Love the new syllabus but where is the text book? Reconceptualising mathematics for senior high school students to build their confidence and success

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This paper is about the development of Prevocational Mathematics: a numeracy syllabus to build student confidence and success. It outlines how we created this syllabus, including:

meeting the political imperatives of the Queensland state, and Australian federal governments and the needs of teachers and senior students (those in Years 11 and 12)

reconceptualising the existing syllabus to incorporate current national and international research on numeracy teaching, learning and assessment practices; numeracy in and for the workplace and financial numeracy.

This new syllabus, by way of detailed examples of good pedagogy and lots of resources, especially hotlinked websites, models ways that work in practice and that do not rely on textbooks. For some teachers, this syllabus is frightening— for others, it is where they have wanted to go with mathematics for a long time.

The Queensland Studies Authority does not run schools. It is a statutory body that is legislated to:

- write syllabuses and guidelines and help schools implement them by providing professional development and support materials
- develop tests for years 3, 5, 7 and 12
- issue senior certificates and tertiary entrance statements.

This paper outlines the successful development of Prevocational Mathematics— a mathematics syllabus for young adults in years 11 and 12 who lack confidence in their abilities and who have had negative experiences in 'school mathematics'. This syllabus replaces an older one called Trade and Business Mathematics. These students do not want to do the academic tertiary entrance mathematics subjects (there are three: Mathematics A, B and C) and typically most have not experienced much success in their previous studies of mathematics.

Syllabuses in Queensland are curriculum frameworks that schools use to construct courses of study. This syllabus is one of a group called study area specifications (SASs). Unlike the syllabuses for tertiary entrance, the work the students do in SASs is not externally moderated by groups of teachers. In both types of syllabuses, school-based assessment is the cornerstone with no external testing in any subject. Schools develop courses of study that differ from school to school to suit students and available resources.

Not being able to do tertiary entrance mathematics is considered the world over, to be a sign that you are inferior — mathematics ability is used as an academic and social filter. The fact that most students who can do the 'harder', more theoretical and abstract mathematics, never use it again in their lives, does not matter: they are better people because they studied a 'hard course'. No wonder some students hate mathematics –from their earliest years there is a stigma attached to those who 'cannot do' mathematics.

Subject names are crucial to try to avoid the ultimate put down of 'vegie' or 'spac' or 'spazo' mathematics, which, by association means that students and teachers of such a subject must also be rejects or deficient in some way. The original title was 'Trade and Business Mathematics', although it was not about 'trade' or 'business' but it had a good acronym for school timetables: TBM. Teachers were TBM teachers of TBM kids.

Students would turn names like 'Mathematics for Living' (a textbook title from years ago) into 'Mathematics for Dying' (a lucrative enterprise of course). 'Practical Mathematics' would become 'Impractical or Useless Mathematics' (and the acronym would be IM or UM!) and so on. The name we almost decided on: 'Workplace and Personal

Mathematics' had to be rejected because of its acronym: WAPM. Eventually we decided on 'Prevocational Mathematics' to denote preparation for future vocations from paid to unpaid that may require some mathematics. Teachers like the title—they think it will give the subject the much sought after 'above vegie' status and the acronym is 'safe'.

Why redevelop the SAS?

During the redevelopment of the SAS according to the prescribed cycle of syllabus revision, we took account of government agendas and teacher dissatisfaction with the existing SAS.

Cycle of syllabus revision

The QSA has a six-year cycle of syllabus revision. This is the time between implementation of revised versions. It involved officers (us) working with a subcommittee of teachers and at least one tertiary person (about nine people who are not paid for their services). Progressive drafts of the syllabus were presented to a Mathematics Advisory Committee of about twenty (practising teachers, tertiary academics and one parent who is neither) who decided when it could proceed to the Curriculum Committee (of Principals). This committee recommended to the Governing Body of the QSA that the syllabus proceed to implementation because it met QSA standards and served the needs of teachers and students. During these quality assurance processes, drafts were put on the QSA website and distributed to a consultative email network of interested teachers for feedback. We sought face-to-face feedback about progressive drafts from heads of school mathematics departments at organised cluster meetings. The very positive responses ('this is just what we need') encouraged us.

The writing of the syllabus took two years. It is being implemented in 2005 and 2006. Standards and Assessment Officers presented the syllabus to teachers in fourteen workshops across the state in February, March and April 2005. These workshops helped teachers understand the philosophy behind the syllabus, share ideas and plan their courses.

