Get your head in the gutter

Moira Hobbs[1]
Unitec
New Zealand

Abstract

This year has seen the writer take on a new role as the part time learning development lecturer on a new campus. One of the cohorts of students arriving at the desk-face is a group of drainlayers studying a night-class one evening a week, with the aim of passing the national Drainlaying Registration Examination prescribed by the New Zealand Plumbers, Gasfitters and Drainlayers Board. This paper profiles the students, in particular those making use of numeracy assistance from the learning development lecturer. It then discusses the students' learning needs, some methods used to address these needs, and some of the resources available.

Introduction

At the beginning of this year, the writer started employment in a new role, as the part-time academic learning development lecturer (ALDL) at a new campus specifically focusing on vocational level courses. The main course to be considered in this paper is drainlaying, and I will discuss the numeracy difficulties experienced by some of the students and how these were dealt with, and also outline how my role this year has influenced my thinking about academic development work and support for these students. I will then describe the process and practice of offering our vocational students a hand across the Mathematics Learning Development Bridge to a position of strong subject knowledge, and the ability to autonomously build and cross their own bridges in the future.

Background

During 2006 the Government developed the Tertiary Education Strategy 2007-12 and produced the Statement of Tertiary Education Priorities (STEP) (Ministry of Education, 2007). This document "highlighted areas of urgent action for the next three years… and this included 'increasing literacy and numeracy skills of the workforce' and 'achieving qualifications at level 4 and above by age 25' as two of four national priorities" (Benseman, 2008, p.18). There was a study completed in August 2007, the Review of Tertiary Needs in the North and West, and this identified a vocational training need in the north-eastern corridor of the Auckland region. As a result, the new Unitec North Shore campus was first envisaged in late 2007, and came to fruition in February of the following year (now called Dept of Community Studies - Te Pae

[1] Hobbs, M. (2009). Get your head in the gutter. In M. A. F. Silvester (Ed.), *Transformations: Proceedings of the 2008 Annual International Conference of the Association of Tertiary Learning Advisors of Aotearoa New Zealand (ATLAANZ)*, (pp. 50-67). Auckland, New Zealand: ATLAANZ.

Whanaki North Shore) with a preliminary three year start-up period underwritten by TEC. It is seen as an incubator project for the institution.

The current range of Certificate courses offered are in Applied Technology (Interior Design, Autotronics, Electronics Engineering), Foundation Studies, English, Business Administration and Computing, Community Skills, Information Technology, Free4U Computing, Workplace Communication, Drainlaying, and Automotive Engineering. Most are during normal working hours, but some are night classes to accommodate those students who are also employed either part or full time.

Although the majority of our 384 students classify themselves as NZ European, with Chinese the next largest group, followed closely by Korean and British/Irish, there is a rich multicultural mix of 26 nations:

NZ European	168	Australian	9
Not declared	33	African, Middle Eastern	8
Chinese	27	Other European	8
Korean	20	Samoan	5
British/Irish	19	Cook Island	4
NZ Maori	16	SE Asian, Sri Lankan, Fijian	3
Other	16	Tongan, Niue, Filipino	2
Indian	12	Cambodian, Dutch, Italian	1
Other Asian	11	Turkish, Japanese	1

While the average age of 45 is higher than that desired by TEC, this is probably because a number of mature students are retraining and transforming their careers, particularly in the Interior Décor and Business Admin & Computing courses … and the average is also pushed up by the Free4U demographic – the oldest of whom is 87! The institution is indeed attracting students from the local area, which is another aim of the community-focused vocational funding (see Figure 1).

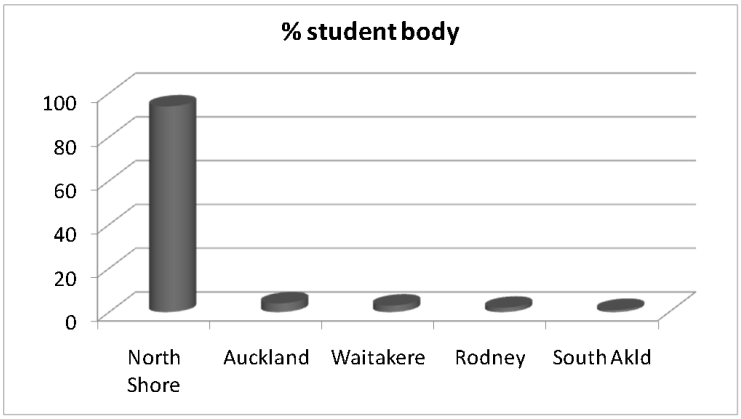


Figure 1. Geographical spread of the student body

One of the four male students who are the subjects of this paper initially visited the learning development lecturer (LDL) after being advised by his course lecturer who

