"Segyehwa, and what it means for teachers and students in Korea and Australia."

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Human activity is being driven inexorably towards globalisation by economic influences and technology.

The emergence in the last ten years of such conglomerates as The European Community, The North American Trade Alliance, and The APEC agreement for an Asia-Pacific free trade area by the year 2020 are evidence to the fact that economic activity is driving nations closer together. The latter agreement between Australia, Brunei, Canada, Chile, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, the Philippines, Singapore, Chinese Taipei, Thailand and the US, offers opportunities for investors to tap into the phenomenal growth of Asia - a market estimated at $US 3 trillion a year and growing at the rate of $US 3 billion per week.

Australia and Korea have been contributing to both economic development and technological advance in this world economic environment. Korea is a world leader in shipbuilding and automotive production. The BMW blasting down the racetrack probably uses an Australian made gearbox; Australian software drives Lufthansa's airline tracking reservations and booking systems; Heathrow, Schipol and Manchester airports use Australian software to manage their systems; The Swiss Stock Exchange uses computer software developed by the Australian Stock Exchange, and Australian designed and installed telecommunication links put Vietnam in touch with the world.

Trade between the two countries is developing rapidly, with Korea now Australia's second largest trading partner. Two-way trade between the two countries reached $6.6 billion in 1993-4, with Korean exports in ships, boats, cars and textiles reaching $1.9 billion. This trade has brought the two nations together, promoted mutual tourism, and increased immigration of native Koreans to Australia. There are presently 2,000 Koreans studying at Australian universities.

Segyehwa will mean that nations, through competition and co-operation, will maximise economic development, meaning jobs, security, and a higher standard of living. At the same time, it holds promise of reducing the resource aggression which has driven so many nations to war in the past, because access to resources will be placed on an economic base. Allied to this is the possibility that economic co-operation will reduce the risk of continual environmental degradation, because there will be less need for nations to ignore environmental side effects of vigorous economic activity in the search for economic prosperity.

Effects of new technologies on students, teachers, and curriculum

At the same time there has been an astounding increase in the production and use of technology to support commerce and trade, and more recently, education. For US$3,000, it is possible to purchase access to Internet and the World Wide Web, which some are describing as an interface which will revolutionise education. Already some universities are beginning to put their course material on the web so that prospective international students can draw down instructional material. For payment of a fee, the student can sit a supervised examination and gain university credit for a successful result.

Students in Australia and Korea are already communicating via email, and the possibilities for using this technology for language instruction and cultural exchange are immediately obvious. Students tend to talk about and do the same kinds of things the world over, so their communication patterns at least seem to be more effective than classroom discourse. As they learn more about each other's school experiences, it is likely that they will begin to question and evaluate the kind of curriculum on offer at their schools, and begin also to articulate their expectations.

Although teachers tend to lag behind students in adopting new technology, it is only a matter of time before Korean and Australian teachers will be able to share experiences immediately over the new communication technology. They will probably talk to each other about salaries, work conditions, teaching techniques, and mathematics, and the communication will flow relatively easily because most Asian teachers read English very well, and mathematical language is, to an extent, universal.

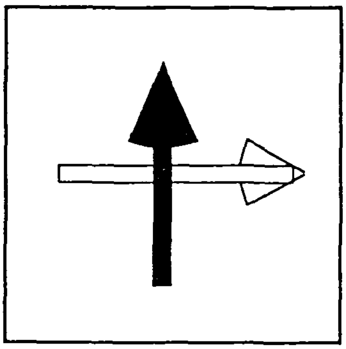
The key notion behind these new technologies is immediacy. Students have been writing letters to penpals in other countries for years, but that style of communication is ponderous and slow, with turn-around times of weeks or months. What the new technology offers is an immediacy which makes messages meaningful and relevant.

As teachers and students in Korea and Australia begin to share experiences, a natural expectation will be that teaching approaches and content will come closer together. Distinctive practices and traditions of each culture will remain, but at the margins, there will inevitably be some cross-fertilisation. At the same time, expertise in using the technology will grow, so that computers themselves will be used more in mathematics lessons. The government in New South Wales state has given a commitment to provide 1 computer for every 10 students over the next 3 years.