Government agendas

(a) Education and Training Reforms for the Future (ETRF)

Currently, Queensland is undergoing major reform in its educational offerings as part of the Education and Training Reforms for the Future (ETRF), 2002. This agenda requires that students be 'earning or learning' at age 16. Many initiatives to facilitate this are under trial ready for implementation in 2006. As part of ETRF, vocational education offered in schools should link to future pathways for students and be highly regarded by industry. This is always a problem for vocational certificates in subjects like English, Mathematics, and Religious Studies because they do not immediately and obviously connect to being a plumber, welder, carpenter, plasterer, diesel fitter or chef (all jobs that are in demand in this state).

The original Trade and Business Mathematics, syllabus developed in 1996 and revised in 1999, used unsuitable vocational certificates that were at too high a level. These certificates were part of the government agenda of the day – one that pushed vocational education. Many countries were doing this at that time. These irrelevant vocational certificates had to be removed and not redeveloped even though many schools mistakenly believed that these certificates had value.

(b) Retention rate

The state government has set an above 80% retention rate to be reached. Many students do not take the tertiary entrance mathematics subjects. Syllabuses have to be developed to meet the needs of students who may not want to remain at school, but must do so until they are 16 or have a job. Teachers need useful pedagogical advice about helping these students to learn in a school setting.

(c) Literacy and numeracy

Concerns about literacy and numeracy loom large on state and federal government agendas. The implementation of the ETRF agenda and increased retention rates have meant that SASs in English and Mathematics had to ensure that they met the needs of students who may not be very literate or numerate and are not tertiary bound. This meant that we had to understand how young people become numerate. This involved conducting a journal and resources search on numeracy teaching and assessment around the world. This research informed the redevelopment of our syllabus.

Teacher dissatisfaction

Teachers across Queensland teaching the original Trade and Business SAS (in 206 schools) were surveyed about what they thought of this old syllabus and asked for ways of improving it. We had a 49% return rate – which is unusual (the typical return is about 25%). A high return rate means dissatisfaction and spleen venting! The resulting 39-page report of teachers' answers to questions and their additional comments (May 2003), guided the revision. It revealed that:

- many teachers and students were unhappy with the irrelevant vocational certificates; many students could not complete them
- teachers liked some aspects of the existing SAS because their students experienced success
- some teachers were not teachers of mathematics and felt they had been 'dumped with the vegie maths kids'
- students were not interested in trigonometry or algebra but did like practical activities that meant something to them
- there were two types of students studying the old SAS, both without well developed numeracy: those who were compliant and willing to work on whatever the teacher provided (often a textbook of exercises) and those who were considered 'feral' and who objected to whatever the teacher provided (yes – a textbook of exercises); some teachers did do radical things like not use a textbook – inventing interesting activities that all the students enjoyed.

The syllabus: not your typical mathematics syllabus

It is different: it is reconceptualised not rehashed

Prevocational Mathematics is different from all other Queensland syllabuses in Years 11 and 12 in that it has an extensive pedagogy section and a large appendix of examples of contextualised assessment that has been developed and used with real students. Our P-10 syllabuses provide this sort of help but our senior syllabuses do not – an interesting difference which will disappear in the near future. The QSA wants more support in or accompanying its senior syllabuses for several reasons: teachers are increasingly busy and do not have the time to keep up with current research in teaching; they may be inexperienced, in an isolated school, or not be a specialist teacher of that subject; they may be in regional areas of Queensland and unable to attend workshops because of large distances to travel and the cost involved.

It is also different from other QSA mathematics syllabuses because it:

- defines numeracy and does not relegate the term to low ability students
- aims to build student confidence and success by encouraging teachers to:
    - view students in terms of what they are able to do rather than in terms of the deficit model
    - scaffold student learning carefully and closely
    - provide much more support to students
- reconceptualises *what* is taught by connecting it to the workplace, leisure and informed citizenship
- reconceptualises *how* mathematics is taught by:
    - placing much more emphasis on pedagogy than content (a problem for textbook writers)
    - promoting learning that is truly contextualised: not confined mostly to textbook-based algorithms or hypothetical scenarios that do not interest students (again a problem for textbook writers)
- promotes a view of assessment that is not based on traditional examinations.