had had previous experience with the LDL at the Main Campus. What began as a one-off consultation transformed into regular 1 – 1½ hour drop-in sessions preceding the night-class. Although the groups mainly comprised 3 students, numbers fluctuated from 1-4 on any given day.

The students' ethnicities were: Niue (1), NZ (2), English/Irish-NZ (1). Three of them lived locally, while one came from the extreme south of Auckland. They were 21, 23, 35, and 37 years of age and, although they had all attended secondary school, only one had a formal educational qualification (from overseas). Three of them had previously done tertiary level courses - Construction Site Safety (2 students) and Construction Passport (1 student) – and passed on the second attempt. One was also repeating the drainlaying course. This student also had a NZ Certificate for the Motor industry. They all had access to a PC with broadband at home, but overall their interaction with computer technology was basic.

In common with all mature students, there were many competing demands on their time. During a one week period the students were involved in the following scenarios:

Student 1 had four hours' sleep then completed a day's work starting at 7 am. Then he drove for about 45 minutes to attend a 1 ½ hour maths calculations tutorial followed by a two hour lesson, after which he returned to site to work on an urgent drain repair. When the job was finished, he was given the rest of week off, plus two weeks of paid holiday. Unfortunately he never returned to class or tutorials.

Student 2 was on holiday in Fiji with his family for two weeks. He was the main caregiver for three children before and after school. His only night off was night-class night, and he was a distance cycling enthusiast in any spare time.

Student 3 was renovating a house in preparation for sale and was off work recuperating from a back operation.

Students 3 & 4 were both considering leaving drainlaying and seeking better paying work in Australia next year.

The exam and mathematics knowledge expected of students

The Registration exam is three hours long and has no formative assessment component, although the course has three class assessments throughout the year. These students are not used to exams, sitting and thinking indoors for long periods, or reading and writing for extended periods. Instead, most of their days are involved with very physical, concrete and kinaesthetic pursuits. It is to be expected that they will have gaps in their meta-knowledge and practice of learning styles and strategies as regards both study and examination techniques such as:

- taking notes
- methods of memorising
- organising notes

- effective revision
- analysing and answering questions
- time management for study and during an exam

However, one of the students did develop a technique through the semester of attending a maths tutorial just before a formal assessment or exam and then doing the maths calculations first in the exam, before focusing on the other parts. All the students were encouraged by the LDL to learn the few critical formulae by heart using a picture and mnemonic, and then to write the formulae as soon as they could in the exam room, for later reference.

The students must gain 60% overall to pass the Registration exam and over the last three years, 8-9% of the paper has been calculations. The following is an example of what students are asked to perform under exam conditions: "Q8 (ii). A drain is 31 metres long and is laid to a grade of 2.5%. Calculate to three decimal places the fall between the access chamber and sewer connection. Show all working (1 mark)" (Plumbers, Gasfitters and Drainlayers Board, 2007).

Consider how this might be approached, given that all the students in this study left school with no formal qualification in maths. Here is another example of an assessment question: "(Q7). Calculate the amount of bedding side support and overlay material required to lay a DN100 drain in a trench 147m long and 0.450m wide to AS/NZS 3500 2.2 2003 Standard. Allow 20% extra for compaction and trench variation (4.5 marks)" (Plumbers, Gasfitters and Drainlayers Board, 2008).

Often there are follow-up questions, such as finding the cost of spoil removal and delivery of base material. These calculations are based on information about: $/m for raw materials and cartage; a % allowance for bulking &/or compaction and/or voids if required; retaining appropriate backfill; truck size, and tip fees.

