, or in other preparation, close your eyes and realise the dependence the students would have on the spoken word. Kath found this helpful, especially in the early days when she found herself at her site, using 'face to face' communication as well as oral, and therefore putting those

students who were sitting with her at an advantage. That difficulty was not hard for Kath to overcome, but the students at both sites found problems with it, and seemed to relate more to other students at the same site.

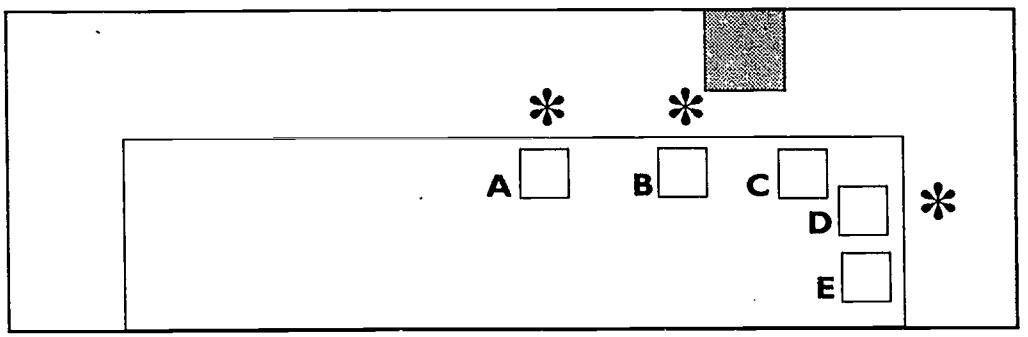
In 1993 with the Maths on Line group this problem disappeared. Kath considers this was due to the increased number of sites and also to having fewer students at each of those four sites. Probably the experience of some continuing students also contributed to the change.

Evaluation

Kath kept a fairly comprehensive evaluation each week for herself. She built in a brief verbal evaluation for the students each week with varied questions. Students ranged in their ability to respond to this, and to assess their own situation. With weekly evaluation Kath had to be careful that the 'success' or otherwise of the technology did not become more important than the teaching and learning.

Room Arrangement

One site was satisfactory, but at the other site began like this



There were no windows in this room, just a skylight.

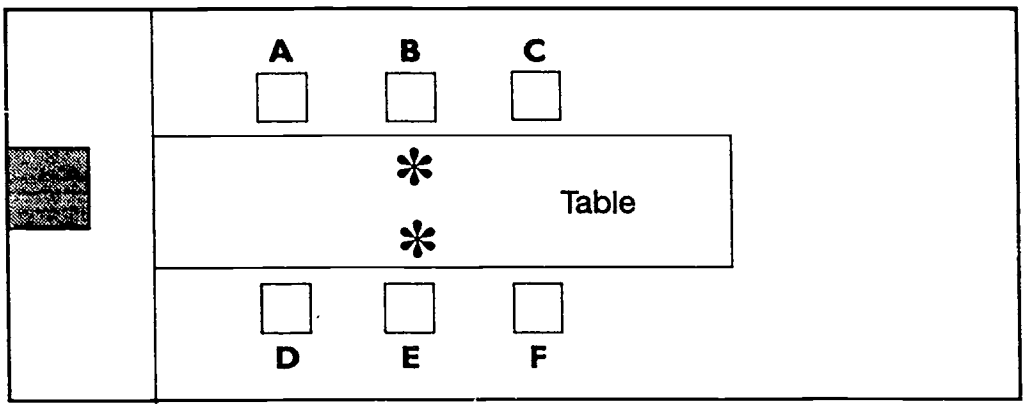
Computer linked to modem. (Fixed position)

Chairs for students

It was difficult for students, A, D, and E to see the screen and work from it.

✻ Microphones for telephone – moveable.

It was difficult to 'engage' the students to the computer screen. Fortunately a new telematics room was set up. It was like this.



This was a much larger room but only had two available microphones which had to be shared.

It was possible to make a T so that each student could see the computer. However, sharing a microphone between two people was sometimes difficult - partly due to students' reluctance to speak into it. Also it seemed that the fact that they faced each other made it 'feel' like an ordinary face to face class at this site, and it became more likely that this group could overlook the students at the second site.

Knowing some of the difficulties students had regarding use of equipment, Kath would get one of the students at her site to call up the other site - although this sounds very simple students put up lots of difficulties and used excuses such as - 'I've got a cold today, I might cough'! and 'I'm not tall enough to reach the phone'! to hide their initial anxiety at having to make the call. However, gradually these fears were overcome and students gained confidence with the equipment.

■ REVIEW

Teaching by flexible delivery is exciting and challenging. It requires good questioning skills, attention to forward planning, and careful lesson preparation. It develops the listening skills of both teacher and students.

Using the computer link has the advantage of an interactive blackboard. However, use of this facility can present difficulties with both the less confident and the over confident student. It assumes basic computer skills, the gaining of which was not one of the goals of the program.

Maths on Line, without the computer link, is accepted by students in their own homes. This has proved an effective learning environment, especially for adults with any negative classroom experiences. Students isolated by distance or disability have the opportunity of group interaction.

Whatever method of group delivery is used, some face to face meetings are essential. Kath found bringing students together at the beginning of the term assisted communication. Subsequent face to face meetings gave an opportunity for informal discussions of any aspects of the program that bothered

students. In the early stages they obviously felt more free to evaluate in the face to face situation than on line.

When students at Level 1 - 2 of the CGE for Adults are participating in flexible delivery it is necessary always to have a support person at each site. This could be a volunteer tutor, or a student with higher level skills. It is also important that all of these support people are present at the first meeting. We found that introducing a tutor after that meeting presented communication difficulties to some students.

Whatever method of delivery is used, the teacher must keep the focus on the contents of the lesson and the processes being used in the learning, rather than on the technology. Technology must always be used as an aid, it should not dominate the learning process.

Return to Study Mathematics Course for Women

LEVEL 2/3

This is Part 1 of the mathematics component of
the Women Into Technology course
which runs at
Northern Metropolitan College of TAFE, Vic.

Teachers and Program Designers:
Penny Halliday and Beth Marr

■ BACKGROUND

This mathematics course was designed as part of the Women Into Technology course at Northern Metropolitan College of TAFE. This is a course which aims to develop women's skills, knowledge and attitudes to a level that will allow them to enter post secondary technology or mathematics/science courses leading to employment. The mathematics component of this course runs for 35 weeks, 7 hours per week and goes from Level 2 to Level 4.

In this document we have written up the first half of this subject as a return to study mathematics course. Although in our implementation it is covered in 1 semester for 7 hours per week, it could equally well be run as a one year long course for 3 or 4 hours per week.

■ GROUP PROFILE

The client group is mature age women seeking to return to the workforce after an absence, mature age women who wish to retrain, younger women who are unemployed, and women of all ages who wish to gain knowledge and skills in a new area for self development.

■ COURSE OBJECTIVES

The course has been designed with the following objectives as guiding principles:

- develop **confidence** in the ability to learn and apply mathematics skills and knowledge taking into account:
  - current levels of achievement
  - past learning experiences
  - present attitudes to mathematics
- develop **mathematics skills and knowledge** at a level and range appropriate to the individual goals and training/further education needs of the student
- develop the ability to **communicate ideas** and problem solving processes using mathematical language both orally and in written form
- **apply mathematical skills** and knowledge to problem solving, investigation and/or modelling activities.

■ SELECTION PROCEDURE

The applicants for the program are asked to attend an interview where their interest in the course, their motivation, and future plans are explored. An important part of the interview has always been to discuss the implications of full-time study and how it fits with their present commitments.

The Return to Study program attracts women with a wide variety of experiences with formal study and with mathematics and science. Correct placement of students is vital to their long term success: entry into a course which is at too high a level, or conversely starts at too low a level, does not serve the best interest of the student. Over the past few years it has become apparent that selecting students purely on the basis of interview is not sufficient to ensure their correct placement. Consequently, a series of maths tasks is now included as part of the interview. These tasks are carried out in an informal way and use contexts familiar to the women. Basic number skills are checked using items in a supermarket catalogue. This allows for discussion to take place about the interviewee's confidence and ability with number. Basic fraction concepts are also assessed, e.g. students are asked to identify a third of a group of counters, and to divide a circle into sixths and shade a stated portion.

Observing students engage with these tasks allows the assessment of confidence and skill levels. It becomes obvious when a student needs a course at a lower level. This means that students who enter the course have the greatest possible chance of success. Many students re-enter study lacking in confidence and need a positive experience to enable them to reach their full potential. To place them in a course at too high a level risks the likelihood of their yet again experiencing failure and reinforcing negative feelings from past schooling.

■ RELATIONSHIP TO THE COMPETENCY STATEMENTS

Progression of Levels

This is a course which aims to lead to formal study of maths/science based subjects. As such it looks beyond numeracy at Level 1 and 2 of the CGE for Adults and into the beginnings of formal mathematical knowledge at Level 3 of the Framework (see CGE for Adults pp87-92 and pp200-203 for further details).

However as it is a re-entry course for adults it cannot expect to begin in its early stages with Level 3 content. We realise that in order to develop new skills and knowledge in our students it is necessary to build on the foundations of their current abilities. We also acknowledge that adult students bring with them skills at a variety of Levels, whether from prior schooling, from work, or from functioning as a parent in their own families. Consequently, we start with many activities pitched at Level 1 and 2.

These Level 1 and 2 activities are set in familiar, domestic and societal contexts. In this, a women's course, they will often focus on the context of women's issues such as relative salaries, time spent on housework, or other topical subjects from the media. For instance the first graphing activity involves constructing graphs from personal data collected from the groups, such as numbers of children, age, years away from formal education. This will become a Level 1 or 2 task depending on the sophistication of the graphs produced (see CGE for Adults pp200-202).

Because of the initial range of skill levels with which students commence the course, many of our early activities are open ended and provide opportunity for creative thinking. This allows for success of all members of the group: tasks can be performed at a routine level, or extended and explored by those more able and curious who find the basics easy. Such people may very quickly be performing at Level 3 competency. So the one task may be performed at Level 2 or 3 by different students.

One example is a task which asks students to work out ***how much water is used by a dripping tap in one year***, and to illustrate their findings in the form of a publicity poster to discourage water wastage. The task involves: design of a system to measure water loss from a dripping tap; calculations of how much this would amount to for a year; conversions into larger units of volume measurement; and decisions on an effective means of communicating this to the public in lay terms.

Since students are given very little firm direction for this task the range of responses varies according to their Level of mathematical sophistication, both in the method of measurement used and the terms chosen to describe their results. Some go as far as using the formula for the volume of a cuboid *(Level 3 - element 3.2 - develop and use simple common formulae - CGE for Adults p92)*, most will however use the volume of household appliances eg 10 washing machines full *(Level 2 - element 2.4 - use estimation and calculation with shape ... - CGE for Adults p90)*. Methods of calculation will also vary in Level depending on the degree of use of decimal calculations.

As the course progresses most activities are at Level 3 but opportunity is provided through the open ended nature of tasks, or extension questions, for students to perform at Level 4. For example, while some students will perform a problem solving task by guess and check techniques and answer only the initial question asked, others will invent symbolic systems to express their thoughts, or use sophisticated analysis of patterns to make further generalisations and pose for themselves 'what if' questions.

In a problem such as ***'How many diagonals in 10 sided polygon?'*** a straightforward answer may be found by drawing a diagram, sketching in all possible diagonals, and deciding on a system by which to count them all *(Level 3 - element 3.4 - use 2D geometric properties -CGE for Adults p92)*. Extension questions, given to students who find this easy, would encourage them to experiment with other polygons, perhaps make a table of their results, explore any patterns which emerge, and try to find a generalisation which would apply to any polygon *(Level 4 - competency - can use, create adapt ... relation and pattern ... CGE for Adults p93)*.

In this, a Level 3 course, simple generalisations are developed with all students, and more formal methods are adopted, including the use of algebraic notation, or formulae, as a means of expressing these generalisations. Contexts used move from the familiar to the unfamiliar as students become competent at using the required methods. For example, the circumference of a circle is initially examined using circular cups, plates and bottles, the rule or formula

generated is later applied in problem solving situations related to distances around the earth and moon.

Integration of the Elements of Competency

Early activities based in measurement, data, spatial investigations, and graphs create an awareness in the students that maths is more than just number skills. They broaden students' expectations of the subject to cover all the elements in the competency statements. At the same time these activities provide the opportunity to teach number skills where necessary in a relevant context.

The introduction to algebra - the use of patterns and relations to make generalisations in mathematics - is also embedded in other strands, particularly measurement, where rules are developed by observing relationships in hands-on and practical situations and extended into generalisations or formulae. This ensures that the formulae, and processes involved in using them are seen to be meaningful. Problem solving also provides a vehicle to develop skills with patterns and relations, developing formulae, and use of algebraic symbols in immediately useable situations.

Wherever possible, activities involve a combination of more than one element of maths competency. For instance, an activity which explores the volume of cubes and cuboids by building them with MAB blocks (activity 9 on page 124) not only develops the concepts of volume and its measurement in appropriate units *(element 3.5 - use estimation and calculation of ... volume relationships of common shapes - CGE for Adults p92)*, it also uses many number skills and at the same time provides an opportunity to develop index notation *(element 3.3 - use appropriate methods of calculating with natural numbers ...)* and the use of algebraic formulae *(element 3.2 - develop and use simple, common, formulae).*

Language Use

In early activities, at Level 2, language use is everyday and informal (see Range/Conditions CGE for Adults p92). Students are encouraged to verbalise their thought processes through group activity and discussion. This stage provides the opportunity for the teacher to introduce mathematical language and symbolic notation for use later in the course. Students are advised to keep a vocabulary section in their workbooks to record new words encountered.

Later, more formal terminology and symbolic representation are required. However, students are still encouraged to relate their thought processes in straightforward English so that reports on problem solving and investigations should be readable documents with a growing degree of sophistication of mathematical language as the course progresses. Pages of symbols without connecting words of explanation are discouraged even at Level 4.

■ IMPLEMENTATION

As mentioned above, experience shows that it is best not to begin only with basic number skills but to mix concept work from a range of areas. In the early days of the course most of our major themes or strands are touched upon using Level 1 and 2 activities based on contexts familiar to the students. Measurement and estimation using parts of the body, and related to household objects is one example of such an activity. Initial graphing activities involve constructing graphs from personal data collected from the groups, such as numbers of children, age, years away from formal education. Early spatial work uses everyday maps and direction giving activities to introduce geometrical concepts and language.

These early activities are usually done in **pairs or small groups** and involve discussion and a chance to get to know one another. They enable students to share and consolidate current knowledge and **gain confidence**. By working across all strands of mathematics at the beginning, students also have an opportunity to discover their own areas of strength. **Language** is explored during these early days and conceptual foundations laid for further study.

This early presentation of diverse skills aims to overcome the view of mathematics as merely a collection of numeric operations and abstract algebraic processes and helps students develop a feeling for maths as being many different things:

- ways of measuring and quantifying the world around us including estimation
- ways of representing such quantities in tabular, graphical, diagrammatic or symbolic form
- ways of looking and thinking to solve problems (e.g. trial and error, looking for patterns, drawing diagrams, used of models)
- ways of developing visual and spatial skills to discover and apply properties of two three dimensional figures
- ways of operating with numbers both with and without a calculator.

In other words maths incorporates **all the strands and elements** of the competency statements.

Early sessions are also the teacher's opportunity to observe the individual strengths and weaknesses of their new students: gaps in basic number skills can be detected and addressed as needed in the relevant contexts and learning situations; activities to strengthen spatial awareness and language can be devised if necessary; and particular talents encouraged with extension work.

A Spiral Approach

All of the early topics are then revisited at intervals during the course. This could be described as a spiral approach: learn a little, let it settle, have time to clear up any difficulties, later on revisit the topic, go into further detail, and develop more skills. An inter-weaving theme of problem solving throughout

the course is very useful to this approach because many areas can be touched upon whilst looking at problem solving skills and strategies.

We see this as an essential difference to a delivery based on standard curriculum documents. These present topics in blocks, therefore teachers tend to treat them that way. Complete a topic, test it, and push on to the next. This technique runs the risk of presenting too much new knowledge, too quickly, without giving students time to incorporate new concepts and language before building on them further. The other risk is that students completely forget the knowledge after it has been tested and the skills dissipate because of lack of practice.

■ COURSE DOCUMENTATION

Overall Timeline

The spiral and integrated approach combines different topic areas and continually re-uses new skills and techniques in differing contexts. To illustrate this technique and provide an overall look at the course we have included a course timeline (see page 119). The solid bars indicate topics being specifically taught; the shaded bars indicate skills which are being developed and practised as an integral part of the activities used to teach the main topic. This time line is based on 7 hours per week class time (a time allocation appropriate to the goals of this student group). It would not be desirable to cover so many topics simultaneously if the class was being run for fewer hours per week, as is usual in a more general course.

Flowcharts of Major Strands

In order to give a clearer idea of how this spiral and integrated approach is applied, we have focussed more closely on just two of the areas, or strands running through the course – graphs and measurement. For both of these themes we have constructed flow charts which illustrate the types of activities used, the sequential development of the themes through the course, and the way topics are interwoven.

In these flowcharts each box contains a group of activities which could be used in a block or sequential time span. Not all of these activities will take a whole session: often two or more activities are done in one session. These blocks are not taught immediately one after the other but are separated by periods of time which could be several weeks. This allows time for concepts and skills developed to sink in. During this time skills and knowledge required for the next block are covered and some completely unrelated topics are presented.

The bubbles on the right of the boxes indicate other areas or elements of maths which are also being dealt with in the activities. Sometimes these are unfamiliar concepts being introduced in these contexts and sometimes they are skills being practised.

Activity outlines

Finally to further illustrate the nature of the learning experiences we have provided a close up view of a few particular activities by detailing outlines of their presentation and our rationale for doing them. Along with each of these outlines we have included analytical diagrams which show, by means of a series of bubbles, the maths skills which are being introduced or practised within the activity and also other outcomes such as development of group skills and communication using mathematical language.

List of Topics

Finally a list of topics is included to indicate fully the content which the course ***may*** cover.