Technology Old and New

In the next section, the intention is to illustrate the use of old and new technology to develop mathematical concepts. All teachers would probably agree that materials make the teaching of concepts easier and more effective, and there would be few teachers who would rely on teacher talk alone. The technologies demonstrated range from paper to computer, but each has been found to be effective in establishing mathematical concepts.

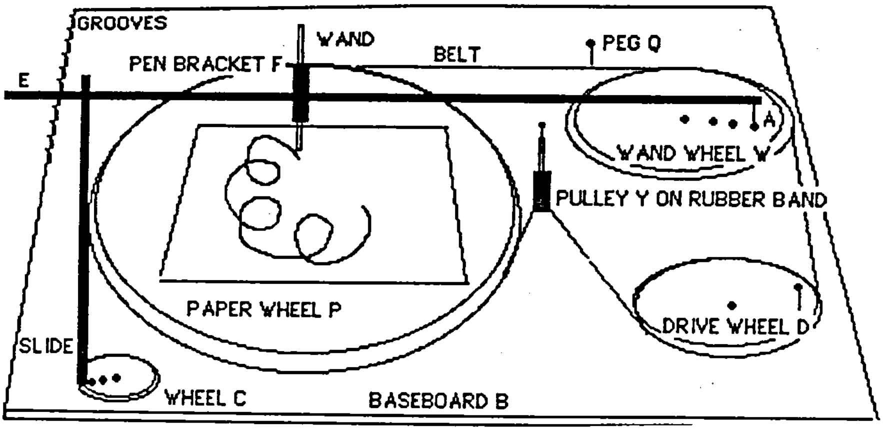
The Magic Arrow



The Discograph

The Discograph is a device which was developed specifically to demonstrate aspects of ratio to middle school students. Too often we tend to forget that students have wide experience of geared structures in such things as bicycles and motor cars which exemplify mathematical principles. The strange thing is that students can use such devices for years without ever thinking through the mathematics.

Gear structures interact in specific numerical ratios. If one gear has 34 teeth and another has 27, then the respective rotations are 27 and 34. The Discograph does not use toothed gears, but rather a belt drive, so wheels can be made any ratio we like by changing the circumference of a wheel.