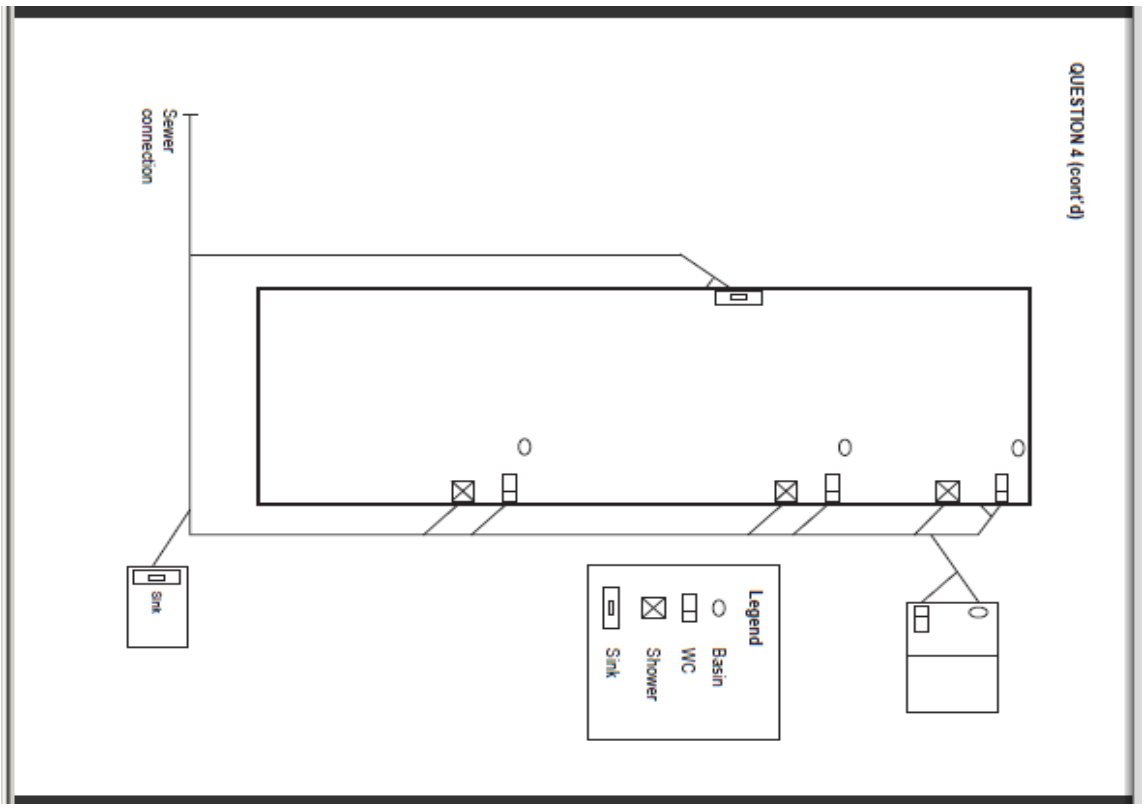
Now, subject lecturers do work on equipping the students to respond to such tasks by going through similar problems and examples in class – and, in the case of this study, referring struggling students to the LDL! The subject lecturer was also supportive and passed on copies of the formative assessments and the model answers to the LDL for later follow-up work with students as necessary.

As learning development lecturers, when we unpack the question(s), we must also consider all the metacognitive and cognitive areas of knowledge, skills and strategies which need to be brought to this task, such as:

- Some of the maths and numeracy skills required e.g. multiplication, addition & subtraction, decimals, circle area, trapezoid and cylindrical volumes, percentages and fractions, gradients, ratios & proportions, formulae, powers, estimating
- Some of the non-mathematical skills required e.g. reading, legal standards, writing, logic, spatial awareness, sketching, transforming 2D – 3D, the concept of balancing an equation, linear layout, jargon

- (Scientific) calculator skills needed. Only two of the students had a proper scientific calculator. One preferred to use the calculator on his cell phone and the other had a very small very basic calculator with no extra functions (not even π).