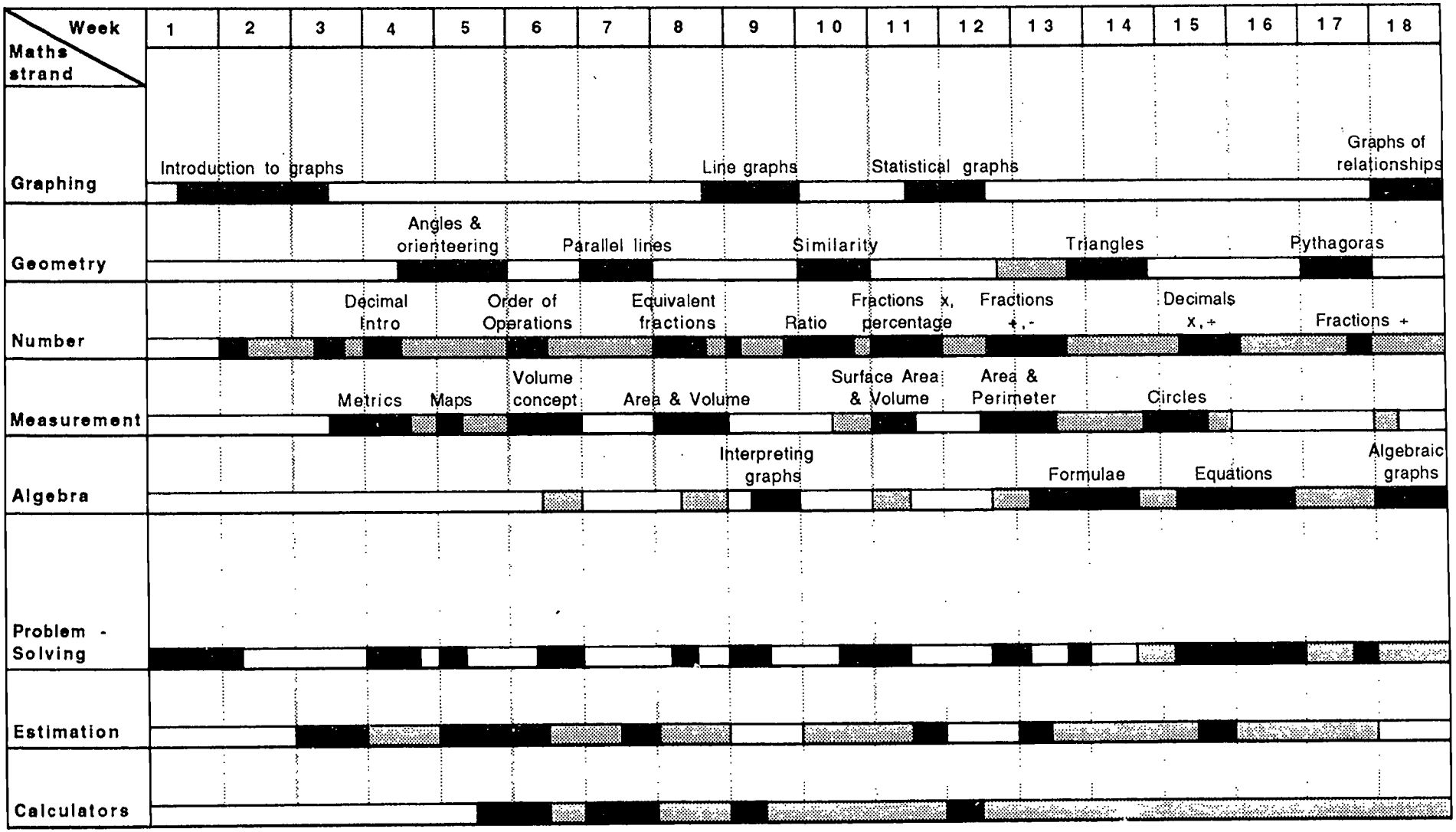
The extent to which this is done depends each year on the capabilities, future needs, and interests of the students. Complete understanding of the topics covered is considered more important than superficially dealing with all topics.

Bibliography

A list of resource materials used is provided on pp 149.

COURSE TIME LINE

KEY Incidental skill Main topic



MEASUREMENT ACTIVITIES FLOWCHART

Integrated Skill

THE METRIC SYSTEM AND METRIC LENGTH

Activity: 1 Multiple choice and true/false questions requiring only general knowledge of the metric system (to be done in pairs) Ref: BMB

Activity: 2 Relating metric lengths to parts of the body, using these measurements to estimate dimensions of various objects and then measuring accurately using tape-measures. Ref: MNB

Activity: 3 A discussion of the metric system including the history and the meaning of prefixes. Exercises including conversion between units of metric length in practical context including examples requiring decimal notation.

Activity: 4 Problem solving involving metric conversions e.g. How high will a stack of one million 5 cent pieces be? How long will a trail of $1 000 000 worth of 5 cent pieces be?

- Decimals
- Problem Solving
- Calculator use
- Estimation

MAPS AND DIRECTORIES

Activity: 5 Cooperative logic problems involving the use of maps and street directories.

Activity: 6 Finding distances on maps using scales.

- Problem Solving
- Ratio
- Estimation

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VOLUME CONCEPT

Activity: 7 Estimating the volume of a range of everyday containers including deceptive shapes. Ref MNB

Activity: 8 Problems on volume in a domestic setting involving knowledge of standard measures and conversions e.g. How many doses could you get from a medicine bottle for a given age?

Activity: 9 Problem solving activity on volume of cubes and cuboids leading to formulae in words, followed by exercise on calculating volumes.

Activity: 10 Project on the amount of water wasted by a dripping tap.

- Estimation
- Decimals
- Calculator use
- Problem Solving
- Formulae

AREA & VOLUME

Activity: 11 An introduction to the concept of area through tesselations. Ref:MNB

Activity: 12 Finding areas by counting squares leading to a formula in words for area of a rectangle.

Activity: 13 Draw on activites 9 & 11 to arrive at a formula for volume of a prism in words. Problem sheet on use of this formula. Ref: MNB

- Problem Solving
- Calculator use
- Formulae

SURFACE AREA/VOLUME

Activity:14 A problem solving activity on how many pentominoes there are and how many of them can be made into boxes.

Activity:15 Using MAB blocks to investigate the difference between surface area and volume by finding the surface area of different shapes having the same volume.

- Problem Solving
- Perception

AREA/PERIMETER RELATIONSHIP

Activity:16 Area of a triangle and parallelogram by counting the squares on grid paper and hence deriving a general method followed by an exercise on calculating area.

Activity: 17 An exercise on finding areas and perimeters of rectangles followed by a discussion on area/perimeter relationships using grid paper, algebra blocks and string. Ref: MNB

Activity: 18 Problem solving tasks on area and perimeter. Ref: Geometry Problems.

Activity: 19 Review of area and volume and an introduction to algebra by writing algebraic symbols for all formulae previously discussed in words. Use of these formulae to solve problems.

Calculator use

Problem Solving

Formulae

CIRCLES

Activity: 20 Measuring radii and circumference of circular objects to arrive at relationship between them.

Activity: 21 Exercise involving the use of the formula for the circumference of a circle.

Activity: 22 Problem solving tasks involving circumferences of circles.

Problem Solving

Formulae

Ratio

Equations

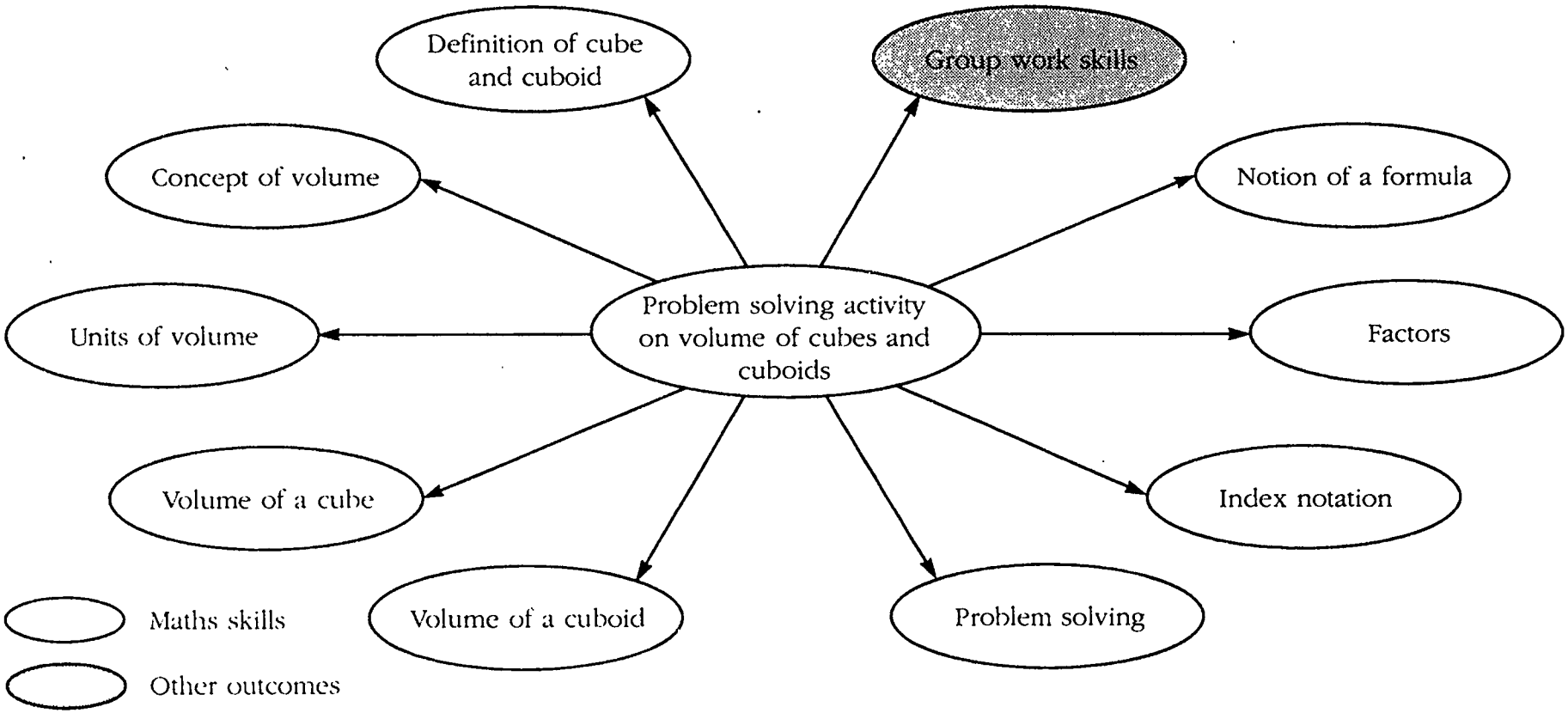
References:

MNB - ***Mathematics: A New Beginning***. Teaching Maths to Women Project. Edited by Beth Marr and Sue Helme, State Training Board, Vic, (1987)

BMB - ***Breaking the Maths Barrier***. Produced at Northern Metropolitan College of TAFE by Beth Marr and Sue Helme. DEET, Canberra, (1991)

Geometry Problems by Reuben Schadler, Dale Seymour Publications, California (1984)

MEASUREMENT ACTIVITY 9 – OUTCOMES



This activity integrates the development of relation and pattern and measurement at competency Level 3. In particular part of *3.2 - Develop simple common formulae and 3.5 - Use .. volume relationship of common shapes.* It also reinforces or introduces the number skills of factors and index notation depending on the prior knowledge of the students - *(element 3.3 - Use appropriate methods of calculating with natural numbers, numbers, fraction decimal fraction, percentages CGE for Adults p 92).*

CUBES AND CUBOIDS

Outline

The sheet headed ***'Cubes'*** (Handout 1) and bags of small MAB blocks are handed out. Students work in pairs answering the questions on the sheets. As they complete the sheet supplementary questions (Handout 2) are handed out one at a time.

The teacher circulates checking on progress and prompting if necessary. The following is an example of a teacher/student exchange in one particular class at the stage when the student was trying to go from counting by building the cube to a general process.

T: How would you work out there were 64 blocks in this cube without building it?

S: We find out how many on the bottom layer and multiply by however many layers it takes to make the cube.

T: So how many would there be in the next sized cube?

S: (Drawing base) The next would be 25 x 4.

T: Can you build this to check?

S: (After building) We forgot a layer so it would be 25 x 5.

T: And how could you work out how many would be in the bottom layer?

S: That would be 5 x 5.

In this particular class by the end of the activity all students had arrived at a method of finding the number of blocks by multiplying the dimensions. As a class we then considered the fact that volume is measured in cubes and that what they had found was a way of working out the volume of cubes and cuboids. We looked at how this could be written as formula using words not letters and how index notation could be used for the volume of a cube.

Rationale

The problem solving approach provides an interesting context for students to develop their understanding of volume and discover methods of calculating volumes of cubes and cuboids so that the resulting formulae are much more meaningful for them. Students doing this activity tend to count the cubes in layers which readily transfers to a general formula for the volume of any prism. Because student are working in pairs and so are talking about what they are doing they have the opportunity to clarify their ideas and also to discuss other associated issues which arise such as factors and indices.

The following are some snippets of conversation which indicate the type of learning that was taking place.

'I counted the blocks in each layer and then multiplied by the number of layers'.

'Is that a cube - don't we need another layer'? 'The layers have to match the number of blocks in the side of the square to be a cube'.

'We didn't get a cube with 24 but we did with 27'. 'But both can be divided by 3'. 'Yes but then can you turn what you get into a square - That's the important bit'.

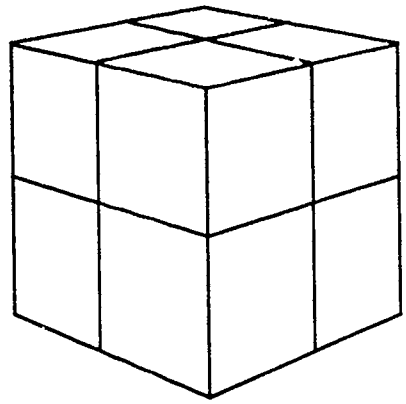
'Oh is that all a factor is'?

'This makes much more sense that it did at school where we were taught a formula. Here we are working back to a formula so I understand what is going on'.

CUBES

HANDOUT 1

Using small blocks make a cube
that has 2 small blocks along each side.



How many blocks did you use?

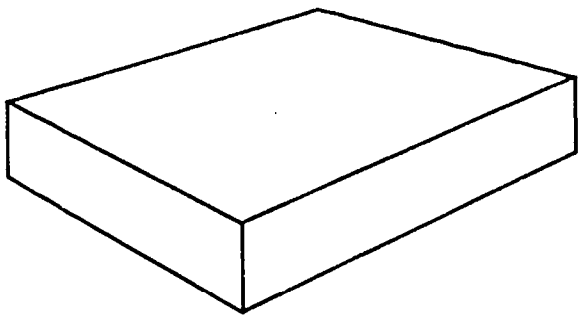
A **Cube** is the same size on all sides.

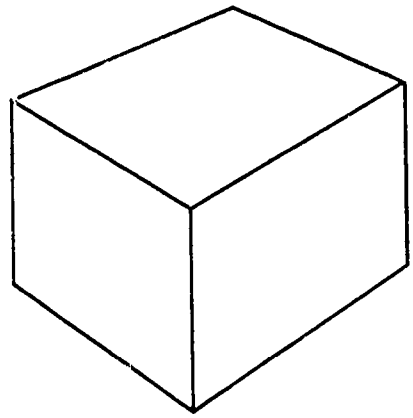
Can you make a **Cube** using:

27 blocks?

16 blocks?

Can you make a box shape with 24 small blocks?





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Breaking The Maths Barrier, B. Marr and S. Helme, 1991

CUBES AND CUBOIDS

HANDOUT 2

SUPPLEMENTARY QUESTIONS

Cut these questions out and distribute them progressively

How many blocks are there in the cube that has 4 blocks along each side?

Can you think of a way of working this out without building it?

How many box shapes can you make with 24 small blocks?

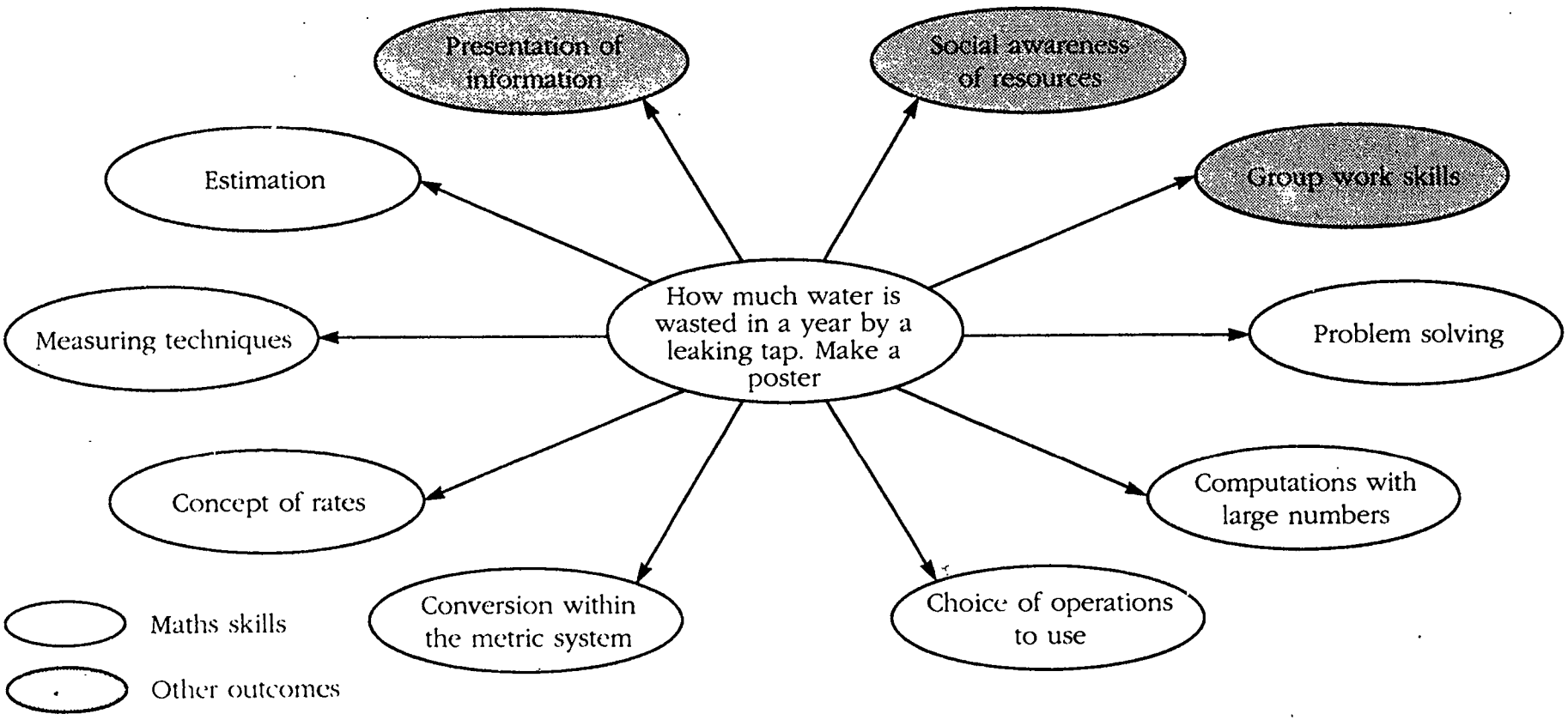
How many box shapes can you make:
With 35 small blocks?
With 36 small blocks?