GROOVES
WAND
PEG Q
BELT
PEN BRACKET F
E
A
WAND WHEEL W
PULLEY Y ON RUBBER BAND
PAPER WHEEL P
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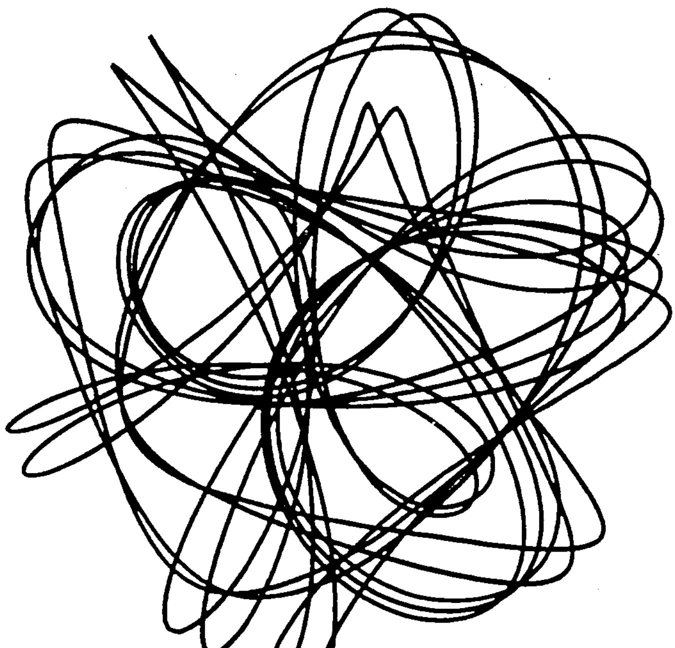
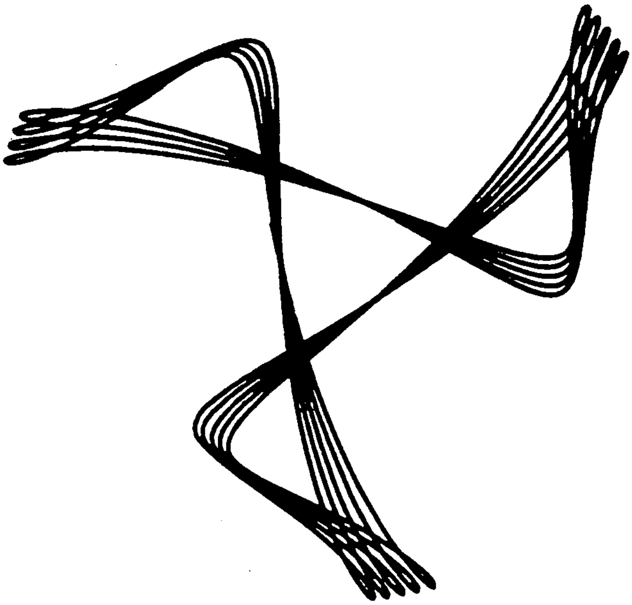
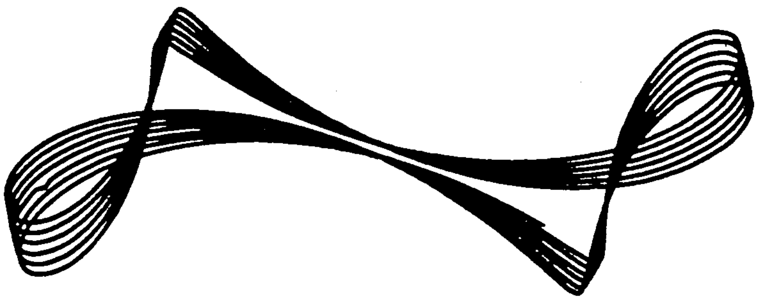
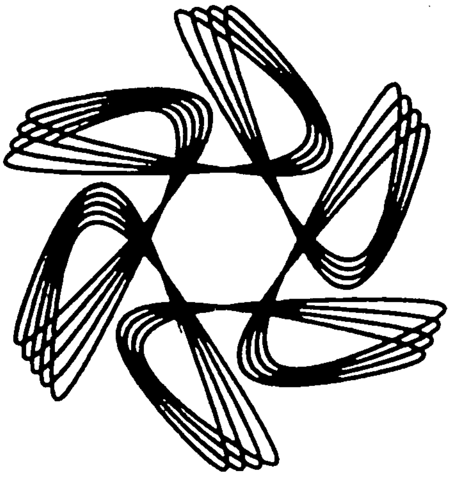
SLIDE
WHEEL C
BASEBOARD B