This year a new level of difficulty was introduced, which involves reading plans and taking off material to scale with a scale rule based on certain industry standards and in a new type of question format in Figure 2:
"The diagram (below) shows an as-built plan of a foul water drainage system. The drainage system complies with AS/NZS 3500 Part 2: Sanitary plumbing and drainage. The scale used is 1 to 200"



Then they must manipulate a table format to calculate the costs:
"(a) In the table below, compile a list of all pipe work, bends, inspections, junctions and gullies to meet the minimum requirements of AS/NZS 3500 Part 2: Sanitary plumbing and drainage. Do not include inspections or fittings at the sewer connection.
(b) Using the costs per item given, calculate the total cost of materials."

Item	Number	Cost per item	Cost
Pipe length 74.5m	74.5	$16.50 per m	
Plain junctions		$22.60 each	
Inspection junctions		$33.50 each	
Plain bends		$19.60 each	
Inspection bends		$29.30 each	

Overflow relief gully (ORG)		$56.50 complete	
Sub total			
GST (12.5%)			
Total cost			

(Total 9 marks)

Figure 2. Registration exam June 2008, Q4
(Plumbers, Gasfitters and Drainlayers Board, 2008)

Although this table may look fairly straightforward, in numeracy terms, it is an extra level of difficulty in understanding mathematical principles. So, it is apparent that this certificate level course has mathematics that is not as easy as it might at first appear. There are still some serious difficulties for our students and apprentices. This was recognised by researchers in Melbourne who investigated building literacy and numeracy into training: "Implicit numeracy competencies in industry standards require a high degree of analytical sophistication and educational expertise … not all Enterprise-Based trainers nor workplace trainers have such expertise" (Sanguinetti & Hartley, as cited in Fitzsimons, 2002, p. 2).

It has also been noted that understanding maths concepts has maturity and developmental implications: "… the ability to firmly understand proportionality is a turning point in mental development" (Hoffer, 1988, p. 293) and an unfortunate phobia with this area of endeavour is also recognised: "Math anxiety is a bona fide anxiety reaction, a phobia with both immediate cognitive and long-term educational implications" (Ashcraft, 2002, p. 184), so we learning development lecturers/advisors need to be aware that some of our students could have difficulties in these cognitive and affective areas to some degree as well.

The Chief Examiner's Report in March 2008 tabled a 54% rate for the 74 candidates in the 2007 exam, and some bleak mathematical feedback:

> The lack of basic mathematical skills continues to disappoint…far too many cannot calculate the area of a circle and the volume of circular objects. Mathematics needs to improve as virtually all plumbing, gasfitting and drainlaying designs involve calculations in some form or other … (Daniel, 2008, p. 2).

Indeed, the group in this study also struggled to remember the formula for the area of a circle and even before the final exam were confused about nomenclature for squared and cubed calculations (^{2} and/or ^{3}). Daniel (2008) continued "… In many cases persons entering this industry could benefit from some additional tuition in

comprehension, linguistic and numerical skills to help their advancement in an industry becoming exponentially more technical and complex" (p. 2).

So there were the following last-ditch challenges for an LDL to enable appropriate support for the students through the examination process:

- Students came with minimal mathematical conceptual understanding and equipment
- They exhibited low linear note-taking and calculations skills
- Tutorial times had to be continually re-negotiated and flexible to coordinate with evening classes, students being delayed on site, and extra day sessions as requested
- The students had basic scientific calculator skills – and even for the final assessment one person didn't have a recommended calculator
- Continual reminders were necessary to get working-out shown in a logical, rational progression (as required in the assessment questions)
- Lack of time was a difficulty for all except the student off on ACC. There was minimal time during tutorials for anything more than techniques for Doing rather than Understanding, so in practice some of the support had to be on a 'do it this way and trust me' basis rather than initiating a deeper understanding of the underlying principles.

However there was some comfort in past research "Although it can be effectively argued that students need to automatize commonly used processes, it can be likewise argued that the most efficient methods are often those that are the least meaningful" (Lesh, Post & Behr, 1988, p. 1). In this regard academic learning development lecturers may be seen more as ambulances at the bottom of the cliff than is ideal as there is no time to satisfactorily teach the theory – just the ways to make it work! Added to this could be the conundrum "You can hide a deficit in literacy but you can be proud of a deficit in maths" (M. Smith, personal communication, September 26, 2008*)*. While the students may openly and readily admit their numeracy weaknesses, there is not the same motivation driving them to overcome these, so this is an area where the LDL can work together with the student to bridge this gap with whatever resources may be available, or developed by the lecturer.