Defining numeracy- a minefield of different opinions

None of the QSA's senior mathematics syllabuses have defined numeracy. We decided to break from tradition and enter the numeracy minefield. This is a dangerous place comprising hundreds of definitions—from those constructed by governments for their own agendas to those constructed by academics, employers, parents and students. Much can hinge on which definition is used formally or informally by different individuals and organisations.

The definition we used in the rationale of the syllabus reflects a broad view of numeracy, not one that is (Steen, 1999) 'just an expanded list of topics to be added to the mathematics curriculum' (p. 3) or one that has the subtext of deficiency —'less mathematics' or 'under-achievement' (O'Donoghue, 2002, p. 49). This definition is a combination of one used by the McLean (1997, p. 5) and a longer one by Gal, van Groenestijn, Manly, Schmitt, & Tout (1999).

> Numeracy is the 'effective use of mathematics to meet the general demands of life at home, in paid work, and for participation in community and civic life'. Numeracy is more than being able to operate with numbers. It requires mathematical knowledge and understanding, mathematical problem-solving skills, literacy skills and positive beliefs and attitudes. When students become numerate they are able to manage a situation or solve a problem in real contexts such as everyday life, work or further learning. This involves responding to these contexts by identifying or locating, acting upon, interpreting, and communicating mathematical ideas and information. Students learn to represent these ideas and information in a number of ways. (syllabus p. 3).

This definition:

- links directly to the way the Australian National Reporting Standards (NRS) for numeracy are constructed: around making meaning, problem solving and communication—we developed our 'expectations of the learner' from their level 3 and some level 4 expectations
- takes account of the shift from a focus on 'an immutable, discrete set of mathematical concepts and skills' to 'multiple practices' shaped by, or situated in social or cultural contexts (Johnston, 2002, p. 20).

Not the deficit model: reconceptualising the 'who'— building student confidence and success

We know that a syllabus cannot by itself alter deeply-held beliefs. The teacher survey results told us that the transmission mode of teaching via a textbook was alive and well, and that students were blamed for failing to achieve. The students were viewed as deficient in many areas of mathematics, and in their attitudes to using mathematics. So there was a need to help teachers reconceptualise the students they were teaching (in terms of numeracy and how to re-engage low achieving adolescents). We agreed with Marr and Tout (1997) that

> numeracy teachers…..needed to confront their assumptions about mathematics and mathematics teaching if they were to offer effective learning experiences to students who had not been successful in the traditional mathematics classroom. (quoted in Johnston,2002 p. 48).

Non-mathematics teachers also teach this subject so their assumptions needed to be confronted as well, but all this confronting had to be done gently. There was also a need to help students reconceptualise the mathematics curriculum and the purpose of the mathematics classroom. We believe our SAS can help teachers discard the deficit model and build student confidence and success (which will in turn help students to disregard their own deficit views of teachers).

Teachers need help to 'confront assumptions'. We have provided this in two ways:

- To help teachers establish a positive learning environment at the start of a course, the SAS provides an outline of possible lessons, a worksheet and sample of a learning contract. This has been adapted and developed from Marr & Helme, (1999) by of one of our subcommittee teachers and used for several years with low achieving adolescent boys. She says that the change in their attitudes to mathematics in the first three weeks of Year 11 is phenomenal; they are happier and more willing to work together. Other teachers are now using this material and experiencing the same attitudinal change from their students and in themselves.
- We have also outlined the features of a supportive learning environment in the introduction to the section on teaching strategies. This helps teachers to confront assumptions concerning how to teach mathematics and what their classrooms might be. The information borrows from the approach in primary schools, which, for a variety of reasons, we don't often use in secondary schools.

  Syllabus extract: *In a supportive learning environment:*
  - learning is cohesive: highly-structured, scaffolded and in manageable steps under close supervision
  - students' own experiences are valued and used as starting points for teaching instead of viewing students in terms of the 'deficit model'
  - activities are varied sufficiently to increase attention span and improve memory by:
    - allowing students to move around to other locations in the classroom (or outside as a class) for some activities rather than remaining continuously desk-bound
    - including whole- and small-group class discussions, roleplays, seminars, etc. rather than relying primarily on 'teacher talk'
    - using humour where suitable to engage the emotions

- assistance such as hints, rules and modelled examples are provided to help students make informed decisions
- more than one opportunity is provided for students to demonstrate their understanding
- adequate time is provided for students to process information
- encouragement and constructive feedback are given freely
- students are praised, reassured and rewarded for improvement in learning — thus the learning environment is non-threatening
- there is a range of different stimuli such as posters (that are changed regularly), plants, soft background music, videos, guest speakers, games, computer software, manipulatives.