Can you think of a system for working this out?

How many small blocks are there in a box shape with 3 blocks along one side, 2 along another and 5 along the third side?

How could you work this out without building it?

MEASUREMENT ACTIVITY 10 – OUTCOMES



The main focus of this activity is the reinforcing of *competency Level 2 measurement and numbers skills.* However it may be a development of competency Level 3 number skills if students choose decimal formulations for the calculations *(element 3.3 - Use appropriate methods of calculating with natural numbers, fractions, decimal fractions, percentages - CGE for Adults p92.)*

THE LEAKING TAP

Outline

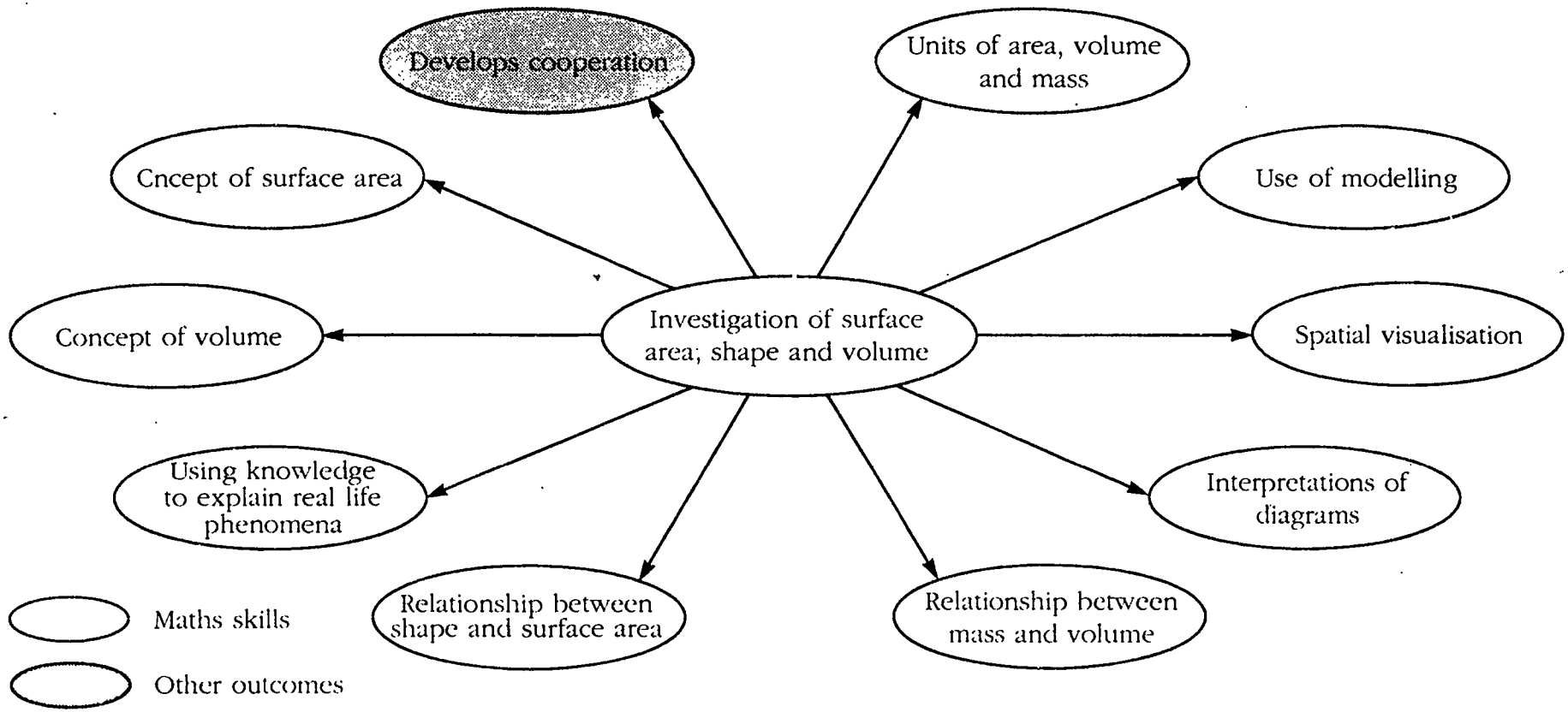
This activity is a project to be done at home. The project is to investigate the amount of water that is wasted in a year by a dripping tap. Students are asked to:

- Make an estimation first.
- Take some measurements and make calculations to find an approximate answer.
- Write a report on how they went about doing their project including assumptions made and methods used as well as calculations.
- Make a poster that could be part of a saving water campaign, illustrating the wastage in a way that people can relate to.

Rationale

This activity requires students to apply a lot of skills and knowledge, both measurement and other, in a real context. Writing it up helps prepare students for projects and problem solving tasks they would have to do if going on to V.C.E. Making a poster forces students to come to grips with the concept of large volumes by relating them to something familiar such as number of baths, washing machine loads or swimming pools.

MEASUREMENT ACTIVITY 15 – OUTCOMES



The main focus of this activity is the development of the concepts involved in measurement and space and shape at competency Level 3. In particular *element of competency 3.5 - use estimation and calculation of the perimeter, area, volume relationship of common shapes; and 3.2 - Develop and use simple, common formulae* - CGE for Adults p92.

SURFACE AREA AND VOLUME

Outline

Students are asked to make two different cylinders from a piece of A4 paper and then asked which cylinder is bigger. This will lead to a discussion about the meaning of 'bigger' and the difference between surface area and volume.

When students have decided which cylinder has the bigger volume they test them using polystyrene beads. The results are discussed. Students are frequently surprised to find the volumes are different.

Students are then handed the sheet headed 'Surface Area and Volume' (Handout 3) together with small MAB blocks. Students work through the sheet in pairs. As students finish the sheet they are given the supplementary questions (Handout 4). Not all students need to be given these questions so it is possible to cater for students working at different rates.

At the end of the activity the whole class discusses what they have learnt by doing the activity.

Rationale

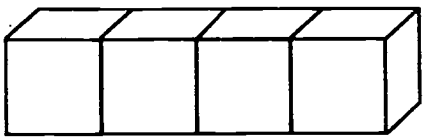
It is often a revelation to students that objects of equal volume can have different surface areas and vice versa. Having students investigate how shape affects surface area and relating it to physical characteristics or behaviour of animals puts these concepts in a context which is meaningful and so leads to a better understanding. This activity also illustrates how modelling can be used to investigate physical properties and requires the students to transfer conclusions reached to real world applications.

SURFACE AREA AND VOLUME

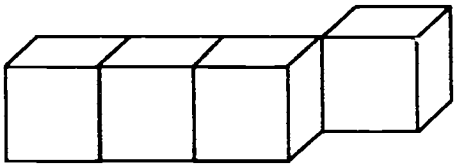
TASK 1

Arrange 4 cubes in each of the ways shown below.

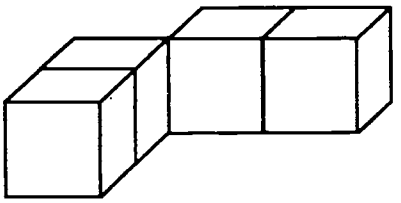
a)



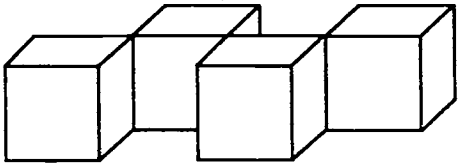
b)



c)



d)



- Using the models, decide on the volume and surface area of each of the figures.
- What is the mass of each of the figures if each cube weighs one gram?
- If you were going to paint them all which would require the most paint?

TASK 2 DISCUSS:

- If each of the models above was some kind of animal, which require the most oxygen to live?
- If it were a worm, which breathes oxygen through the skin, which would get the most oxygen? Is a worm better off being bumpy or smooth?

SURFACE AREA AND VOLUME

SUPPLEMENTARY QUESTIONS

Cut the questions out and distribute progressively.

Use cubes to investigate whether a worm is better off being long and thin or round and fat, in order to get the most oxygen.

Why does a sleeping child adopt a foetal position when the covers fall off?

What are the dimensions of a cuboid with a volume of $64cm^3$

Which will produce the least surface area?

GRAPHING ACTIVITIES FLOWCHART

Integrated Skill

INTRODUCTION TO GRAPHS

Activity: 1 In groups constructing pictorial representations of personal data.

Activity: 2 In groups looking at graphs from media focussing on the features of graphs, types of graphs and when each type is used, effectiveness, ease of reading and whether they are misleading.

Activity: 3 Interpreting bar and line graphs.

Activity: 4 Drawing bar graphs and pictographs of personal and given data, using simple scales.

Number skills

Estimation

LINE GRAPHS

Activity: 5 Drawing line graphs of given data requiring complex scales - large numbers and decimals.

Activity: 6 A look at the ways in which graphs can be distorted and how this is used to create a desired impression. Re-drawing distorted graphs correctly.

Activity: 7 Interpreting the general shape of line graphs representing real situations, choosing the most likely graph for a given situation.

Activity: 8 Drawing a graph to fit a given situation.

Activity: 9 Writing a commentary that fits a graph representing four competitors in a swimming race.

Large numbers

Decimals

Metrics

Area

STATISTICAL GRAPHS

Activity: 10 Drawing pie charts.

Activity: 11 Gathering data and grouping into intervals in order to draw histograms and cumulative frequency curves. Reading median and percentiles off cumulative frequency curves.

Angles

Calculator

Percentage

GRAPHS OF RELATIONSHIP

Activity: 12 Performing experiments, tabulating and graphing results. Interpreting the graphs.

Activity: 13 From given descriptions of situations involving direct variations making tables of values and drawing graphs. Discuss characteristics of direct variation and related graphs, and arrive at formulae.

Activity: 14 Working out formulae from graphs of situations involving direct variation.

Metrics

Ratio

Formulae

Reference:

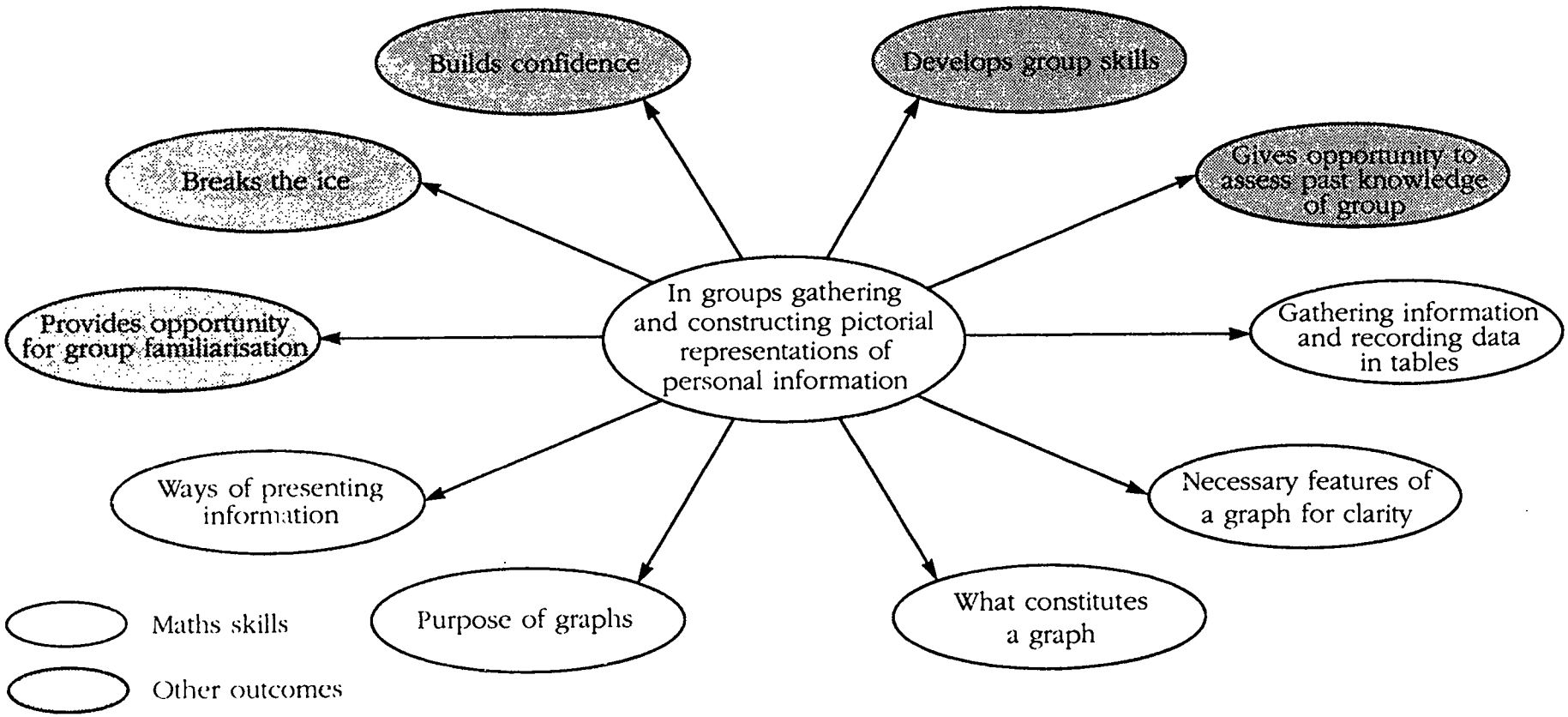
Mathematics at Work, Modelling your World - Volume 1 by Ian Lowe.

Breaking the Maths Barrier. Produced by Northern Metropolitan College of TAFE by Beth Marr and Sue Helme.

Investigating Change Unit 1 by Mary Barnes.

see details on p149

GRAPHING ACTIVITY 1 – OUTCOMES



This activity may be performed at competency Level 1 or 2 but definitely the follow up discussion develops data and graphs - at competency Level 2 *(element 2.1 - Interpret data and organise it into tables and charts CGE for Adults p.90).* It utilises competency Level 1 number skills - *(element 1.3 - use natural number CGE for Adults p88).*

INFORMATION IN PICTURES

Outline

- Each member of the class in turn makes a simple statement about themselves which includes a number, e.g: I am 168cm tall; I have 3 pets.

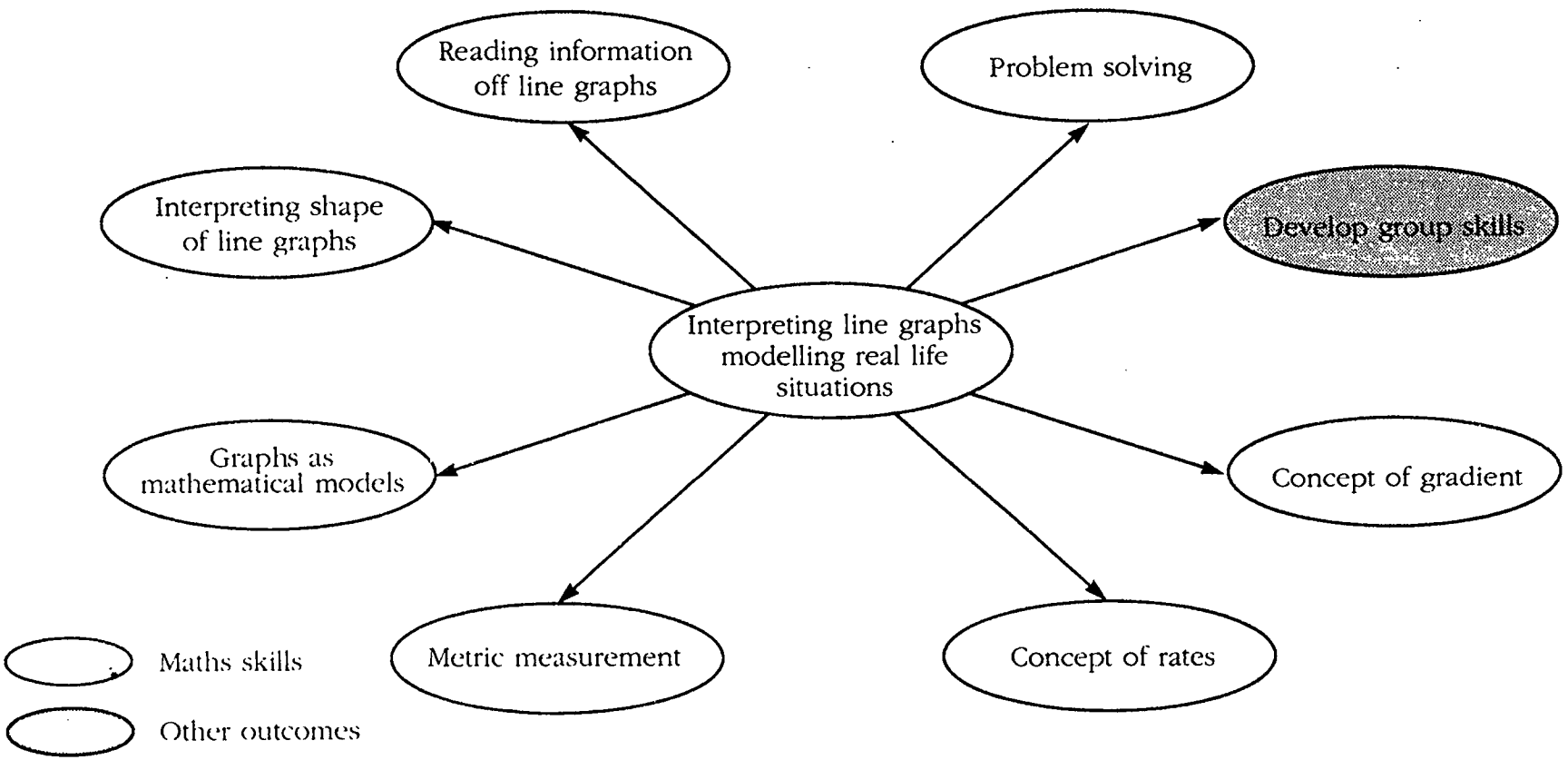
- Using these statements as a source of ideas, students in small groups decide on a question they want to ask everybody in the class and gather the data. They are then asked to draw a '*pictorial representation*' of the information.