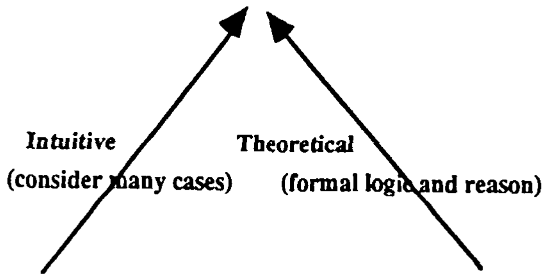




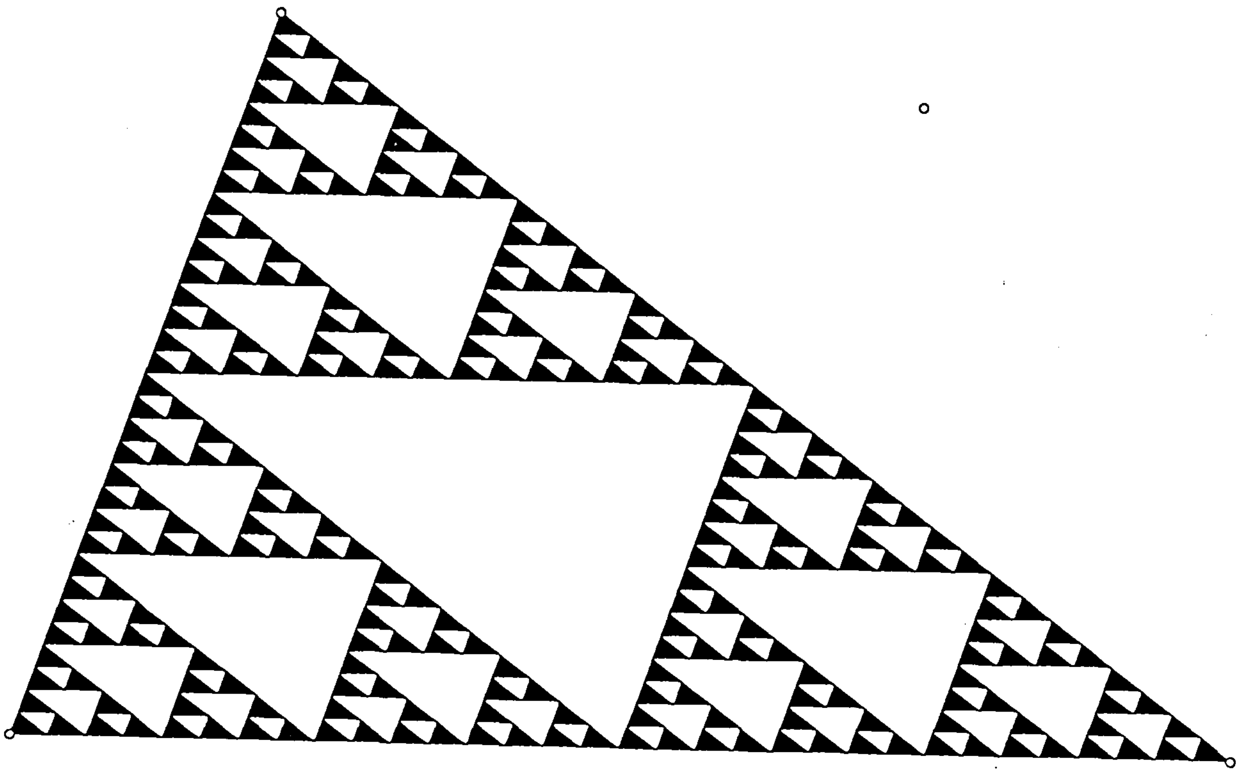
Geometer's Sketchpad

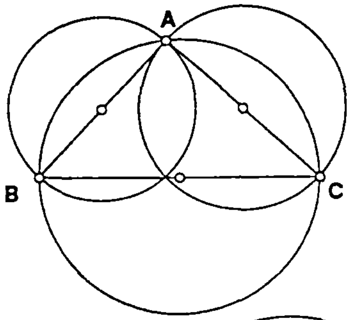
This computer package was devised to be used to establish geometrical results in a friendly way. Teachers will appreciate that there are two basic approaches to establish geometrical results.

Two ways to establish geometrical results

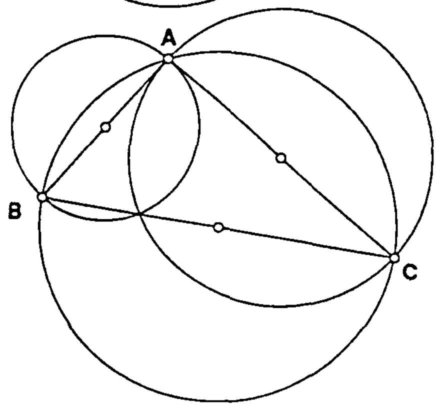


The Geometer's Sketchpad (and similar programs like Cabri Geometre) are effective because they enable students to explore many geometrical cases by measurement, conjecture and proof. The procedure is extremely rapid, with students being able to explore the following example within 5 minutes. They very quickly intuitively realise that the area of the circle on the hypotenuse is equal to the sum of areas of the circles on the other two sides. They can then go on to explore the areas of corresponding squares.