From discussion with our subcommittee, tertiary contacts and advisory committee, and from our own teaching backgrounds, we know that many teachers are afraid to be creative. This is because they assume that mathematics is about algorithms, and therefore so must numeracy be. They needed *permission to be creative* and examples of how to do this. Our new SAS provides lots of examples of different learning experiences, assessment ideas, teaching strategies and contextualised 'projects'.

Reconceptualising the 'what'

When considering the 'what' of the SAS, the following points made by Forman & Steen (2000) served almost as guiding 'principles':

- many mathematics teachers have 'virtually no experience using mathematics in real work contexts' (hence we would provide examples)
- 'many studies show that adults rarely use much of the mathematics they learned at secondary school' (hence we had to decide what is of use after school)
- 'workplace tasks typically require sophisticated problem solving using primarily elementary mathematics'. (p. 86)

School versus workplace mathematics

Workplace mathematics is often very different from school mathematics. Workplaces, with their own social and cultural practices, require that workers use workplace-specific numeracy practices to ensure efficiency – these differ from workplace to workplace, even in the same industry.

According to Vergnaud, (2000)

> the mathematical domains that appear again and again in the routines at the workplace are: proportionality, graph reading, map reading, evaluation and approximation. (page XVIII).

This observation belies the conundrum that, in some industries, the mathematics (to a mathematician) is overt (carpenters read an imperial-to-metric conversion table), while in other industries, there 'appears' to be no mathematics involved at all.

For example, boat builders mix fibreglass and binders by the feel of the mix, adjusting the amount of binder by trial and error depending on conditions, such as on a humid or cold day, pool builders do not use formal measurement and geometry— instead they estimate by eye (among other 'tricks of the trade') the number of truckloads of soil to be removed (Zevenbergen, 1995).

These different ideas about what mathematics is or is not in the workplace can be traced to different perceptions of what is numeracy. These different perceptions are also held within workplaces. Numeracy in the workplace research (in which the QSA is an advisory and funding partner) involving school leavers working in 19 Gold Coast small industries, revealed that older employers saw numeracy as related to number work only (pencil and paper calculating and mental arithmetic). In sharp contrast, school leavers and younger employers saw numeracy as 'an applied notion' —they did not bother with mental calculations or algorithms when a calculator or computer was handy; they viewed problems holistically, applying their number sense, problem solving and estimation skills (Zevenbergen, R. & Zevenbergen, K. 2003). The definition of numeracy used in the SAS supports this latter view.

No school mathematics syllabus can hope to teach students how mathematics is used in every workplace, nor could such a syllabus keep up to date with the rapid changes in workplace practices. Our SAS takes account of the above research by preparing students for the workplace through:

- explicitly promoting calculator and computer use

- revisiting the mathematics from the compulsory years of schooling in a way that appeals to young adults
- promoting development and use of range of mathematical skills such as,
  - estimation and approximation
  - multiple problem-solving strategies (including evaluating)
- taking a more applied approach to teaching mathematics (encouraging teachers and students to 'see' mathematics in everyday activities)
- providing examples of numeracy in the workplace
- encouraging schools to organise work experience for Prevocational Mathematics students so they can see numeracy as situated practice and apply some of what they learned in school.

Organisation of the mathematics

In the SAS, the mathematics is intertwined through the general objectives of *knowing*, *applying* and *explaining.* These are defined below:

> *Knowing* involves knowledge of content and the use of basic skills such as working with given rules, operations and procedures in simple situations. It also involves learning how to use measuring instruments and calculators. The use of computer software is strongly encouraged. The recall of rules is not a requirement of this objective.
>
> *Applying* involves students using familiar mathematics in different contexts in a supported environment. This means that when carrying out tasks, students interpret and analyse these contexts to identify familiar mathematics. This allows them to develop strategies (for example, organising, comparing and validating), select and apply rules and procedures (for example, measuring, calculating) and, where relevant, predict consequences and reach decisions.
>
> *Explaining* involves students using basic mathematical and everyday language to present and explain their responses to tasks in both familiar and different contexts. Their responses can be presented in various forms for different purposes to suit the task: orally, visually or in writing. To explain their responses, students describe, state opinions, outline arguments, comment on and give reasons for suggested consequences, proposed recommendations or decisions. (Syllabus, p. 7).