- When students have completed their drawings they are looked at by the whole class noting the different ways information can be presented, the advantage of a picture over numbers, and whether the pictures effectively convey the information.

Rationale

This activity is done early in the course because it is non-threatening, doesn't rely on number skills which will vary greatly in any new group and gives members of the group an opportunity to get to know each other. Students are asked to draw a '*pictorial representation*' rather than a graph so that they don't feel constrained to follow mathematical conventions. This helps students to see that a graph is any diagram which effectively conveys data before looking at the standard types of graphs. By drawing pictures of personal information it is easier for the students to assess the effectiveness of the representations and realise the importance of headings and labels in conveying information.

GRAPHING ACTIVITY 7 – OUTCOMES



This activity develops relation and pattern at the beginning of Level 3; introducing graphs as mathematical models of relationship between real phenomena, rates, and gradients. *(Competency Level 3 - The student can use and analyse and adapt a range of everyday and some complex data, relation and pattern, number, measurement and shape).* It also reinforces competency Level 2 measurement and data in the interpretation of the graphs *(element 2.1 - Interpret data and organise it into tables and charts [graphs] CGE for Adults p 90 - 92).*

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INTERPRETING GRAPHS

Outline

Students initially work in groups of 3 or 4. Each group is given a copy of 'Coming to College' (Handout 5) and asked to firstly match the four given stories with four of the graphs and then to come up with a scenario which could correspond to the fifth graph.

When the groups are ready their answers are compared. If there are differences someone from each group is asked to argue their case until agreement is reached within the whole class. This process provides the opportunity for key features of the graphs to be discussed, e.g. parts of the graphs that correspond to being stationary and speed being indicated by the slope of the graph. Any key features which do not come out in general discussion can be brought up by the teacher.

The sheet headed 'The Bath' (Handout 6) is handed out and in pairs students come up with a story that matches the graph. Again these are shared noting in each case whether the stories take account of all the features of the graph. Students often come up with very creative explanations. After considering whether the stories fit the shape of the graph, the axes are looked at in terms of whether the depth of water and the time scale are realistic.

More examples are given in which students in small groups choose the graph which is most likely to describe a given situation e.g. 'The Flag' (Handout 7). Other examples can be found in **Investigating Change** Unit 1 by Mary Barnes. The teacher circulates and discusses each group's choice with them.

Students are then given some line graph interpretation exercises to do individually. These again focus on getting meaning from graphs and being able to give reasons for the shape.

Rationale

This activity requires students to interpret the general shape of a graph rather then just read off values at particular points. Being able to interpret whether a graph is increasing or decreasing steadily, where it is increasing fast and where it is increasing slowly and what different shaped curves illustrate is an important skill to develop before considering the graphs of particular functions. Looking at graphs relating to situations students are familiar with, or can imagine, makes understanding the characteristics of line graphs easier. It also helps students realise that graphs are mathematical models of real situations.

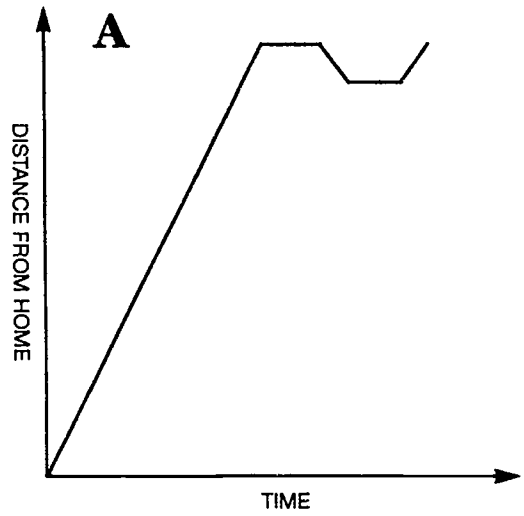
COMING TO COLLEGE

Students who go to College at Midtown usually travel by bicycle.

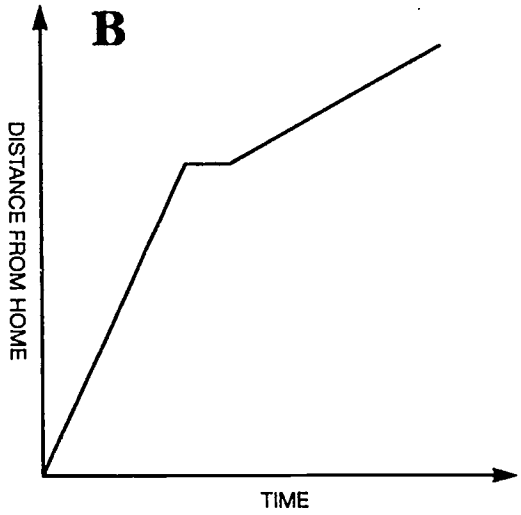
Here you can see five graphs. On the following page there are four stories. Which story goes with which graph?

What do you think Mary might have said? (Fill in the spaces on page 2 of this worksheet.)

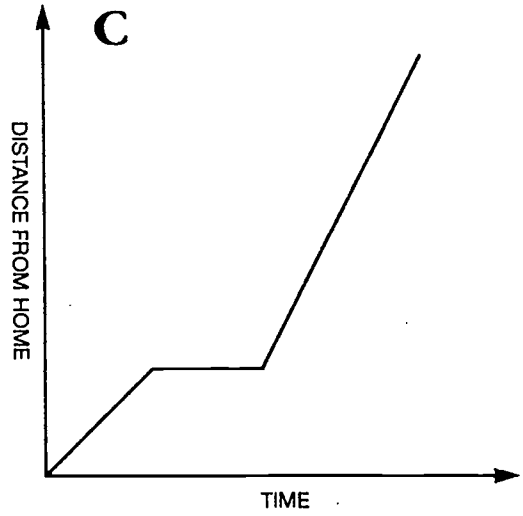
A



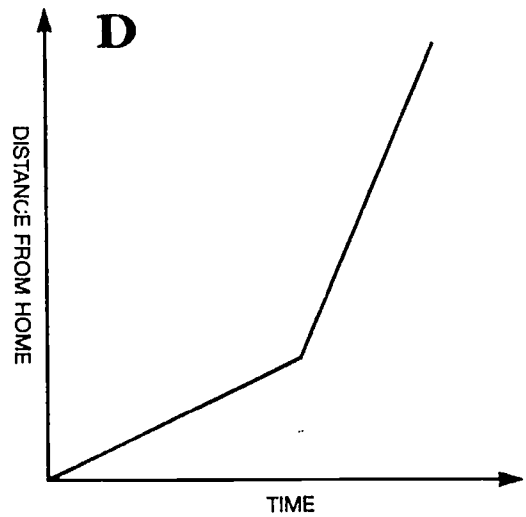
B



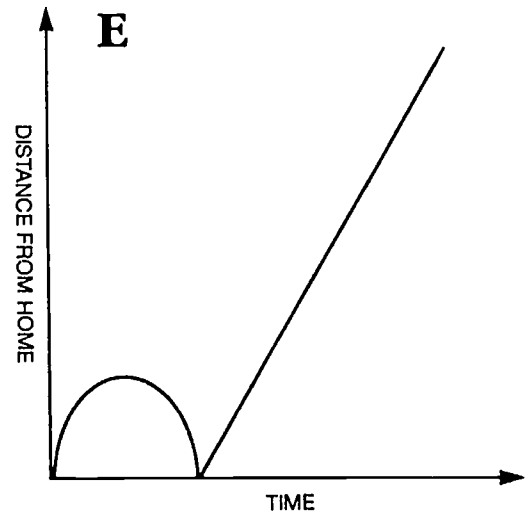
C



D



E



COMING TO COLLEGE

Helen: I had just left home when I realised that I have aerobics tonight and I'd forgotten my gear! So I went back home and then I had to hurry to be on time.

Yvonne: I always start off very calmly. After a while I speed up, because I don't like to be late.

Franca: I went by car this morning, but ran out of petrol a few blocks from the college. So I had to walk for the rest of the way and was just on time.

Kathy: I put my daughter Lisa onto her special seat on my bike and rode her to the childcare centre. I talked for a while to the new worker there and then hurried to the college.

Mary: .....

.....

.....

.....

.....

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.....

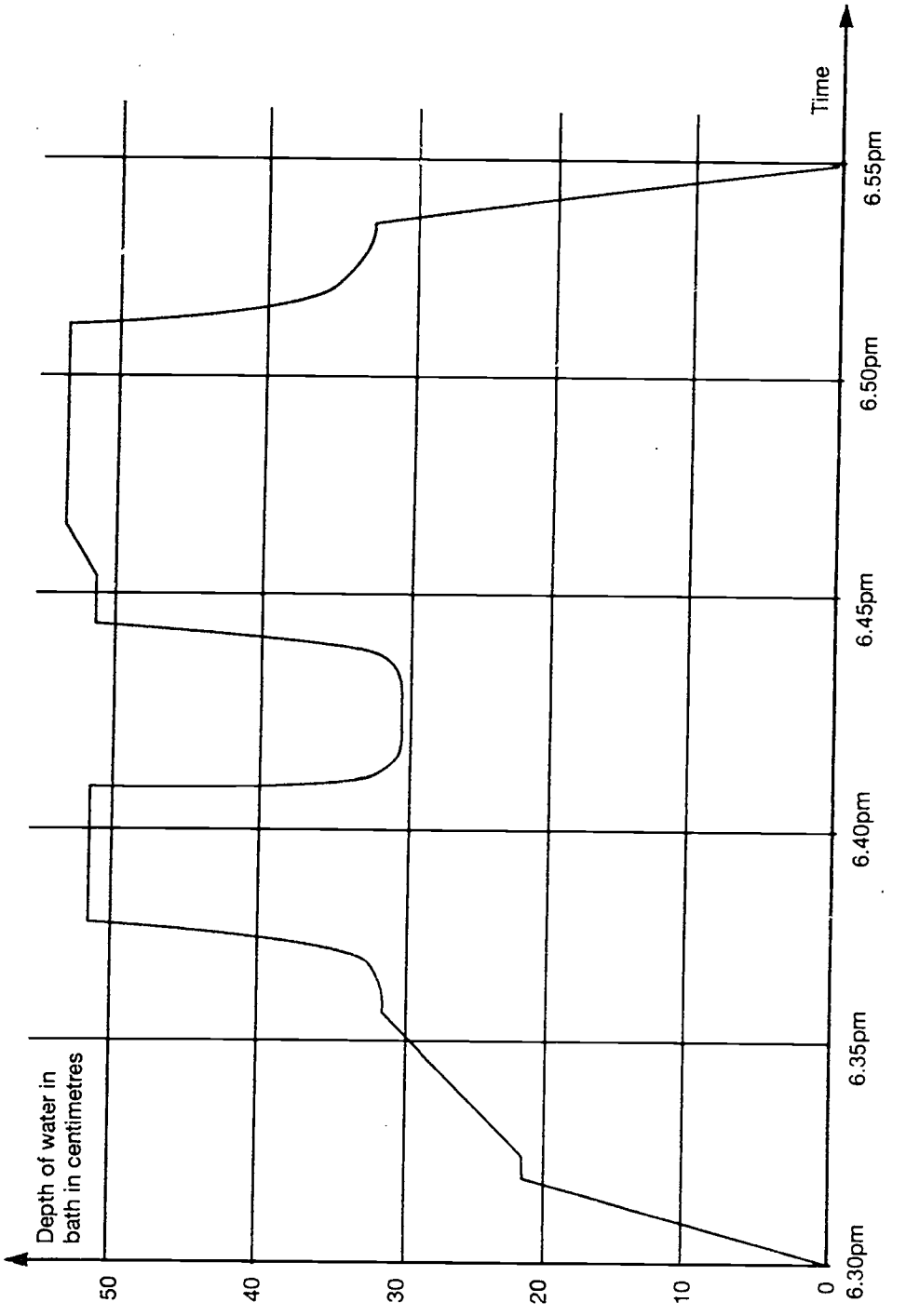
.....

Breaking The Maths Barrier, B. Marr and S. Helme, 1991

THE BATH

HANDOUT 6

Susie came home from a very tiring day at work and decided she needed a relaxing bath. The graph below tells part of the story. Can your group put the story of Susie's bath into words?



Breaking The Maths Barrier B. Marr and S. Helme [illegible]

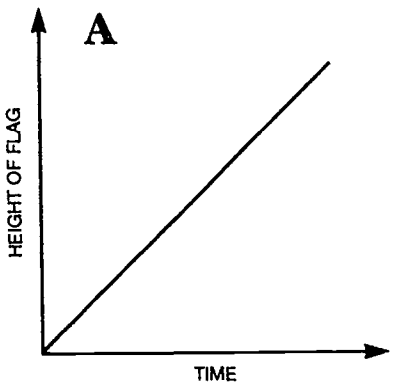
THE FLAG

HANDOUT 7

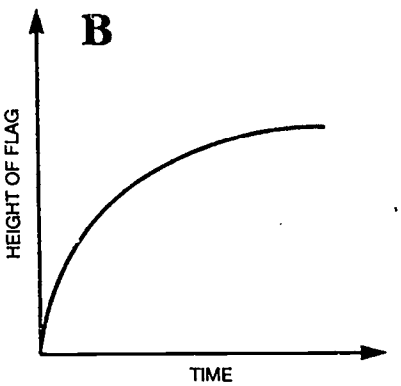
Every morning at the summer camp, the youngest girl guide has to hoist a flag to the top of the flagpole.

Which graph is the most likely to describe the situation as the Girl Guide hoists the flag.

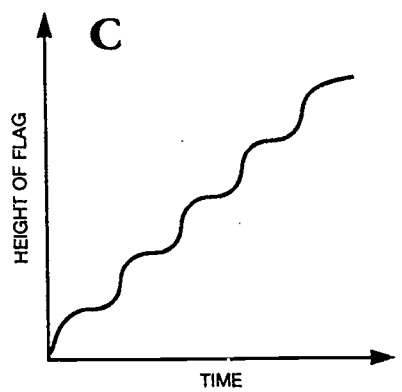
A



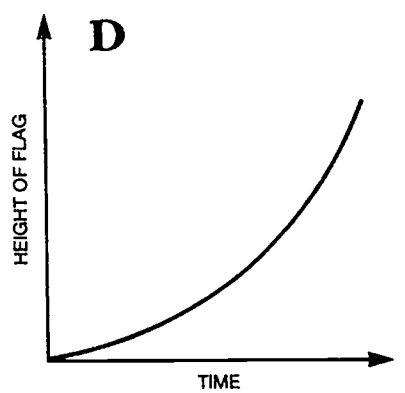
B



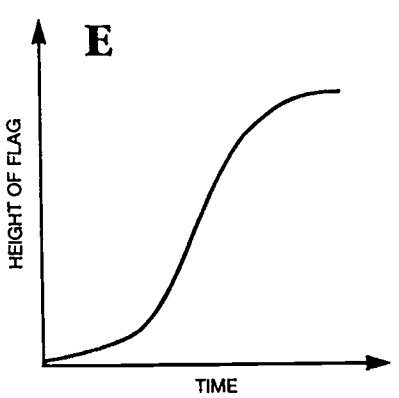
C



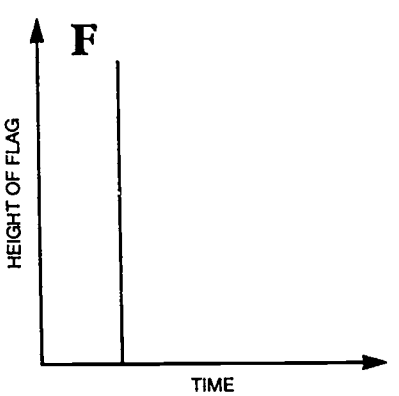
D



E



F



If you think that none of these graphs are realistic, draw your own version and explain it

from *Mathematics Teaching: Making Changes. A Handbook for Mathematics Teachers Running Workshops*, New Zealand EQUALS Network

LIST OF TOPICS

The list below should not be seen as a defined course. We select topics from the list according to the capabilities, needs and interests of the participants. We prefer to aim for complete understanding of some topics rather then trying to necessarily cover all of them. Other people using this as a guide should select course content according to time available and the needs of their students.

Level 2 Competency Statements - Elements, Performance criteria, and Range and Conditions to be found on p90 CGE for Adults.

Level 3 Competence Statements - Elements, Performance Criteria and Range and Conditions to be found on p 92, CGE for Adults - see also relevant Background Work or statements of outcomes, p 203 CGE for Adults.

Level 4 Competence Statements - Elements, Performance Criteria and Range and Conditions to be found on p 94, CGE for Adults - see also relevant Background Work or statements of outcomes, p 205 CGE for Adults.