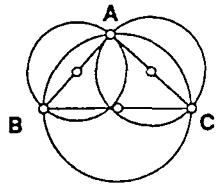




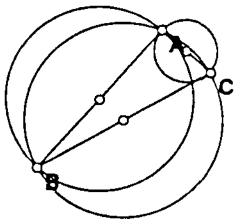
Angle(BAC) = 90 °
Area(Circle 3) = 12.72 square cm
Area(Circle 2) = 7.00 square cm
Area(Circle 1) = 5.72 square cm
Area(Circle 3)-Area(Circle 2)-Area(Circle 1) = -0.00 square cm



Angle(BAC) = 90 °
Area(Circle 3) = 20.64 square cm
Area(Circle 2) = 14.92 square cm
Area(Circle 1) = 5.72 square cm
Area(Circle 3)-Area(Circle 2)-Area(Circle 1) = -0.00 square cm



Angle(BAC) = 90 °
Area(Circle 3) = 3.54 square cm
Area(Circle 2) = 1.95 square cm
Area(Circle 1) = 1.59 square cm
Area(Circle 3)-Area(Circle 2)-Area(Circle 1) = -0.00 square cm



Angle(BAC) = 90 °
Area(Circle 3) = 6.39 square cm
Area(Circle 2) = 0.67 square cm
Area(Circle 1) = 5.72 square cm
Area(Circle 3)-Area(Circle 2)-Area(Circle 1) = -0.00 square cm

The Overhead Projector

Examples presented.

What this will mean to Korea/Australia relations

Segyehwa may be the solution to the world's problems. At present, environmental degradation is seen to be justified in terms of an unfortunate side effect of attaining an acceptable standard of living. So, Australia has to rely on massive exports of coal to maintain its standard of living. This coal is burnt to provide steel and power for other nations including Korea, and in the process over 700 million tonnes of deadly Carbon Dioxide is produced. Chemical agriculture, which was thought to be justified in terms of making Australian produce competitive on world markets, has been seen to have devastating consequences for some parts of Australia, with huge tracts of land rendered useless by salting. Now we are beginning to realise that environmental protection can be factored into economic activity, and can even be a positive influence for growth. Koreans and Australians share a special respect for the natural environment, and they have a high level of technical knowledge which needs to be shared. Globalisation may lead to greater rationalisation of economic productivity between nations without a decrease in standard of living.

What does segyehwa mean in terms of our professional activity? At the school level it is only a matter of time until schools and students are talking to each other over the internet. This will lead to greater collaboration, and inevitably, greater understanding. Korean students will learn English by communicating with students their own age, and Australian students will learn something of the culture and traditions of Korea.

There will be increased opportunities for teachers across the world to communicate and to examine each other's teaching style and practices. There are presently significant differences in the way Korean and Australian teachers go about their tasks, as well as in the conditions under which they work. Greater communication through the new technologies may lead to change in techniques curriculum and conditions in both countries.

Some Aspects of the Australian Situation

In the National Collaborative Curriculum Project, the national government is collaborating with state agencies to restructure the school curriculum. The driving issues at present are the need to improve the skill level of the workforce, and the need to provide courses which are meaningful for the additional 50% of students, who would, until recently, have left school at the age of 15. So far, the project has put forward proposals for curricula in arts, health, mathematics, English, studies of human society and environment; technology, science, and languages other than English. Each proposal is an attempt to put forward an umbrella for a host of different discipline areas. Studies in Human Society and Environment, for example, brings together history, geography, economics, Asian, legal, business, religious and Aboriginal studies, ecology, politics, law, sociology, anthropology, and global environment. These curriculum initiatives have encountered considerable opposition, because, as we all know, teachers are often reluctant to change. There has been some tension between those who work in the "real classroom", who have what might be called a localised view of schooling confined to the school and its community, and the administrators who have what might be called a wider view of the role and function of schooling, and who are attempting to bring about change.