Content in contexts; five topics

The SAS outlines five topics that are not studied as stand-alone, but in combination and in contexts that are meaningful to students. The topics may be revisited in different contexts during the course. They are grouped into three categories according to the purposes and functions of using mathematics in various contexts. They are based on the framework of the 2002 Victorian Certificate in General Education for Adults (CGEA) developed by Language Australia.

The five topics are:

> *Mathematics for interpreting society: number (study area core)*
>
> *Mathematics for interpreting society: data*
>
> *Mathematics for personal organisation: location and time*
>
> *Mathematics for practical purposes: measurement*
>
> *Mathematics for personal organisation: finance.*

These topics were designed to link directly to the Years 1-10 Key Learning Area Mathematics (KLA) syllabus both in content and pedagogy. The KLA has eight levels: foundation, levels 1-6 and beyond level 6 discretionary outcomes. Prevocational Mathematics presumes that Year 11 students enter the subject having achieved level 3 or 4 (about grades 5-7) outcomes or equivalent. In contrast, to enter Mathematics B or C for tertiary entrance, students have to achieve the beyond level 6 outcomes, usually in Year 10.

Threaded through the topics are most of the mathematical demands in:

- the numeracy component of the Certificate II in General Education for Adults (CGEA)
- the entry level trainee requirements in ten training packages (O'Callaghan, 2000)
- six of Steen's 'seven strands of quantitative thinking' (1999, pp.3-4), suggested for grades 5-9, excluding finding unknowns by manipulating symbols or using models which is too abstract for students; the strands are:

- higher arithmetic (ratio, percentage, proportion)
- measurement geometry in two and three dimensions (length, area, angles, volume)
- data analysis (graphing data, estimating error, we did not use the term 'statistics' as it has connotations for teachers of complex formulae)
- mental arithmetic (estimation, approximation, mental calculation but not requiring 'exact' mental calculation)
- argument and persuasion (types of reasoning, using quantitative evidence)
- chance and risk (we did not use the term 'probability'— instead students estimate, compare and control risk).

In developing the finance topic, we relied heavily on the *Financial Literacy in Schools*, ASIC (Australian Securities and Investment Commission) discussion paper, June 2003. This paper defined financial literacy (or 'numeracy' in terms of our syllabus) as:

> the ability to make informed judgments and to take effective decisions regarding the use and management of money (p. 12).

Reconceptualising the 'how'

To help teachers reconceptualise their own teaching practices we used twelve of the thirteen strategies outlined by Ginsburg and Gal (1996). These strategies, which drew upon an overview of more than 20 years of research focused on adults who had "deep-seated negative beliefs and attitudes towards….mathematical learning" (p. 1).

We incorporated into these strategies:

- practices that our subcommittee of teachers had developed that were effective in re-engaging students
- ways of changing the classroom environment to take account of brain research and adolescent learning
- research on effective teachers of numeracy (Doig, 2001)
- the teaching strategies in the CGEA.

The strategies are listed below – they are expanded in detail in the syllabus (pp. 31-41).

1. Ascertain and evaluate attitudes and beliefs regarding both learning mathematics and using mathematics: getting to know your students.
2. Determine what students already know about a topic before instruction.
3. Provide opportunities and time to explore mathematical ideas with concrete or visual representations and hands-on activities.
4. Encourage the development and practice of estimation skills.
5. Encourage development of mental mathematics skill as an alternative computational strategy.
6. View computation as a tool for problem solving, not an end in itself.
7. Encourage the use of multiple solution strategies
8. Develop students' calculator and computer skills.
9. Provide opportunities for group work.
10. Provide opportunities for students to communicate about mathematical issues.
11. Plan for practical and contextualised learning.
12. Develop students' skills in interpreting numerical or graphical information in everyday texts.