Problem solving

- Problem solving is used throughout the course in the teaching of other topics to introduce new concepts or reinforce existing ones. However, the problem solving process itself is also taught as a separate skill and a range of strategies considered including
  - guess and check
  - drawing diagrams
  - using hands on materials
  - simplifying the problem
  - looking for a pattern

Calculator use

- The use of calculators is encouraged throughout the course but the need for estimating to check reasonableness of calculations is emphasised. Calculator skills are also taught separately including
  - memory
  - percentage
  - constant
  - square and square root functions
  - efficient use of a calculator

Measurement

Level 2

- Metric Units of Measurement
  - language of the metric system (prefixes)
  - estimation of lengths and volumes in metric units
  - accurate measurement of lengths using metric units
  - concept of perimeter
  - conversion between systems
  - problem solving involving different metric units of volume, and estimation in every day contexts

Level 3

- Area
  - introduction to concept
  - estimation using metric units
  - derivation of formulae for rectangles and triangles
  - use of area formulae for a variety of shapes
- Volume
  - derivation of formula for prisms
  - use of formula in problem solving situations
  - comparison of volume versus surface area
- Angle
  - use of a protractor to measure and construct angles
  - estimating angles
- Circles
  - language of circles
  - circumference of a circle and meaning of π as a ratio

Graphs and Data

Level 2

- Graphs
  - pictograms and bar graphs using simple scales
  - analysis and interpretation of statistical graphs in the media
- Statistics
  - mean, median, mode

Level 3

- Graphs
  - bar graphs and line graphs using more complex scales
  - distortion of graphs
  - pie charts
  - interpretation of line graphs which model relationships such as distance/time graphs
  - plotting graphs of physical phenomena from tables of two variables
  - line of best fit
  - concept of direct variation from a graph
- Statistics
  - frequency tables and histograms
- Probability
  - notation
  - probability of simple events
  - use of tree diagrams

Geometry

Level 2

- Angles and Direction
  - concept of angle
  - language of direction
- Shape and Perception
  - name, describe and draw two dimensional and three dimensional shapes
  - spatial perception

Level 3

- Angle and Triangles
  - language of angles and triangles
  - angles and parallel lines
  - angles in triangles
- Similar Figures
  - properties of similar figures
  - finding unknown lengths
  - interpretation of scale drawings and maps
- Pythagoras' Theorem
  - solution of right angles triangles

Number

These topics are not taught in isolation but are dealt with as they arise in other contexts.

Level 2

- Estimation
  - use of rounding for estimating calculations with whole numbers
- Basic Numerical Operations
  - order of operations
  - multiplying and dividing by powers of 10
  - reading of metric scales expressed as decimals
  - meaning of square, square root and cube operations
- Fractions, Decimals and Percentages
  - concepts and naming
  - fractions of a quantity
  - fractions 1/10, 1/100, etc., as expressed as decimals and vice versa
  - common fraction/percentage equivalents eg: 50%, 10%
  - percentage of a quantity: simple percentages using informal methods
  - multiplying and dividing decimals by powers of 10

Level 3

- Estimation
  - estimating answers to calculations with fractions, decimals and percentages
- Fractions, Decimals and Percentages
  - equivalent fractions
  - expressing percentages as decimals and fractions and vice versa
  - operations on fractions and decimals
  - percentage of a quantity
  - percentage increase and decrease
- Ratio
  - concept and language
  - calculations of equivalent ratios
  - dividing a quantity in a given ratio
- Positive and Negative Numbers
  - introduction to the concepts in everyday use
- Introduction to Indices
  - whole number bases especially 10

Algebra

Algebra is not introduced as a separate topic but arises out of other contexts particularly measurement and problem solving.

Level 2

- Introduction to formulae
  - use of written expressions to describe generalised rules in area, volume and problem solving.
- Linear Equations
  - basic concepts only and use in practical situations

Level 3

- Formulae
  - use of letters to represent generalised numbers
  - derivation of simple formulae
    - from common knowledge
    - for area of rectangles
    - for volume of a prism
  - substitution in simple formulae
- Linear Equations
  - use of mathematical equations for problem solving
  - solution of simple equations with one operation
  - equations with two operations
  - equations with unknown on both sides

■ BIBLIOGRAPHY

The following are teacher references, not recommended text books for students.

Main Reference:

Mathematics: A New Beginning *Teaching Maths to Women Project, edited by Beth Marr and Sue Helme.* Published by State Training Board of Victoria. (1987)
(Distributor: Northern Metropolitan College of TAFE - Maths Department)

Other References:

Access to Algebra Books 1 & 2, *Ian Lowe, Jayne Johnston, Barry Kissane, Sue Willis..* Published by Curriculum Corporation, Victoria (1993).

The MCTP Activity Book Volumes 1 & 2, *Charles Lovitt and Doug Clark.* Published by Curriculum Development Centre, Canberra (1988).

Mathematics at Work: Modelling your World - Volume 1, *Ian Lowe.* Published by Australian Academy of Science, Canberra (1988).

Problemoids Book 1, *Bill McCandliss, Albert Watson.* Published by Hawker Brownlow Education, Australia (1988).

Teaching Problem-Solving Strategies, *Daniel T. Dolan, James Williamson.* Published by Addison-Wesley Innovative Division, USA (1983).

Get it Together, *Tim Erickson et al.* Published by EQUALS, Lawrence Hall of Science Berkeley, California (1989). A book of cooperative logic problems.

Pre-Algebra with Pizzazz, *Steve and Janis Marcy.* Published by Creative Publications, Inc., California (1978)

Mathematics at Work: Shape, Size and Place, *Project Director and Editor: Vern Treilibs.*Published by Australian Academy of Science, Canberra (1980)

Geometry Problems: One Step Beyond, *Reuben Schadler* Published by Dale Seymour Publications, California (1984)
Most of the problems in this book are too difficult for this Level, but some are very good for reinforcing measurement and space concepts.

Some Beginnings in Algebra, *Teaching Maths to Women, Project edited by Beth Marr and Sue Helme.* Published by Northern Metropolitan College of TAFE, Victoria (1994)

Investigating Change Unit 1: Functions and Modelling, *Mary Barnes.* Published by Curriculum Corporations, Victoria (1991)
This book is the first in a series for learning calculus and as such uses notation which is unsuitable for this Level, but neverth less has excellent early graphing activities.

Breaking the Maths Barrier, *Beth Marr and Sue Helme.* Published by Department of Employment, Education and Training, Canberra (1991). This is a Staff development kit but is full of excellent ideas and activities suitable for students. (Distributor: Northern Metropolitan College of TAFE, VIC)

Bridging Maths Course

LEVEL 4

This is adapted from Part 2 of the mathematics component Women Into Technology course – a return to study course for women which runs at Northern Metropolitan College of TAFE, Vic.

Teachers and Program designers:
Penny Halliday and Beth Marr.

BACKGROUND

As with the Return to Study Maths course for Women this mathematics course was designed as part of the Women Into Technology course at Northern Metropolitan College of TAFE. Women Into Technology is a course which aims to develop women's skills, knowledge and attitudes to a level that will allow them to enter post secondary technology or mathematics/science courses. The mathematics component of this course runs for 35 weeks, 7 hours per week and goes from Level 2 to Level 4 of the Victorian Adult English Language, Literacy and Numeracy Accreditation Framework.

In this document we have written up the **second half** of this subject as a Bridging Mathematics course. Although in our implementation it is covered in 1 semester for 7 hours per week, it could equally well be run as a one year long course for 3 or 4 hours per week.

GROUP PROFILE

The appropriate client group is adult students seeking to return to further study in TAFE Advanced Certificates, Associate Diplomas, and VCE mathematics and science subjects, or who wish to gain knowledge and skills in a new area for self development. They are usually a combination of mature aged women re-entering education after of a long absence whilst working or raising a family, younger people who are unemployed, and NESB people studying mathematics after taking English language courses, all of whom for one reason or another have not studied sufficient mathematics whilst at school.

There are two possible categories of student within these parameters:

1. students who are following on from a recent mathematics course in an adult education setting and have therefore laid the foundations for study in mathematics
2. students who have not studied any maths for many years but have some prior knowledge.

COURSE OBJECTIVES

The course has been designed with the following objectives as guiding principles:

- develop **confidence** in the ability to learn and apply mathematics skills and knowledge taking into account
  - current levels of achievement
  - past learning experiences
  - present attitudes to mathematics
- develop **mathematics skills and knowledge** at a level and range appropriate to the individual goals and training/further education needs of students planning to enter mathematics based TAFE Training courses or VCE Mathematics subjects
- develop the ability to **communicate ideas** and problem solving processes using mathematical language both orally and in written form

- **apply mathematical skills** and knowledge to problem solving, investigation and/or modelling activities.

■ SELECTION PROCEDURES

We run this course as the second half of a year long program, so most of out students are continuing. However, sometimes students do join the course mid-year. In these instances students' suitability is assessed by giving them maths tasks to do within the context of an interview. Students are required to: demonstrate sufficient understanding of fractions and percentages to enable them to perform simple calculations which do not require them to remember formal processes; indicate some familiarity with algebra by being able to use a formula or solve a simple equation by inspection; interpret a graph; demonstrate some spatial ability by interpreting a drawing of a 3-dimensional figure or selecting the correct figure that would be made from a given net.

We believe that for selection into any Level 4 course students should be required to perform some maths tasks. Experience has shown that students selected on the basis of interviews alone are not always appropriately placed, and, even if another course is available for them to go into when this becomes apparent, they do not want to leave the group. Student without sufficient basic skills to enable them to succeed will not get much benefit from the course and indeed may have their negative feelings about maths compounded.

■ RELATIONSHIP TO THE COMPETENCY STATEMENTS

Progression of Levels

This is a course which aims to lead students with some basic mathematical foundations to the formal study of maths/science based subjects. As such it aims to have students displaying mathematical competencies at Level 4 of the Accreditation Framework by the end of the course.

Ideally a course at this level would be continuing from a conceptual and skill development base laid in a Level 3 course. However, as it is a re-entry course for adults it cannot expect this to be true for all students. It is more likely that many members of such a class will not have studied mathematics for many years. We acknowledge that adult students bring with them a variety of skills and knowledge, whether from prior schooling, or from work. They will have differing strengths and weaknesses in different areas, or mathematical strands, according to their backgrounds, their type of work, and their recent experiences. Consequently, in a course such as this it is necessary to consolidate concepts and skills which would normally be considered Level 3 (CGE for Adults p92) and possibly even some at Level 2 (CGE for Adults p90), such as knowledge of the metric system and sensible use of a calculator (CGE for Adults p90).

This does not necessarily have to be done under a heading of 'Revision' however, concepts and formulae can be revised in creative ways through problem solving or as incidental to other topics. For example, a problem solving task such as :

Is there a rectangular shape which has a perimeter with the same numerical value as its area?

provides an interesting situation in which students can reconstruct their concept of area, and perimeter *(Level 3 - element 3.5 - use estimation and calculation of the perimeter, area, volume relationship of common shapes)* at the same time as practising important problem solving skills such as use of diagrams, and guess and check.

So that early activities will be challenging for all students, who come to the course with a wide range of skill levels, many of these tasks are open ended or have extensions which provide opportunity for creative thinking. This allows all members of the group to succeed: tasks can be performed at a number of levels. Students still revising or rethinking concepts and formulae will answer the initial questions as asked, usually pitched at Level 3. They may have to explore ideas with diagrams and hands on materials - an important phase in creating meaning for themselves of fragments recalled from past schooling - fragments which at the time may well not have been understood at all. At the same time students with recent familiarity with the concepts involved may invent symbolic systems to express their thoughts, or use sophisticated analysis of patterns to make further generalisation and pose for themselves 'what if' questions *(Level 4 - the student can use create, adapt and transfer ... relation and pattern ... measurement and shape - CGE for Adults p93).*

One such initial question might be:

A Cornflakes box is 35cms high, 25cms wide and 8cms deep. What is the area of cardboard needed to make the box?

Subsequent extension questions could be:

Try and find the dimensions of a box with the same volume but requiring less cardboard?

What dimensions will give you the same volume with the least amount of cardboard?

Why do you think the manufacturers choose the dimensions given for the box?

Alternatively the problem can be made open ended by merely asking:

Is this the least amount of cardboard necessary to make a box of this volume?

and leaving it to the imagination of the student how far they will take their response. Of course this can be assisted by some prompting from the teacher if necessary.

From early stages in the course generalisations are developed with all students, and more formal methods are adopted, including the use of algebraic or symbolic notation, and formulae, as a means of expressing these generalisations. Initially these formulae are simple, corresponding to familiar situations *(element 3.2 - develop and use simple, common formulae - CGE for Adults p92).* Also at the beginning of the course students may be grappling with the use of simple linear equations in problem solving contexts, and with the processes involved in solving them as well as substituting into basic for-

mulae *(element 4.3 - organise and process algebraic information - CGE for Adults p94).* As the course progresses however, such methods should be taken for granted, and in fact developed considerably, just as number skills are at Level 3.

During the course contexts used move from the familiar to the unfamiliar as students become competent at using the required methods. For example, the first graphs examined illustrate familiar situations and relationships such as distance vs time, in travel graphs; profit vs number of objects sold; or cost of a taxi vs distance travelled. Later on the graphs become abstract in nature, and may be expressed purely in symbolic terms as the general form of a linear graph, $y = mx + c$, is analysed *(element 4.2 - employ graphical representation of algebraic data - CGE for Adults p94).* This generalised knowledge can then be used to make predictions in real but unfamiliar situations which can be modelled by straight line graphs such as by working out the equations for lines of best fit plotted from experimental data.

Integration of the Elements of Competency

At this stage of mathematics education, indeed as with all stages, it is extremely undesirable to treat the strands of mathematics separately. It is vital to recognise their interdependence.

Algebra, graphs, measurement and number all come together in many meaningful activities. For example, plotting graphs of the areas of circles against their radii gives an opportunity to recall the appropriate formula and how to use it whilst actually looking at a particular type of non linear graph *(elements 3.5 - use estimation and calculation of the perimeter, area, volume relationship of common shapes CGE for Adults p92, 4.2 - employ graphical representation of algebraic relationships - CGE for Adults p94).* Alternatively, graphs can be used to investigate relationships if the areas of the circles are found by actually measuring, ie. counting squares, the subsequent graphs of Area vs Radius, and then of Area vs Radius squared, can be used to derive the formula *(elements 4.2 - employ graphical representation of algebraic relationships, 4.3 - organise and process algebraic information, and 4.5 - formalise geometric relationships - CGE for Adults p94).*

Generalising the relationships between quantities – in symbolic form as in algebra, or pictorially as with graphs, and understanding the connections between these two forms of representation *(element 4.2)*, is the cornerstone of most further study of mathematics . It is essential for the understanding of calculus in later years.

At Level 3 the use of patterns and relations to make generalisations in mathematics – algebra – is introduced in a meaningful way through problem solving and investigations in other strands, particularly measurement. Rules such as those for area and volume of regular shapes are developed by observing relationships in hands-on and practical situations and extended into generalisations or formulae. Wherever possible this means of further developing algebraic skills is maintained at Level 4; particular skills being learned in the context of other strands as they arise naturally, and manipulative strategies making sense

because they are obvious extensions of a problem solution. For example, rather than teaching a lesson on equations containing squares and square roots as an isolated skill, they are taught when needed, to solve problems relating to the use of Pythagoras' Theorem, or in finding the radius of a circle of given area; or if a perimeter, seen from a diagram is expressed as $l + w + l + w$ it will become quite obvious that the *l*s and *w*s may be added to give $2l + 2w$ or even, when viewed differently, $2(l + w)$. This illustrates the common sense behind the adding of algebraic terms, the use of brackets, and the distributive law *(element 4.3 - organise and process algebraic information - CGE for Adults p94).*

Whilst algebraic skills are developed through other strands initially, as the course progresses these skills themselves become a major tool within all other strands of maths at Level 4. It is intrinsic to trigonometry *(elements 4.5, 4.4, space, and measurement strands - see CGE for Adults p205)* where symbols are used to represent unknown quantities, and equations are used in order to find their values. It is essential to the study of statistics, *(element 4.1 - use simple statistical analysis techniques - CGE for Adults p94)* where complex rules are expressed, no longer in words, but as formulae. In calculations of areas, surface areas, volumes, and other properties of structures such as spheres and cylinders in the 3 dimensional world, the use of formulae is fundamental.

As indicated above in reference to algebraic skills, space and shape are continually interwoven with measurement at this level. The quantitative study of triangles using Pythagoras' techniques and the trigonometric identities of sine, cosine and tangent is dependent on the prior study of triangles, parallel lines, and their geometric properties. Finding areas and volumes often requires the use of Pythagoras or trigonometry to find unknown lengths.

Language Use

Students are encouraged to verbalise their thought processes through group activity and discussion. At this level students are encouraged to use more sophisticated or formal mathematical language and symbolic notation. They are advised to keep a vocabulary section in their workbooks to record new words encountered. However, students are still encouraged to relate their thought processes in straightforward English so that reports on problem solving and investigations should be readable documents with a growing degree of sophistication of mathematical language as the course progresses. Pages of symbols without connecting words of explanation are discouraged even at Level 4. *(Performance criteria - describe and record any results using both familiar and formal language, symbolic and graphical representation - CGE for Adults P94).*

■ IMPLEMENTATION

As mentioned above, experience shows that it is best in the early days of the course to mix concept work from a range of areas. Early activities are usually done in pairs or small groups and involve discussion and a chance to get to know one another. They enable students to share and consolidate current knowledge, gain confidence, and discover their own areas of strength. Language is explored and revised during these early days

It is important not to devote these opening sessions to mere revision of fractions, decimals, and other mundane number skills taken out of any meaningful context. Such practice only serves to reinforce memories of maths as a series of unrelated routines to be remembered rather than to introduce a new expectation of the subject as relevant, interesting, and cohesive. Early sessions are the teacher's opportunity to observe the individual strengths and weaknesses of new students whilst engaged in activities which are new and different from past school exercises. Gaps in fundamental skills and knowledge can be detected and addressed by giving them particular focus in the relevant contexts and learning situations as they arise. One example to illustrate this point is the following problem solving task which revisits the concepts of length, area and volume in a fresh light.

The task is based on a very entertaining excerpt from The BFG by Roald Dahl. Unfortunately for copyright reasons we are unable to publish it in full. However, reading the passage aloud to the students adds novelty and fun to the task.

The passage describes the servants at the Queen's Palace preparing to entertain a twenty-four-foot giant for breakfast with the Queen. Since the giant is four times as tall as a six-foot man, the butler calculates the size of the table and chair as four times as high as a normal table and chair and decides the giant will require four times the amount of food for breakfast.

The questions are:

1. ***Would the giant be comfortable?***
2. ***Would he have enough to eat?***
3. ***Why?***

This is typical of a number of problems which require students to visualise and model the situation, rather than merely dredging up semi-remembered formulae from past schooling. It invites discussion which leads to examination of concepts and of the actual meaning behind any formulae which may be used.

A Spiral Approach

The spiral approach as described in the Level 3 return to study course, earlier in this document – learn a little, let it settle, have time to clear up any difficulties, later on revisit the topic, go into further detail, and develop more skills – is still relevant at this level. This approach is illustrated by the treatment of Algebra and Graphs provided in the course documentation which follows.