The National Statement on Mathematics for Australian Schools

The Australian Education Council is a small group consisting of the 8 state Ministers for Education, and the National Minister for Education Employment and Training. In 1990, the Council endorsed the document "A National Statement on Mathematics for Australian Schools", which is the first curriculum document released under the National Collaborative Curriculum Project. Through the Advanced Education Council, each State and Territory has agreed to use the document:

- to review the advice and support they provide for mathematics teaching
- to plan professional development activities for teachers
- as a basis for further professional consultations.

The document was compiled by a reference group of mathematics consultants, who collaborated with mathematicians in Universities and colleges, mathematics educators, key professional associations, and a range of community groups. To recognise the role of the latter, it was decided to produce two documents - one for the profession, and one for a "community audience". The Statement is intended to inform current practice. While recognising the high quality of a range of existing practices, it suggests that significant changes in content and teaching method may be needed.

Broad Directions

The Statement has been written in two parts. The first part gives a general statement of principles, and attempts to answer questions such as "What is mathematics, why is it important, and for whom?", "What are the goals of school mathematics?", and "What conditions will effectively support the effective learning of mathematics?".

Part 2 sets out the recommended scope (what might be called the extent, and range; but what others might call "content") of the curriculum. This is described within 8 strands:

- attitudes and appreciations
- mathematical enquiry
- choosing and using mathematics
- number
- space
- measurement
- chance and data, and
- algebra.

Within each strand, detailed descriptions of topics and experiences are given within four population groups, called Bands. Band A corresponds to junior primary, B to senior primary, C to junior secondary, and D to senior secondary. The typical citizen would, it is claimed, need exposure to each of bands A,B, and C. The goal of schooling should be for all students to gain access to the mathematics contained in these bands, although at different times and at different rates.

It was not considered justified to include content on the basis that it had always been in the syllabus, or that it would be necessary for a small minority of students for future study. Rather, content was included if it was judged to be:

- clearly and directly useful for the majority of students,
- useful for the majority in the future, and needs gradual development
- of social or cultural significance
- pleasurable, and likely to improve attitudes towards mathematics.

The Statement took as fundamental, the following premises:

- students should study mathematics for the twelve years of schooling
- students will need to use mathematics when they leave school
- achievement and participation in mathematics should not be linked to gender, social class or ethnicity.

An important theme of the statement is that there are other important aspects of mathematical behaviour besides symbol manipulation. Mathematical thinking is seen to be just as important as content, and needs to be explicitly developed. The capacity to read, write, speak and listen to mathematics, and to material in which mathematics is embedded, are essential. "Getting skills" is not sufficient to ensure that students will choose to use them appropriately, or in the correct context. Understanding the nature of mathematics, and the role of conjecture, explanation and justification in mathematical thinking is also important.

For the number strand, the mental manipulation of quantities is regarded as more significant, in line with the new role for calculators as the "paper and pencil" of computation. Mental arithmetic should be regarded as the "major personal tool" for computation, with written arithmetic being held in reserve for computations which go beyond mental capacity. The Statement argues that students should have access to calculators at all levels, and it specifies what students should be able to learn to do with them.

There appear to be three sources of disagreement with the Statement. The first source argues that the Statement parallels the prescriptive National Curriculum in the United Kingdom which is enshrined in legislation. The second source sees the statement as supplanting the legitimate role of state departments of education, which have traditionally controlled curriculum. The third source fears that the statement will contribute to the diminution of standards of mathematical attainment. This latter group appears to argue that a certain level of mathematical skills is needed for students to undertake more advanced professional studies in engineering, physics, chemistry and economics.

A second phase of the project is the production of professional development packages for teachers in each of the strands. The first of these packages will be trialled in June. A related project has responsibility for developing a set of learning outcomes known as "Profiles". These will be used by teachers in reporting on individual achievement in mathematics, and will contribute to national reporting on the achievement of students. These have been widely distributed throughout the profession, and the Advanced Education Council moved to publication in 1994.

The Profiles

The Profiles are a complex and controversial attempt to move away from written answer tests to a more practical assessment regime in Australian schools up to Year 10. The intention is that teachers will closely examine each student's work, and come to a conclusion about that student's knowledge and capability. There are eight levels of competence spread over six topic areas.