Resources for an academic learning development lecturer

The following resources were found to be invaluable during the year:

- Building up good rapport with the content lecturer - The lecturer invited the LDL to the Orientation for the new student cohort to talk about services and assistance which they could access and expect. By the end of semester the drainlaying lecturer was popping in for a chat during most sessions and was in fairly frequent e-mail contact, e.g. "I will encourage all again tonight and with luck we may get a few more" (Lecturer, personal communication, July 23, 2008) and "Oh great - together we may be able to get them through" (Lecturer, personal communication, September 23, 2008).

- Looking at old exam papers – While this may seem obvious to experienced LDLs and learners, the students being discussed in this paper had not considered this, and even when given the web details by the LDL for sourcing this information, none of them made reference to them again either verbally or in writing
- Joining a Numeracy Community of Practice Group – This group facilitated monthly presentations and 'workshops', including examples of 'successful practice' relating to teaching certain maths concepts, and generally promoted shared thinking about numeracy and the learning progressions. Especially memorable was the DEANZ webinar as part of a current Ministry of Education project, presented by Harvey Mellar and Niki Davis**,** "Can adults use E-Learning to increase their literacy and numeracy?" accessed through Elluminate software (personal communication, September 26, 2008). The group gathered to share the experience and following 'in-house' panel discussion
- Networking with others doing similar LDL work – There was very supportive collegial support from fellow maths lecturers in learning development
- Consulting Foundation Studies lecturers – similarly, a wonderful crossover of information especially with respect to resources.

It became evident after the second session that there were no support texts, exercises or sample problems for the students, so it was necessary to develop a set of stepped and guided practice worksheets, leading up to the total calculation package which directly reflected the examination requirements and the site situations they will be expected to cope with.

It was important for LDLs to be proactive, autonomous and creative. While being thrown in the deep end in terms of a new content area, the basic concepts of studying and learning styles and strategies remained the same. However, having to accommodate a new context also had its benefits, as there was an authentic need to negotiate a shared understanding of drainlaying and learning. So all participants and the LDL could recognise skills and deficits in each other and help each other to learn together. As in finding a new job, 65% of the success is from networking, both from other lecturers and students - share ideas and share the load!

Computer use and elearning

The use of technology in learning is somewhat taken for granted in the 21st century, but this may not always be appropriate. Even though there does not seem to be much elearning for vocational students developed as yet, we still need to consider the students' access to the technology and programmes and their computer literacy.

Figure 3. Plumbing e-book home page (Mardle, 2007)

In an attempt to fill this gap, an ebook programme with multimedia throughout is being developed by colleagues at this institution (see Figure 3). All students receive an orientation, and some contractors have uploaded parts of it for trialling in their workplace. A project to develop electronic resources for numeracy support for plumbing, gasfitting and drainlaying apprentices has been scoped and is now awaiting a programmer.

The three of the students in the tutorial group who had access to a PC with broadband (one also had a laptop) used them for the following applications:

- 2 used internet baking
- 1 used it for purchasing car parts on TradeMe and viewing Youtube sites
- 1 used it to search for cycling events
- all used for email to some degree

While elearning and distance learning may seem attractive options, whether students have the metacognitive capacity and commitment to study independently is also worth consideration. One of the students and his boss had previously tried to do a drainlaying course by correspondence, but each week got more difficult and they couldn't manage to make the Saturday morning times to study, so both gave up.

Another source of inquiry into online learning that has useful suggestions for these students is that undertaken by a neuroscience researcher, Slavkin (as cited in Clemons, 2005) who focuses on Brain-Based Learning, i.e. "... any teaching technique or strategy that utilizes information about the human brain to organize how lessons are constructed and facilitated with emphasis placed on how the brain learns naturally" (p. 5).