We see this as an essential difference to a delivery based on standard curriculum documents. These present topics in blocks, therefore teachers tend to treat them that way. Complete a topic, test it, and push on to the next. This techniques runs the risk of presenting too much new knowledge, too quickly, without giving students time to incorporate new concepts and language before building on them further. The other risk is that students completely forget the knowledge after it has been tested and the skills dissipate because of lack of practice.

■ COURSE DOCUMENTATION

Flowchart of Major Strands

As mentioned earlier the interrelationships between algebra and graphs, both used as alternate ways of expressing relationships, is of major importance at this level of mathematics. We have therefore chosen these interweaving themes to illustrate the integrated approach used in this course. This is shown in an overview diagram on page 160. The column labelled 'Algebra' contains those activities which are developing algebraic skills without relating to graphs. The column labelled 'Graphs' contains activities in which graphs of real situations are looked at without connecting them to algebraic formulae. The third central column, 'Algebra and Graphs Combined', contains activities in which algebraic relationships are connected to their graphical representation, or used to solve equations.

For each of these themes we have then constructed flow charts which illustrate the types of activities used, the sequential development of the themes through the course, and the way topics are interwoven. The Graphing Activities Flowchart consists of all activities under the 'Graphs' and 'Algebra and Graphs Combined' columns in the Overview while the Algebra Activities Flowchart corresponds to the 'Algebra' column.

In these flowcharts each box contains a group of activities which could be used in a block or sequential time span. These activities are of varied length: some take less than a session, some take considerably more. The blocks are not taught immediately one after the other but are separated by periods of time which could be several weeks. This allows time for concepts and skills developed to sink in. During this time skills and knowledge required for the next block are covered and some completely unrelated topics are presented.

The bubbles on the right of the boxes indicate other elements of maths, or other areas of study or general interest which are also being dealt with in the activities. We have called them Integrated Skills on the diagram.

Activity Outlines

Finally, to further illustrate the nature of the learning experiences we have provided a close up view of a few particular activities by detailing outlines of their presentation and our rationale for doing them. Along with each of these outlines we have included analytical diagrams which show by means of a series of bubbles the maths skills which are being introduced or practised within the

activity and also other outcomes such as development of group skills and communication using mathematical language.

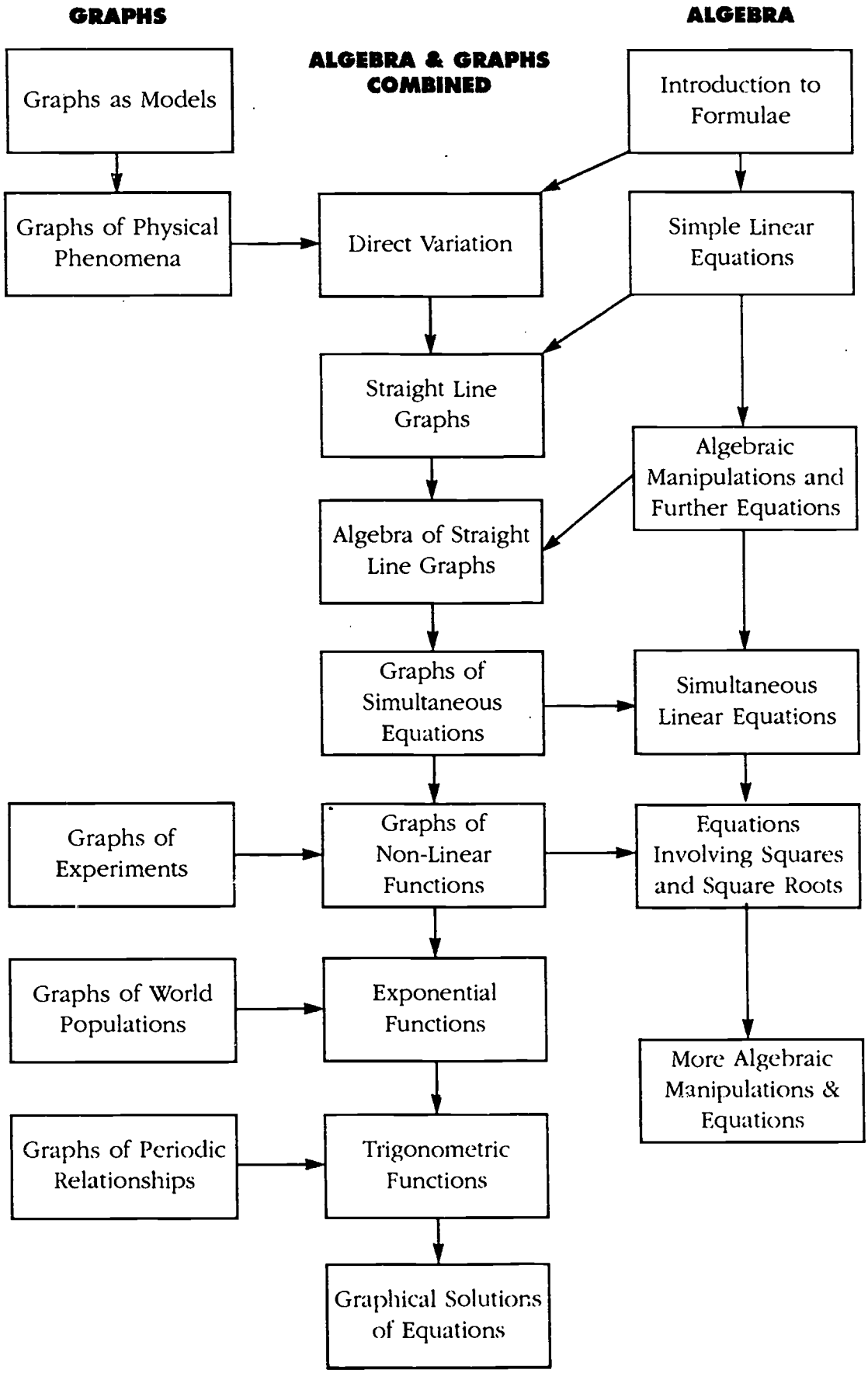
List of Topics

At the end of the document there is a list of topics normally covered in the course, along with options which are included depending on the capabilities, aims and interests of the students.

Bibliography

A list of resource materials used is provided on page 190.

ALGEBRA & GRAPHS OVERVIEW



GRAPHING ACTIVITIES FLOW CHART

The following flow chart includes all of the activities corresponding to the 'Graphs' and 'Algebra and Graphs' columns in the Overview diagram. Those activities in the 'Graphs' column are indicated by *.

Integrated Skill

GRAPHS AS MODELS

Activity: 1* Interpret line graphs modelling real world situations such as, distance, height, volume vs time, or price vs profit,

Metrics

Activity: 2* Draw graphs modelling real world situations involving varying change by considering likely general shapes, not plotting points.

Rates

GRAPHS OF PHYSICAL PHENOMENA AND DIRECT VARIATION

Science

Activity: 3* Plot graphs of real phenomena from given tables of values such as percentage of sugar in apples as they develop, change in volume of gas as temperature varies, tax paid for different incomes. Interpret graphs qualitatively.

Ratio

Activity: 4 From descriptions of situations involving direct variation (e.g. amount of fertiliser required for varying areas of garden), make tables of values. work out formulae and draw a graph. Discuss common characteristics of situations, formulae, graphs, and the relationships between them. Brainstorm other situations that would involve direct variation.

Measurement

Activity: 5 Perform some experiments (e.g. Hooke's Law, circumference of circles vs diameter), which will give direct variation relationships. Tabulate and graph results. Draw lines of best fit and work out formulae from graphs.

Irrational numbers

STRAIGHT LINE GRAPHS AS MODELS

Activity: 6 Use problem solving task that will produce a linear function to make up a table of values, work out a formula and draw a graph. In groups discuss why the situation produces a straight line graph and how formula relates to the graph.

Activity: 7 From descriptions of real world situations (e.g. costs of car hire, home visits by tradespersons), which can be modelled by linear functions, make up tables of values, work out formula and draw graphs. In groups investigate the relationship between features of graphs (gradient and y-intercept) and formulae. Use graphs to find solutions to equations.

Activity: 8 Brainstorm other situations that can be modelled by linear functions. Make up a formulae and sketch graphs.

Problem solving

Formulae

Rates

Financial applications

ALGEBRA OF STRAIGHT LINE GRAPHS

Activity: 9 Group activity matching cards with graphs. equations, and possible scenarios.

Activity: 10 Arrive at a general form of linear functions: $y = mx + c$. Exercise drawing graphs of equations and vice versa.

Activity: 11 From given tables of values of experimental data which lead to straight lines, plot points, draw lines of best fit and from graphs, work out formulae.

Activity: 12 Use x and y intercepts to graph linear equations.

Formulae

Problem solving

Scientific method

Algebraic manipulations

GRAPHS OF SIMULTANEOUS EQUATIONS

Activity: 13 From descriptions of real world situations which can be modelled by two linear functions, determine common values (e.g. alternative charging schemes).

Activity: 14 Exercise on solving some linear simultaneous equations graphically.

Problem Solving

Financial calculations

GRAPHS OF NON-LINEAR FUNCTIONS

Activity: 15* Perform some experiments involving non linear relationships and graph results (e.g. Ohm's Law, time for a pendulum to swing as length changes, distance vs time for a marble rolling down a slope). Interpret graphs.

Activity: 16 From descriptions of real examples of inverse variation, draw up tables, work out formulae and draw graphs. In groups discuss relationship between the situations, formulae and graphs. Brainstorm other situations that would produce similar graphs.

Acitivty: 17 Draw graphs relating to a number of situations involving quadratic relationships such as, height of falling object from the formula, stopping distance for a car travelling at different speeds. Use graphs to find unknown values. Relate to equations being solved.

Activity: 18 Use graphs to solve some problems involving maximum and minimum values of quadratic expressions (e.g. the maximum area that can be enclosed by a given amount of fencing).

- Scientific method
- Problem Solving
- Formulae
- Perimeter
- Area
- Indices

EXPONENTIAL FUNCTIONS

Activity: 19 Draw graph of world population. Discuss why graph is the shape it is. Calculate average annual growth rate for the past 5 years and use this to predict world population for the next 50 years.

Activity: 20 Problem solving task resulting in exponential function such as, number of ancestors, populations or payrates doubling daily. Graph results and determine formula.

Activity: 21 Given half-life for a radioactive substance, make up a table of values and graph radioactive decay.

- Indices
- Problem solving
- Environmental Issues
- Chemistry

PERIODIC FUNCTIONS

Activity: 22* Draw graphs modelling periodic relationships (eg a skier repeatedly going up a mountain on a chairlift and skiing down, regular fluctuations of a bank balance). Brainstorm other situations producing periodic relationships.

Activity: 23* Model a ferris wheel using a wheel. Graph height off the ground of one basket vs angle of rotation.

Activity: 24 By reading values off unit circle draw graphs of sine and cosine functions.

Rates

Angular velocity

Trigonometry

Physics

GRAPHICAL SOLUTION OF EQUATIONS

Activity: 25 Use graphs to solve problems involving a variety of functions. Use of numerical methods to zero in on the solution.

Problem solving

References:

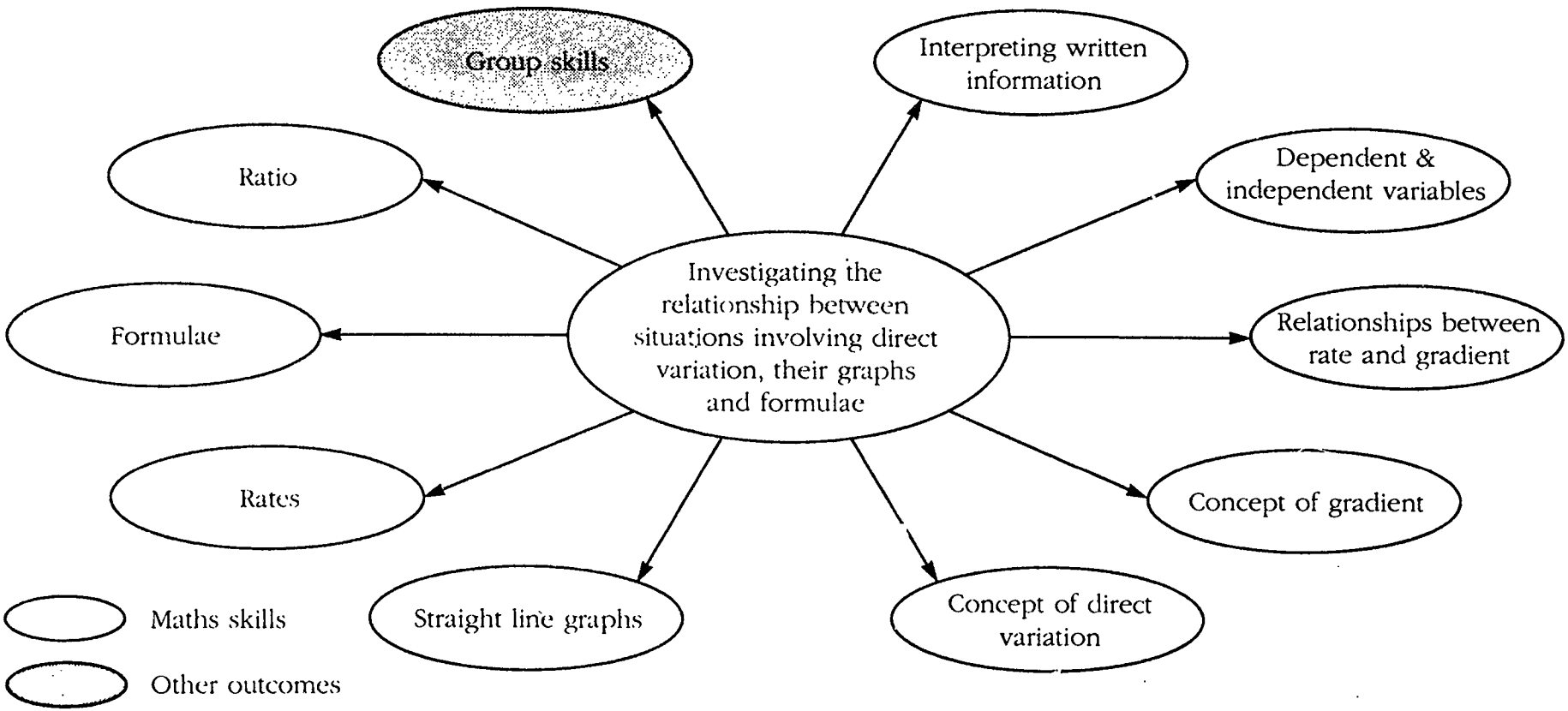
Investigating Change Units 1 & 2 by Mary Barnes.
Published by Curriculum Corporation, Carlton (1991)

Mathematics at Work: Modelling your World. Volume 1 by Ian Lowe.
Published by Australian Academy of Science (1988)

Access to Algebra by Ian Lowe, Barry Kissan and Sue Willis.
Published by Curriculum Corporation, Carlton (1993)

Jacaranda Maths 10 by Brian Hodgson.
Published The Jacaranda Press (1988)

GRAPHING ACTIVITY 4 – OUTCOMES



This activity reinforces relation and pattern at competency Level 3 *(element 3.2 - develop and use simple, common formulae)* and leads into relation and pattern at competency Level 4 - Looking at relationships between graphs and formulae *(element 4.2 - Employ graphical representation of algebraic relationships CGE for Adults p 94).* It also reinforces some competency Level 3 number skills - ratio - *(part of element 3.3 .... appropriate methods of calculating with natural numbers, fractions, CGE for Adults p 92)* and competency Level 3 measurement - rates (CGE for Adults p 203).

DIRECT VARIATION

Outline

Sheets headed 'Direct Variation' (Handout 1) are distributed, one to each pair to ensure students work on the questions together. The first question is discussed in general terms as a class to make sure students understand what they are required to do. Which variable will go on the horizontal axis and which on the vertical is also discussed for each question, by considering which is the dependent and which is the independent variable.

Students then work through the three questions in pairs. When they finish, they combine with another pair to discuss the graphs and formulae as directed on the sheet. When all groups have had sufficient time to discuss the questions fully, the class as a whole is brought together to compare conclusions. At this stage the teacher makes sure that the students have a general feel for the situations and their characteristics as well as looking at the concept of rate of change and its relationship to the gradient and the formula.

A list is then made of the situations that students have come up with. Students each choose one of these situations, draw a sketch graph of it and make up a formula for it.

Rationale

Graphs need to be related to real situations so that students understand what a graph being a straight line signifies about the situation being represented, and in turn how this relates to the corresponding formula. By investigating the situations and graphs themselves rather than having the conclusions presented to them students gain a better understanding.

Dealing with direct variation before general linear relationships enables students to focus on the connection between straight lines and constant rate of change and how this fits into the formula without having to worry about the y-intercept. Once this understanding is established, students readily transfer it to general straight line graphs.

DIRECT VARIATION

HANDOUT 1

In pairs consider the following situations:

1. Jan was knitting a scarf. Each ball of wool knitted into 20cm of scarf. Draw up a table showing the length of scarf she would be able to knit from different numbers of balls of wool up to 10 balls. Draw a graph of this information. Write a formula relating the length of scarf to the number of balls of wool.