The notion of contextualised learning and assessment permeates all the research on the teaching of mathematics and the development of numeracy. What we are promoting is that teachers use contexts that students are interested in and which are relevant to them (be it 'schoolies', the 'formal', mobile phones, childcare or buying a car) rather than what we, as teachers, think is relevant. We encourage teachers to think of mathematics not just as tasks on school worksheets but as something that arises naturally in many contexts' (Steen, 1999, p. 3).

Reconceptualising assessment: but I have to have an exam

Just as assessment grows out of learning experiences, the assessment strategies were developed from the teaching strategies listed above. The following quote from the syllabus, summarises the intent of assessment:

> Regardless of whether assessment is informal or formal, it should extend well beyond examining students' ability to find the right answer for a computational exercise. It should assess the many additional skills and knowledge areas that are part of being numerate, such as interpreting claims about data, acting upon numerical information in technical documents and forms, applying mathematical reasoning and solving realistic problems, communicating about mathematical issues and explaining one's reasoning (p. 45).

The assessment strategies are listed below. They are outlined in detail in the syllabus (pp. 45-48).

1. Conduct assessment mostly in class time.
2. Encourage students to talk about what they are doing and the choices they are making.
3. Develop contextualised assessment tasks.
4. Use open-ended extended tasks that may have more than one reasonable solution and/or solution path.
5. Assess a broad range of skills and reasoning processes using a range of written and non-written methods.

The syllabus also states that:

> Because this study area specification emphasises contextualised assessment of a broad range of skills and reasoning processes and is not test-based, *it is strongly recommended that examinations be kept to a minimum or not used at all. If they are used, then they should be 'open book' — students should be able to bring resources to the examination to help them*. (p. 46).

Making judgments about student work

During a course of study, students develop a folio of evidence upon which teachers make judgments about student achievement in the general objectives of knowing, applying and explaining. QSA syllabuses use a framework for making these judgments. This framework comprises criteria and standards. The criteria: knowing, applying and explaining are derived from the general objectives. The standards awarded for each of these criteria are descriptions of the typical performance of a student on a scale from A to E. A set of principles of assessment is used to assist teachers to come to an exit judgment and overall level of achievement. For this reconceptualized SAS, we provided additional advice to teachers to help them apply the standards. This advice required them to take into account the nature of support that different students will need during assessment, to help them achieve.

Implementation: introducing the SAS to teachers

At a series of fourteen workshops across Queensland in 2005, teachers were encouraged to share with their peers what they did and to try to be creative in developing learning contexts for their students. One teacher took his students to cemeteries – to do 'cemetery maths', another did market gardens, another did the mathematics of murder. A teacher at Chinchilla, in the far west, planned to buy poddy calves and do the mathematics of growing and selling them (and the mathematics of slaughtering them too!). We did not put this last idea in the SAS (can you imagine it in a textbook?).

These creative teachers were fearless and had supportive administrations. They confidently and enthusiastically 'sold' their ideas to the fearful teachers at the workshops. We encouraged the teachers to have fun with the students and to *always ask students what they thought of the activity*: how could it be improved; did they understand what they were trying to do; did they have success?. This was another ploy to view students differently: as people whose opinions do matter.

Teacher feedback about the syllabus as presented in workshops, varied but was predominantly positive. Below is a sample of teacher evaluations:

- Love it – it frees me up to do what I want and what the kids are interested in.
- So easy to read and so many good ideas.
- Love it but I am not very creative, so where is the textbook?
- Well it is not real mathematics is it?

Conclusion

In reconceptualising this Year 11-12 syllabus, we have met the needs of teachers and followed state and national government directives to produce a syllabus that is grounded in extensive research and supported by samples of good practice, lots of ideas and resources. It is connected to the Years 1-10 Mathematics syllabus and provides a way of building students' confidence and success. Implementation has commenced in 2005 with a predominantly positive response from teachers at workshops. They appreciate the scope of the syllabus and the opportunity to be creative in developing ideas for contexts.

Entrenched behaviours and lack of time to be creative or even laziness for some teachers mean that we have heard the comment several times 'love the syllabus but where is the textbook' (in pleading tones). We know of at least one publisher in Melbourne who has commented to us that their writers were going to have difficulty writing a textbook because the syllabus did not lend itself easily to a textbook –now you know why.

References

Australian Securities and Investments Commission (2003). *Financial Literacy in Schools*, discussion paper, June. Sydney: ASIC.