Many of the techniques described include practices to promote opportunities to maximize understanding and then retention of information to enhance student

learning, and for the students in this study the following suggestions were directly applicable:

- *learning styles* - as 85% brain is wired for visual processing, it is important to include all styles or modalities
- *increase attentiveness* – as the average attention span is 15-20 min, it is beneficial to plan for this, e.g. crossword tests, interaction
- *role of emotion* - a strong emotional connection means chemicals in the brain send messages that the activity is important and should be remembered (but if the emotion is too strong the opposite can happen e.g. threat or stress decreases the efficiency of the rational thinking cortex and learning stops)
- *stimulate the brain* with exiting, fun tasks to increase curiosity, anticipation and surprise
- *ensure students feel safe* i.e. they feel encouraged and comfortable with challenging, questioning, having opinions, having control, and receiving positive feedback.

Strategies for a learning development lecturer

Basic techniques found to be most useful over the past year included using concrete examples, visual techniques and few but simple memory techniques. It was also important to be aware (and make the students more metacognitively aware) of different learning styles, and to scaffold students carefully through stages of difficulty while relating this to what happens on site. One illustration of this was the use of physical examples, from simple area and volumes through to complex calculations, while trying to create a visual image with sketches and describing concepts via body language (e.g. Fall and Invert Levels) so students had a 'feel' for what the question was asking. It was also important to incorporate opportunities to engage both sides of the brain e.g. using mnemonics, patterns and mind maps. Much of the work centred around:

- Repetition and practice (elaborate rehearsal to move short term memory into long term memory)
- Making model questions based on class work, exams and external national certificate exams (now Australasian)
- Building up ability and confidence
- Helping students find time to do more study e.g. discussing study timetable options and having tutorials just before night class
- Always being positive – this group of students often talked of repeating the course, or said they didn't think they would pass. Because of their backgrounds these students may not have the self-belief that they can be academic achievers. Evidence of this is found in the following comments recorded over a one week period:
  "I should have paid more attention at school"
  "I should have sat up the front of the class"
  "You'll see me again next semester"
  "shit" in answer to *How was your exam?*

The need for all these above-mentioned strategies and techniques poses the question, given the mathematical background of this study group: Are the students, the industry and the institutions expecting too much? ... which then leads to the very important considerations of; what is numeracy; the issues around diagnostic testing; should numeracy be embedded; and if so how much, and how best can this be done?

What is numeracy?

The definition of numeracy has been the topic of debate for several years now, and there does not seem to be any unequivocal answer. Gail FitzSimons (2002) from Monash traces the definition of numeracy from being a subset of literacy, to a mathematical need in the workplace, to an appendix to literacy, to a much broader concept than just facility with numbers or basic arithmetic (i.e. to include spatial and quantitative & statistical literacies), then to a political definition describing it as a capacity for action:

> Klein (as cited by FitzSimons, 2002) considers numeracy not as a thing to be possessed, but as a capacity for action. Thus in relation to numeracy, democratic power depends upon access to mathematical knowledge — information selectively derived from a range of possibilities and which is capable of being interpreted and understood – access to which is also unequally distributed (p. 2).

FitzSimons continues:

> According to Engestrom's framework (as cited in FitzSimons, 2002), transformative learning requires qualitative transformations, questioning and deviation from established norms, a collaborative journey through the Zones of Proximal Development of Activity groups, and expansion from isolation to collaboration, through dialogue and debate. Or, as Brennan expresses it: learning from conversations and research partnerships (as cited in FitzSimons, 2002, p. 6).

It is this definition that most approximates what is being achieved by the participants described in this paper – students and LDL working together, helping to transform each other and themselves through discussion and (dis)agreements, pushing towards the next level of understanding and ability. The Ministry of Education's Curriculum update 45 offers this less philosophical definition: "To be numerate is to have the ability and inclination to use mathematics effectively – at home, at work and in the community" (Ministry of Education, 2001, p. i).

This "positions numeracy as an adult concept and also acknowledges the impact of disposition on numeric behaviour" (Thomas, 2008, p. 137). It is not just a problem of childhood, and people make choices about using it or not. Thomas further claims that

a 1996 survey had shown "that numeracy could be a barrier to effective participation in society for up to 50 per cent of the New Zealand adult population" (p. 137).

The latest definition from the "Embedding Literacy and Numeracy: Theoretical Framework and guidelines" (TEC, 2008a) gives a more down to earth and practical explanation of numeracy: "The bridge between mathematics and real life" (p. 38). A person's numeracy refers to their knowledge and understanding of mathematical concepts and to their ability to use their mathematical knowledge to meet the varied demands of their personal, study and work lives.