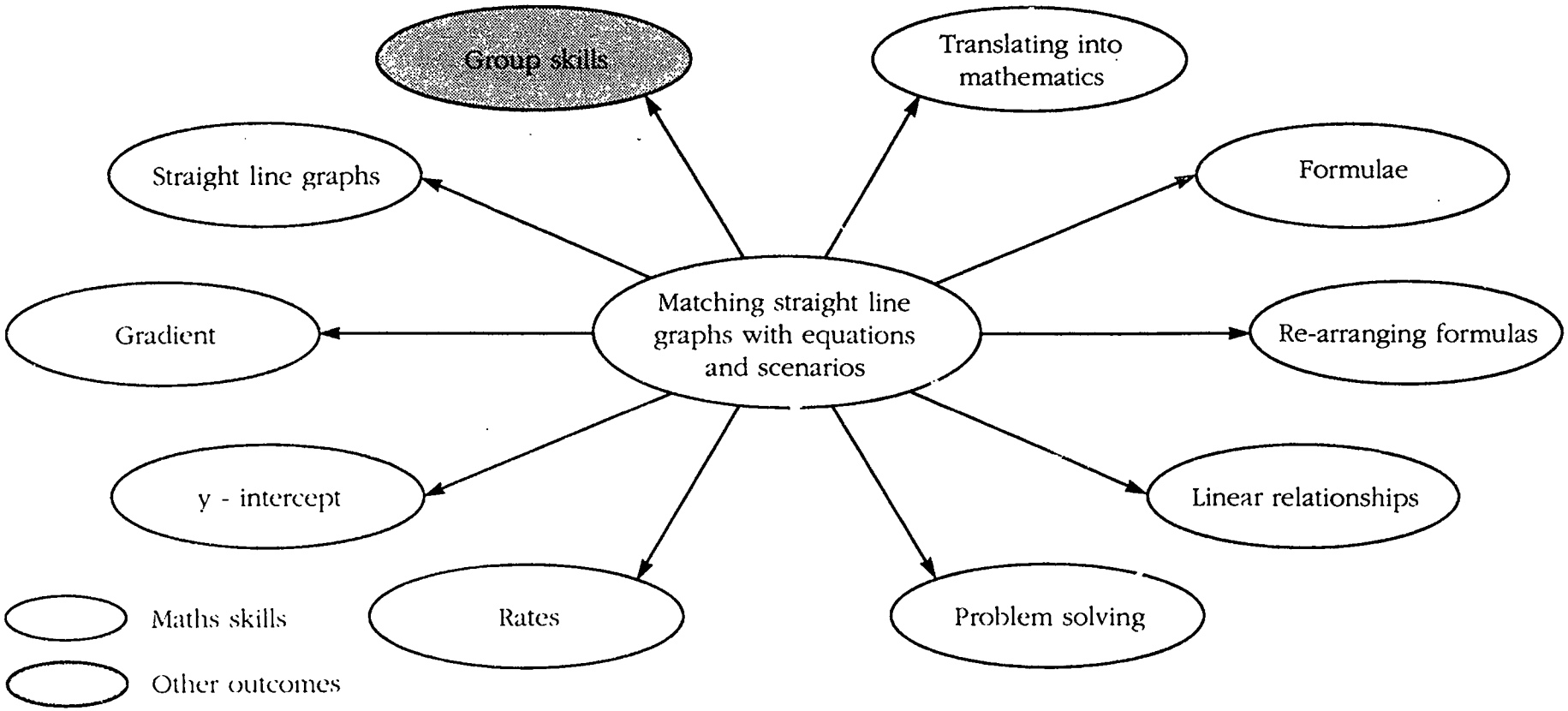
2. Vu and Stefan have pulse rates of 75 and 60 beats per minute respectively. Draw up tables of values showing their number of heart beats for different times up to 8 minutes. Write formula and draw graphs for both Vu and Stefan on the same graph.

3. Juliana wanted to fertilise her garden. The instructions said to use 100 g per $2m^2$ of garden. Draw up a table of values showing the amount of fertiliser required for different areas of garden up to $50m^2$. Draw a graph and write a formula relating amount of fertiliser and area of garden.

With another pair compare your graphs and discuss:

- What are the common features of all these graphs?
- What is similar about all the formulae?
- What is it about these situations that leads to their having these graphs and formulae?
- Referring to question 2, when the heart rate is different what is different about the graph? What changes in the formula?
- If in question 3, 150g of fertiliser per $2m^2$ had been required, what would you expect the graph to look like? What would the formula be?
- Think of other situations that you would expect to produce similar graphs and formulae.

GRAPHING ACTIVITY 9 – OUTCOMES



This activity develops relation and pattern at *competency Level 4 - The student can use, create, adapt and transfer complex data, relation and pattern, number, measurement and shape.* In particular it focuses on integrating *element 4.2 - Employ graphical representation of algebraic relationships; and element 4.3 - Organise and process algebraic information with interpretation of real life data involving measurement and number (CGE for Adults p 94).*

SCENARIOS, GRAPHS & EQUATIONS

Outline

Prior to the class Handout 2 – scenarios, graphs and equations - needs to be photocopied on to card and cut up. Enough sets should be made to cater for the class divided into groups of 3 or 4 students.

The class is divided into small groups and a set of cards given to each group. Students then match each scenario with its graph and corresponding equation. When all groups have finished the class is brought together to compare answers. If there are any discrepancies the students try and justify their answers until consensus is reached.

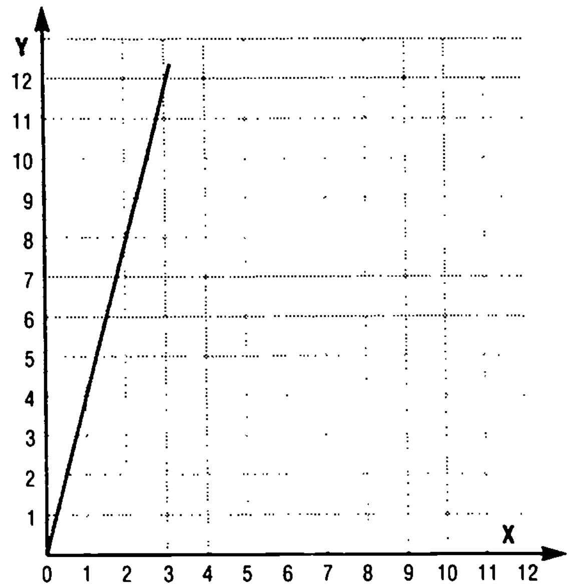
Rationale

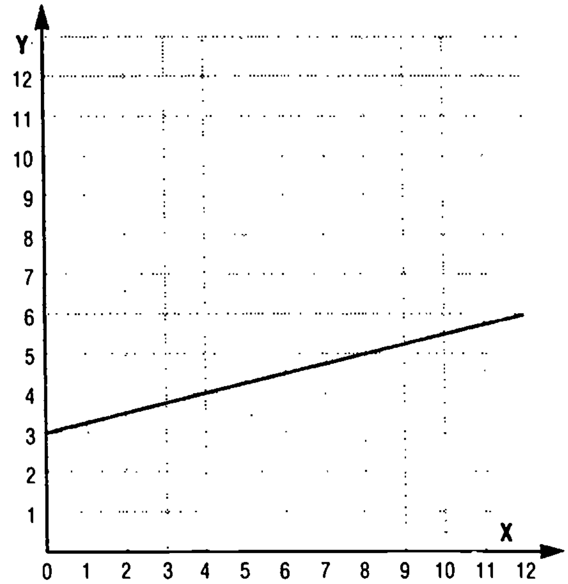
This is done as revision of linear relationships and their graphical models before formalising linear functions in an abstract way. Even when dealing with the algebra of graphs students should not lose sight of the situations they may be representing and the relevance of gradient and y-intercept to these situations.

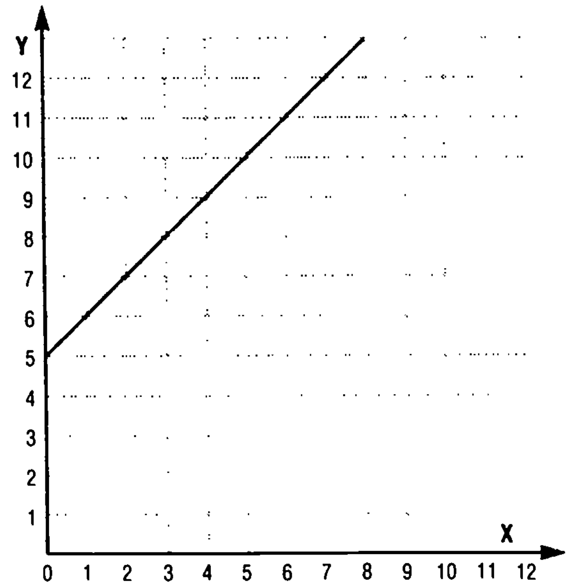
Doing this as a group activity means there is a lot of discussion about the numbers in the equations and their significance on the graphs, which gives the students the opportunity to recall concepts, use the relevant language and reinforce their understanding in a non-threatening way.

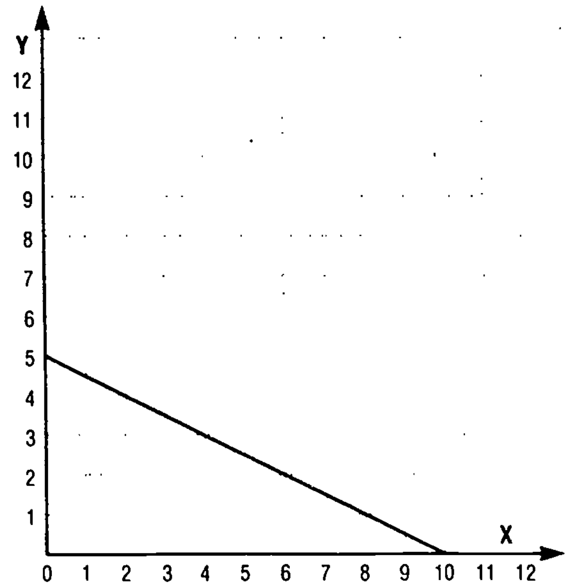
SCENARIOS, GRAPHS & EQUATIONS

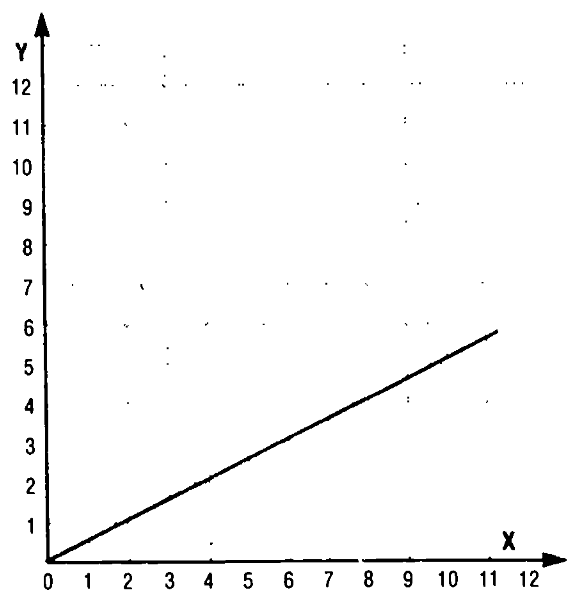
HANDOUT 2 P.1

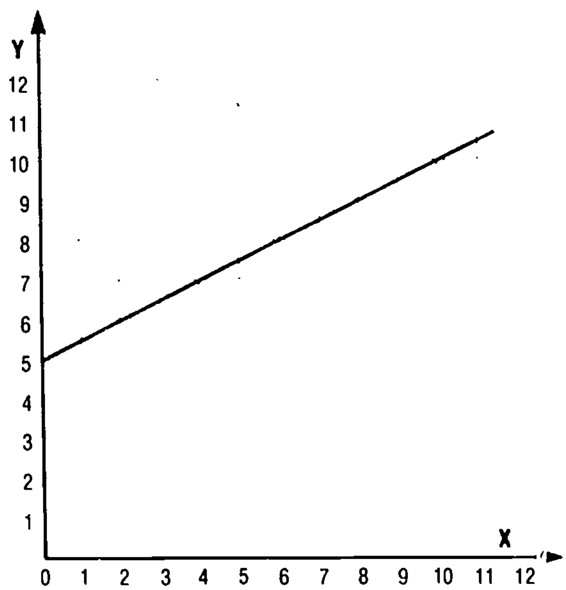






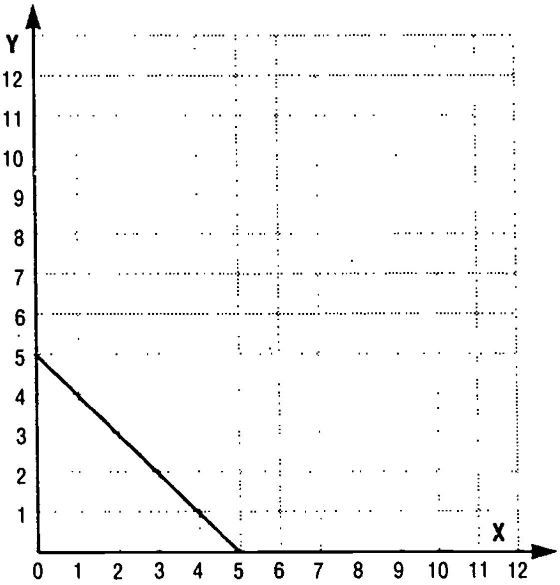


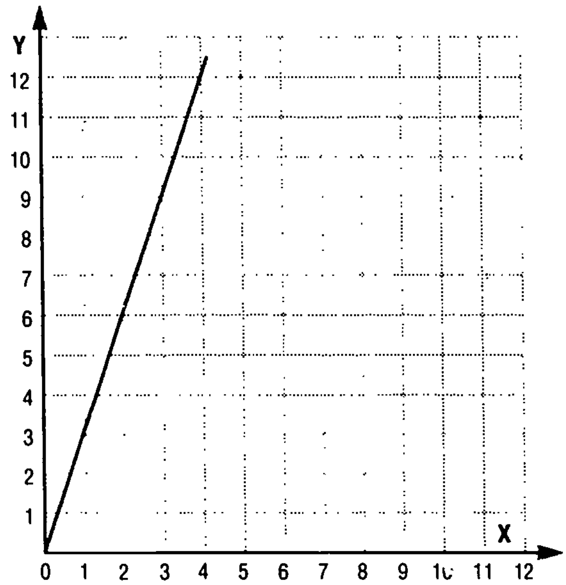


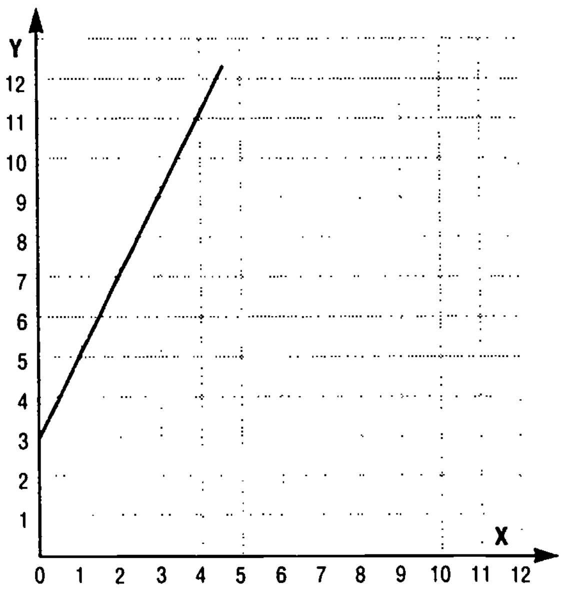


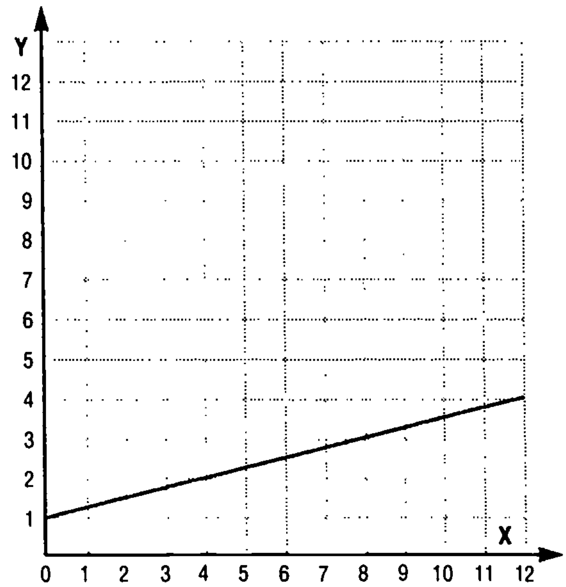
SCENARIOS, GRAPHS & EQUATIONS

HANDOUT 2 P.2









SCENARIOS, GRAPHS & EQUATIONS

The relationship between the perimeter of a square and the length of its sides.

The mass of a baby with a birth-weight of 3 kg who then grows steadily ¼kg per week.

The cost of a taxi ride if the flag fall is $5.00 and the charge per kilometre is $1.00.

Joanne cycles home from school, a distance of 5 km, at 30 km per hour. The relationship between distance from home and the number of minutes she has been cycling away from school.

The relationship between the reduced charge and the standard charge for someone who has a half price concession.

SCENARIOS, GRAPHS & EQUATIONS

HANDOUT 2 P.4

The amount of money spent at a fun fair if it costs $5.00 to get in and 50¢ per ride.

The relationship between the number of girls and boys playing in a 5 person basketball team.

The relationship between distance covered in metres and time in seconds if jogging at 3 metres per second.

When Sue is cooking potatoes she allows 2 potatoes per person plus an extra 3.

When George cooks roast beef he buys ¼ kg per person plus an extra kilogram to have left over for sandwiches.

SCENARIOS, GRAPHS & EQUATIONS

HANDOUT 2 P.5

$y = 4x$	$y = \frac{1}{2}x + 5$
$y = \frac{1}{4}x + 3$	$y = 5 - x$
$y = x + 5$	$y = 3x$
$y = 5 - \frac{1}{2}x$	$y = 2x + 3$
$y = \frac{1}{2}x$	$y = \frac{1}{4}x + 1$

ALBEGRA ACTIVITIES FLOWCHART

Integrated Skill

INTRODUCTION TO FORMULA

Activity: 1 Look at how formulae are used to express generalised rules in situations students are familiar with. Exercise on making formulae to describe real life situations such as cooking times and quantities per person, or taxi fares.

Activity: 2 Exercise on substitution in formulae related to measurement and other familiar situations.

- Problem solving
- Metrics
- Area & Volume

SIMPLE LINEAR EQUATIONS

Activity: 3 Use problem solving tasks already solved by other problem solving techniques to illustrate the use of equations in problem solving. Students write equations corresponding to simple situations and solve them by seeing what fits.

Activity: 4 Model process of solving equations by using balance scales and unknown weights in paper bags. Students solve linear equations involving one or two operations.

Activity: 5 Model the process of solving equations with algebra blocks. Exercise on solving problems using algebra blocks.

Activity: 6 More complex problem solving tasks to be solved by using equations.

Activity: 7 Solve equations using backtracking.

- Problem solving
- Fractions
- Decimals
- Perimeter

ALGEBRAIC MANIPULATIONS & FURTHER EQUATIONS

Problem solving

Activity: 8 Present word problems resulting in equation with unknown appearing on both sides. Model process of solution using balance scales or algebra blocks. Students solve similar equations.

Measurement

Activity: 9 Draw on equations related to problem solving questions students have already solved to look at when it makes sense to add and subtract algebraic terms. Exercise on adding and subtracting like terms.