Department of Education, Training and Youth Affairs, Australia. *National Reporting System* (NRS). Retrieved February, 17, 2003 from the World Wide Web: http://www.nrs.detya.gov.au/theory/26comm.htm

Doig, B. (2001). *Summing Up: Australian numeracy performances, practices, programs and possibilities*. Camberwell,Victoria: ACER.

Forman, S. & Steen, L. (2000). Bringing School and Workplace Together: Preface to section 2. In Bessot, A. & Ridgway, J. (Eds). *Education for Mathematics in the Workplace.* Mathematics Education Library (Vol. 24). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Gal, I., van Groenestijn, M., Manly, M., Schmitt, M., & Tout, D. (1999). *Adult Literacy and Lifeskills Survey Numeracy Framework Working Draft*. Retrieved March, 23, 2003 from the World Wide Web: http://www.ets.org/all/numeracy.pdf

Ginsburg, L., & Gal, I. (1996). *Instructional Strategies for Teaching Adult Numeracy Skills*. Philadelphia: National Centre on Adult Literacy, University of Pennsylvania.

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

Johnston, B. (2002). *Numeracy in the Making: Twenty years of Australian adult numeracy.* Sydney: ALNARC, University of Technology.

Johnston, B., Baynham, M., & Kelly, S. (2001). *Understanding numeracy practices: Pedagogical implications*. Sydney: University of Technology.

Johnston, B., Baynham, M., Kelly, S., Barlow, K., & Marks, G. (1997). *Numeracy in Practice: Effective pedagogy in numeracy for unemployed young people*. Canberra: Australian National Training Authority.

Marr, B., & Helme, S. (Eds.) (1999). *Mathematics: A New Beginning: A resource book for teachers of adults returning to study*. Victoria: ARIS Language Australia.

McLean, K. (1997). Towards a national report card. *EQ Australia, Assessment*, Spring. Curriculum Corporation. Retrieved February, 17, 2003 from the World Wide Web: http://www.curriculum.edu.au/eq/archive/eq_97/mclean.htm

O'Callaghan, C. (2000). *Literacy and Numeracy for VET: The nuts and bolts of vocational education and training*. Canberra: DEST. Retrieved February, 19, 2003 from the World Wide Web: http://www.decs.act.gov.au/publicat/litnumVET/default.htm

O'Donoghue, J. (2002). Numeracy and Mathematics. *Irish Mathematics Society Bulletin.* 48, 47-55.

Queensland Studies Authority. (2004). *Prevocational Mathematics Study Area Specification*. Retrieved March, 15, 2005, from the World Wide Web: http://www.qsa.qld.edu.au/yrs11_12/sas/math-prevoc/index.html

Queensland Government. (2002). *Education and Training Reforms for the Future*: A white paper. Brisbane: Queensland Government.

Queensland Studies Authority. (2003). *Report of Results of Teacher Survey: Trade and Business Mathematics SAS*. Internal publication.

Steen, L. (2001). *Mathematics and Numeracy: Two literacies, one language*. Retrieved December, 1, 2004, from the World Wide Web: http:www.stolaf.edu/people/steen/Papers/twolits.html

Steen, L. (1999). Numeracy: The new literacy for a data-drenched society. *Educational Leadership*, *57* (2) 8-13. Retrieved December, 1, 2004, from the World Wide Web: http://www.ascd.org/publications/ed_lead/199910/steen.html

Language Australia (2002). *The Certificate in General Education for Adults* (GCEA). Melbourne: Adult Education Resource & Information Service.

Vergnaud, G. (2000). Introduction. In Bessot, A. & Ridgway, J. (Eds). (2000). *Education for Mathematics in the Workplace.* Mathematics Education Library (Vol. 24). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Zevenbergen, R. (2004). Technologising Numeracy: Intergenerational differences in working mathematically in new times. *Educational Studies in Mathematics 56* (1) 97–117.

Zevenbergen, R., & Zevenbergen, K. (2003). Numeracy in New Times: Implications for youth, work and employment. In J. Mousley (Ed.), *Mathematics education research: Innovation, networking and opportunity: Proceedings of the 26th Annual Conference of the Mathematics Education Research Group of Australasia*, Vol. 2, (pp. 799-807). Geelong: Mathematics Education Research Group of Australasia.

Zevenbergen, R. (1995). The Situated Numeracy of Pool Builders. *Critical Forum 4*, (2) 34-46.