Level	Working mathematically	Space	Number	Measurement	Chance and Data	Algebra
1						
2						
3						
4						
5						
6						
7						
8						

Within each topic area there are various contributing competencies. For example, within "Working mathematically", there are:

Investigating,
Conjecturing,
Using problem-solving strategies,
Applying and verifying,
Using mathematical language, and
Working in context.

Examples of outcomes that a teacher would be looking for in "Investigating" are:

Level 3 Poses mathematical questions prompted by specific stimulus materials

Level 8 Shows persistence, autonomy, flexibility and self-reliance when working mathematically.

Within "Chance and Data" the contributing competencies are:

Understnding, estimating and measuring chance variation,
Collecting data,
Organising data,
Displaying and summarising data, and
Interpreting data.

Examples of outcomes that a teacher would be looking for in "Collecting data" are:

Level 3 Contributes to discussions to clarify what data would help answer particular questions

Level 6 Plans experiments and surveys collaboratively and independently

The approach parallels similar initiatives in England, but the Australian profiles are a distinctive innovation. From the point of view of helping students to reach understanding and application, they are eminently reasonable. But it remains to be seen whether teachers will be able to put the profiles into practice, particularly at a time when Australian classrooms are becoming more difficult to manage.

The strength of the profiles framework is that it encourages a problem-solving approach. The teacher would pose a problem such as the following, and then observe the students at work to form a judgement about the level of their mathematical competence. The way a student behaves in response to the question will indicate the level of their mathematical thinking.

> The average of the numbers 0.1, 0.11, and 0.111 is:
>
> A) 0.041 B) 0.107 C) 0.11 D) 0.1111 E) 0.17
>
> Explain why options A and E are impossible.
>
> The person who set this question chose the wrong answers very carefully. Explain why they chose these wrong answers.
>
> Use a diagram to show why your answer is correct.

Booklets of student work on trials of the profiles have been published to guide teachers. Examples of student work follow.

References:

Mathematics - Work Samples. (1994) Melbourne: Curriculum Corporation.

Mathematics - a curriculum profile for Australian schools. (1994) Melbourne: Curriculum Corporation.

Olssen, K., Adams, G., Grace, N., and Anderson, P., (1994) *Using the Mathematics Profile.* Melbourne: Curriculum Corporation.

The outcomes involved in this example are:

Working mathematically

Strand organiser	Outcome at level 3:	Outcome at level 5:
Investigating	Poses mathematical questions prompted by similar or related questions or by specific stimulus materials	Begins and extends tasks by asking some mathematical questions, including 'What would happen if...'
Conjecturing	Makes and tests conjectures including by responding to questions of the kind 'What would happen if...'	Understands a conjecture as a guess with reasons and draws on mathematical knowledge to give reasons for conjectures before testing them
Using problem-solving strategies	Uses problem-solving strategies that include those based on selecting key information and representing it in models, diagrams and lists	Uses problem-solving strategies, including those based on selecting and organising key information and being systematic
Applying and verifying	Uses a variety of ways when prompted to check working and choice of method	Checks that answers fit specifications and make sense in the original situation
Using mathematical language	Integrates terms and notations from space, number, measurement and chance and data into comparisons and descriptions of things	Uses mathematical terms and notations with some care to describe objects and relationships and report conclusions with clarity
Working in context	Describes some of the mathematics of own and other cultures, past and present	Explains some ways mathematics is used, or has been in the past, to represent, describe and explain our world

A

(4 x $5.95) + 3x(3.42 x $9.25) =

B

C

I used a calculator to work ib out. Because I used a calculator I took away the dollar sign and the decimal point. Then I did the 3.42 x 925 and I got 3 163.5.

D

Then I figured out that that would be $31.63.5 **F** Because you cant have 0.5 of a cent you would bring the price up to $31.64. **E**

To work out the next part I used the calculator again. The answer was $23.80 **G**

H

To work out the total I added $31.64 + $23.80 and I got $55.44. So that I got it right in my head I tested ib on the calculator. It was right.

I