Activity: 10 Introduce the distributive law by looking at alternative methods of calculating the perimeter of a rectangle. Further demonstrate with arrays of dots and situational examples. Exercise on expanding brackets.

Positives & Negatives

Activity: 11 Solve equations requiring use of the distributive law. Solve situational problems involving setting up such equations.

Activity: 12 Students set up equations for word problems where the unknown is in the denominator. Use equations with obvious solutions as prompts for students to discuss how to solve such problems. Exercise on solving similar equations.

Ratio

SIMULTANEOUS LINEAR EQUATIONS

Problem solving

Activity: 13 Introduce formalised substitution methods following students' instinctive use of it in appropriate problem solving situations. Exercise on writing equations for problems and solving them using the substitution method.. Solving pairs of equations without context.

Activity: 14 Demonstrate elimination method for problems in which substitution is unnecessarily complex. Practise method in contextual situations. Further practise on purely algebraic examples

Activity: 15 Exercise on solving pairs of simultaneous equations using the most appropriate method.

Perimeter

EQUATIONS INVOLVING SQUARES & SQUARE ROOTS

Activity: 16 Use problems (e.g. what length must a pendulum be to tick once a second? what size round cake tin will produce a cake of the same height as a 20 cm square tin?) to look at solving equations with squares and square roots. Exercise solving such equations.

Area

Pythagoras

MORE ALGEBRAIC MANIPULATIONS AND EQUATIONS

Problem solving

Activity: 17 In pairs students compare numerical calculations involving a minus sign outside a bracket and the corresponding expanded form in order to come up with a rule, and discuss why the rule makes sense. Exercise on simplifying expressions involving a minus sign outside brackets.

Activity: 18 Further practise at solving more complex equations.

Activity: 19 A look at how backtracking can be used to solve equations with squares, square roots, and unknown in the denominator.

Activity: 20 Model process of factorisation by removing a common factor using algebra blocks. Exercise on removing a common factor.

Activity: 21 In groups students discuss a series of questions which lead them from simplification of numerical fractions to simplification of algebraic fractions requiring factorisation. Practise simplifying algebraic fractions.

Fractions

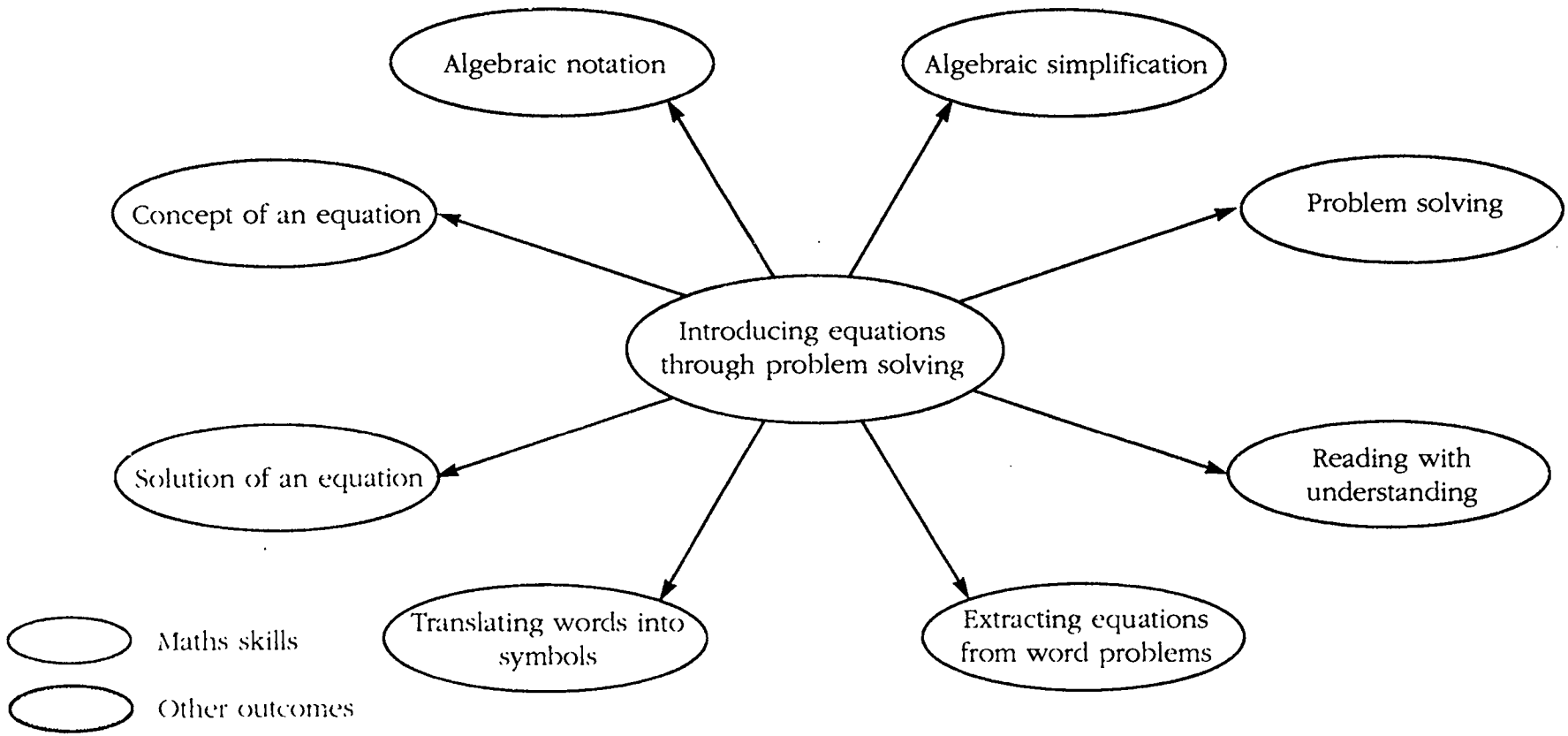
References:

Some Beginnings in Algebra Teaching Maths to Women Project edited by Sue Helme and Beth Marr. Published by Northern Metropolitan College of TAFE

Access to Algebra by Ian Lowe, Jayne Johnston, Barry Kissane, Sue Willis.Published by Curriculum Corporation, Carlton (1993)

Algebra with Pizzazz by Steve & Janis Maray. Published by Creative Publications, Palo Alto, California (1984)

ALGEBRA ACTIVITY 3 – OUTCOMES



This activity develops relation and pattern at *competency Level 3 - The student can use analyse and adapt a range of everyday and some complex data, relation and pattern CGE for Adults p 92.* The supplementary questions, however are pitched at Level 4 because they involved greater algebraic skills *(element 4.3 - Organise and process algebraic information CGE for Adults p 94).*

INTRODUCING EQUATIONS

Outline

The students are given a problem to solve in small groups using any strategy they like, e.g.

A woman is twice as old as her son who is twice as old as his sister. Their combined ages are 84. How old is the daughter?

When students have had time to solve the problem the class is brought together and strategies used are discussed. How it can be solved algebraically is then looked at. Questions are asked such as:

- What are we trying to find?
- What would a suitable symbol for this be?
- If d represents the daughter's age, how could we represent the son's age? The mother's age?
- What do we know about the ages? How could we write this?

When students arrive at something like $d + 2d + 4d = 84$ the idea of adding the ***d's*** is elicited from the students. This makes sense to the students without talking about "like terms" because the terms have meaning. Once the equation is in the form $7d = 84$, the students are asked to work out the answer. Although they will generally be able to work this out in their heads, the process they used is discussed.

A second problem is worked through as a group. Students are then given a sheet of problems (Handout 3) to be translated into equations and then solved by seeing what fits rather than using equation solving processes. As students finish they are given supplementary problems (Handout 4) one at a time to be solved in groups.

Rationale

Although this is a Level 3 activity we would still use an activity like this to introduce equations in a Level 4 course. Even if students have come across algebra before they may well have only done it as abstract exercises. Students respond better to learning new skills when taught in a context which provides a reason for developing the skills. Introducing equations as a way of solving problems gives students motivation for learning algebraic manipulation. It also makes equations more interesting and enjoyable, and more satisfying to solve than if they are not related to a situation. Having students translate worded problems into algebraic notation also firmly entrenches the notion that an equation is just another way of expressing a statement about an unknown. Solving them by working out what fits before looking at processes gives students initial success and reinforces the fact that the solution is the value that makes the equation true.

INTRODUCING EQUATIONS

PART A

The following problems are written in words. Your task is to identify the unknown and translate the problem into an equation (a mathematical statement with an '=' sign in it). Here are some models of equations. Choose the appropriate one for each question but of course replace the question marks and * with figures given in the question.

$$n + * = ?, \quad n - * = ?, \quad *n = ?, \quad \frac{n}{*} = ?$$

The first one is done for you.

1. Six more than a favourite number is twenty-seven.

   What is the unknown quantity? The favourite number

   What symbol can you use? f

   Translate '6 more than a number is 27' into an equation: f + 6 = 27

2. Nine more than a certain number is 37.

   What words represent the unknown quantity? _____

   What symbol can you use for this? _____

   Translate 'nine more than a certain number is 37' using your symbol _____

3. Seventeen less than my lucky is 25.

   An algebraic symbol for the unknown quantity is _____

   Translate the given information into an equation using your symbol: _____

4. Tania withdrew $320 from her bank account on July 3rd. This brought the balance to $1450. The unknown quantity is the balance before July 3rd.

   A symbol for this could be: _____

   Translate the information you have been given into an equation: _____

continued...

From: Some beginnings in Algebra - Marr and Helme

INTRODUCING EQUATIONS

5. Jason forgot how many members used to be in the tennis club but he knew that after the nine new members joined there were 38 members

   What is the unknown in this statement? _____

   Represent this with a symbol: _____

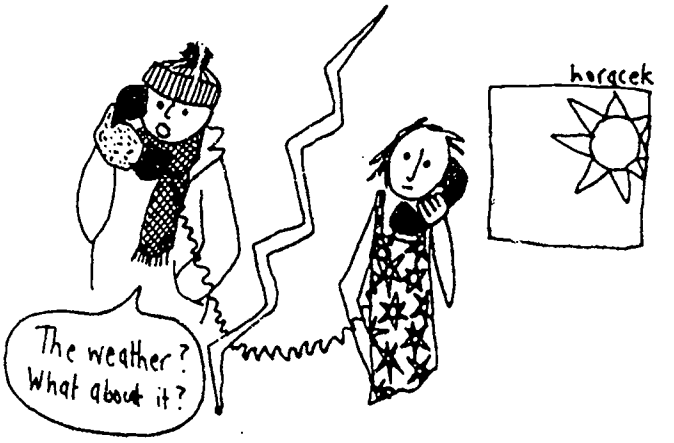
   Write an equation which summarises the information you have been given: _____

6. The temperature in Frostville is 5°C. This 17° less than the temperature in Warmtown at the same time.

   What is the unknown quantity here? _____

   A symbol for this could be: _____

   Translate the information in this problem into an equation: _____



7. I pay a third of my take home pay on rent. My rent bill is $128 per week.

   What is the unknown? _____

   A symbol for this could be: _____

   Translate 'a third of my take home pay' into algebra using your symbol. _____

   *Now write **an equation** for the information you have been given:* _____

PART B

Now that you have done all the translations above you should have seven equations. Go back and find values for each of the unknowns (in other words solve the equations).

INTRODUCING EQUATIONS

HANDOUT 4

SUPPLEMENTARY PROBLEMS

Cut these out and distribute progressively

A woman paces out 48m in walking completely around the edge of a rectangle garden.

If the rectangle is three times as long as it is wide, how long is each side?

In a group of 28 people all have either blue, brown or hazel eyes. If there are four more people with hazel eyes than blue eyes and three less people with brown eyes than blue eyes, how many people are there with eyes of each colour?

Sandy has a rather large collection of books. When a friend asked her what kind of books she liked she said:

'I have six times as many novels as biographies and 16 more non-fiction than biographies. All together I have 96 books'

How many books of each type does Sandy have?

■ LIST OF TOPICS

This course includes aspects of all strands of mathematics. In this list the topics have been separated into different areas, but wherever possible they are integrated when being taught.

The course aims to cover all topics listed up to 'Options' to give students a sound general mathematical foundation. However it is usual that in the latter part of the course some students will need to consolidate while others will be ready to extend their knowledge. At this stage students who are ready, choose extension topics according to their interests or needs. The topics usually chosen are listed under 'options'.

Level 3 Competence Statements - Elements, Performance Criteria and Range and Conditions to be found on p 92, CGE for Adults - see also relevant Background Work or statements of outcomes, p 203 CGE for Adults.

Level 4 Competence Statements - Elements, Performance Criteria and Range and Conditions to be found on p 94, CGE for Adults - see also relevant Background Work or statements of outcomes, p 205 CGE for Adults.

Problem Solving

Problem solving is used throughout the course in the teaching of other topics to introduce new concepts and skills or reinforce existing ones. However, the problem solving process itself is also taught as a separate skill. Problems are set to demonstrate and provide practice at using a range of strategies including:

- guess and check
- drawing diagrams
- using hands on materials
- looking for a pattern
- setting up a model
- simplifying the problem

Students are also required to write reports for a number of problem solving activities.

Algebra

Algebra is not initially taught as a separate topic but is introduced through other contexts, particularly measurement and problem solving. Algebraic manipulations are not specifically taught until students have had a lot of experience at using algebra in meaningful contexts. It has been found that students pick up algebraic skills quickly if they have a firm foundation in the use of algebra.

Level 3

- Formulae
  - making formulae to generalise real life situations and solutions to problems
  - substitution in formulae related to measurement and other familiar situations
- Equations
  - use of simple mathematical equations in problem solving
  - solution of simple linear equations

Level 4

- Formulae
  - substitution in more complex formulae
  - simple transposition of formulae
- Equations
  - solution of more complex linear equations involving unknown on both sides, unknown in denominator and brackets
  - introduction to numerical and graphical methods for solving non-linear equations
- Simultaneous equations
  - use of simultaneous equations in problem solving
  - algebraic solution of simultaneous linear equations
  - graphic solution of simultaneous equations
- Algebraic Manipulations
  - combining like terms
  - distributive law
  - factorising using a common factor

Graphs

Level 3

- Graphs as models
  - interpreting and drawing graphs which model real phenomena
  - concept of direct variation from a graph

Level 4

- Straight line graphs
  - relationship between formulae and graphs of direct variation
  - real situations which result in straight line graphs
  - finding the equation of a linear function from a graph
  - lines of best fit
  - graphical solutions of simultaneous equations

- Non-linear graphs
  - drawing and analysing a variety of graphs from real life situations and experimental data
  - recognition of the shapes of graphs corresponding to quadratic, inverse and exponential functions
  - interpreting rates of change from graphs of real life phenomena
  - use of graphs to solve maxima and minima problems involving quadratic functions
  - graphical solution of non-linear equations

- Periodic graphs
  - drawing graphs to model real situations resulting in periodic graphs
  - graphs of trigonometric functions

Number Skills

These topics are not taught in isolation but are dealt with as they arise in other contexts.

Level 3

- Fractions, Decimals and Percentages
  - operations on fractions, decimals and percentages as required
  - estimating answers to calculations with fractions, decimals and percentages

- Ratio
  - calculations of equivalent ratios
  - dividing a quantity in a given ratio
  - applying ratio to scale drawings and maps

Level 4

- Positive and Negative Numbers
  - operations on positive and negative numbers

- Indices
  - index laws
  - scientific notation
  - meaning of zero, negative and fractional indices
  - concept of irrational numbers

- Calculator Use
  - scientific calculator skills as required
  - efficient use of a calculator
  - round off errors

Space

Level 3

- Polygons
  - investigation of geometric properties of triangles, quadrilaterals, and other polygons

Level 4

- Similarity
  - properties of similar figures
  - finding unknown sides in similar triangles
  - scale drawings and maps

- Pythagoras' Theorem
  - solution of right angles triangles in real world contexts

- Trigonometry
  - definition of trigonometric ratios within right angled triangles
  - solution of right angled triangles
  - unit circle definition of trigonometric functions
  - graphs of sine and cosine

Measurement

Level 3

- Area and volume
  - problem solving to reinforce concepts and revise formulae for area of a rectangle and triangle and volume of a prism (given area of base)

- Circles
  - derivation and use of circumference formula

Level 4

- Area
  - area of a circle
  - calculating the area of complex figures

- Volume and Surface Area
  - calculating volumes of prisms, cylinders, pyramids and spheres
  - calculating surface areas of prisms, cylinders, pyramids and spheres
  - comparing volume and surface area

- Accuracy in Measurement
  - significant figures
  - upper and lower bounds to calculations involving measurement
  - rounding answers appropriately

Statistics and Probability

Level 3

- Averages
  - calculating mean, median and mode
  - selecting most appropriate average

- Measures of spread
  - range

Level 4

- Measures of spread
  - interquartile range
  - mean and standard deviation

- Statistical gr. .hs
  - histograms
  - box plots
  - cumulative frequency graphs

- Normal Distribution
  - major properties of normal distribution

- Correlation
  - scatterplots

- Probability
  - probability of simple events
  - use of tree diagrams
  - multiplication principle

Options

Other topics may also be covered by the group or individuals according to their goals. These are usually taken from the following:

- Quadratic Expressions and Graphs
  - factorising quadratic expressions
  - algebraic identities
  - solving quadratic functions
  - graphing quadratic functions
  - solution of simultaneous equations, one linear and one quadratic

- Algebraic Fractions
  - simplifying algebraic fractions
  - addition, subtraction, multiplication and division of algebraic fractions

- Trigonometry
  - radian measure
  - arc lengths
  - areas of sectors and segments
  - symmetry properties of trigonometric functions

- Cubic Functions

- expansion of cubics from factors
- drawing graphs to solve problems involving cubic expressions
- using the factor theorem to factorise cubics
- solving cubic equations graphically

- Geometry
  - straight edge and compass constructions
  - angles in circles

- Matrices
  - examples of uses of matrices
  - addition, subtraction and multiplication by a scalor
  - multiplication of matrices
  - identify and inverse matrices
  - use of matrices to solve 2 x 2 simultaneous equations

- Introduction to Calculus
  - rate of change of a linear function
  - interpreting graphs with respect to rates of change
  - calculating average rate of change from the gradient of a chord
  - finding approximate value for instantaneous rate of change by drawing tangent and calculating gradient
  - finding instantaneous rate of change by calculating successive approximations.

■ BIBLIOGRAPHY

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