Another of the reasons that TEC became concerned about numeracy and literacy is that workplaces are demanding higher numeracy and knowledge skills as the economy seeks to improve in both efficiency and quality. Parsons & Brynner (2005) describe how numeracy and literacy are major factors aiding workplace success today for several reasons, including:

- a decreasing number of unskilled jobs in manufacturing
- growth in the service industry
- more financial accountability expected of employees
- stronger OSH regulations
- work places have become a lot more technology-based
- and that this is a greater problem for women because they tend to opt for accounting jobs or jobs that use information and communication technology.

Our institution has distilled the definition to read: "Numeracy is the use of a combination of both mathematical knowledge and strategies to solve everyday problems" (Unitec, 2008, p. 3). But whatever definition we use, there is a challenge for the development lecturers, the students, the institutions and the country: to work together to transform more of our students into numerately capable members of the workforce and wider community.

Diagnostic testing

There is ongoing discussion about the need for screening and/or pre-course and post-course diagnostic testing … and the ensuing debate whether diagnostic testing should be summative or formative (i.e. with the aim of monitoring progress and understanding, and identifying learning needs so teachers can adjust their programme accordingly, and so that students may better appreciate where their current knowledge base is and where they need to move to). Because of course and student time constraints, this comment about a new computer programme (not currently available at this institution) is also relevant: "Re-teaching two or three years of math is impractical, if not impossible, so Math Prep software will assess each student's weakest areas and focus learning where it is needed" (Ciccone, 2007, p. 2).

However, Benseman, Lander and Smith (2008) believe there is also still a need for further exploration of the relationship between the length and intensity of courses e.g. short & sharp or of a longer duration. The Adult Numeracy Initiative (2004) has a

Diagnostic Assessment Tool as a key feature which involves a procedure of guided interview questions about attitudes, strategies and knowledge related to steps within the Numeracy progressions. It is designed to provide tutors with useful information about a learner's number knowledge and number strategies by developing a number profile of the learner which also highlights knowledge gaps, which can then be matched with goals and a map of relevant tasks.

Students at the writer's institution are currently assessed by the literacy advisor/lecturer at the beginning of the course and then again after 10-15 weeks, using a 30-minute Numeracy Skills Analysis developed in-house. The test is often at the entry point, although is probably most useful if used informally as formative assessment embedded throughout the course rather than as a discrete assessment item at each end of a course.

Research so far shows that raising the quality of numeracy teaching can lead to improved outcomes for learners, particularly through the use of Foundation Learning Progressions and associated assessment items with one of the next steps being "to investigate how this can be scaled up to efficiently and effectively support the varied professional learning needs of tutors working across a wide range of contexts" (Thomas, 2008, p.141). It would certainly be worthwhile for this to include up-skilling and resourcing the learning development lecturers, who may be neither discipline expert nor numeracy expert, but advisors with interests in both areas, and with a desire to assist student development with teaching and learning awareness and strategies.

In this regard, two of the three TEC Numeracy documents that most relate to the drainlaying students and could be of use to them are:

- Measure and Interpret Shape and Space
- Make Sense of Number to Solve Problems, (i.e. all but Strand 3 Reason Statistically)

While advisors may welcome conversations around the need and appropriateness of screening/gatekeeping vs. diagnosis/mapping for students, the hands-on day to day work involves responding to the needs and requests that are presented and what we can do to enable students to be successful and keep studying.

Autonomy

Of course advisors may also have another driver, i.e. wanting to nurture a sense of autonomy so the students can keep on learning and developing for the remainder of their lives if they wish. This means allowing students to maintain appropriate responsibility for all the decisions concerning all the aspects of their learning – the objectives, content and progression, methods & techniques, monitoring and evaluating. Autonomy has been defined by Holec (as cited in Nunan, 1996, p. 13) as "the ability to take charge of one's own learning". The importance of this facility is also recognised by TEC: "Adults need to be involved in setting learning goals and monitoring their progress towards these ... Motivation is a key factor in engagement

and achievement" (TEC, 2008a, p. 9) and of course everyone in the tertiary sector is currently aware of the need to ensure positive outcomes for the students in terms of success and retention for research, status, and financial reasons.

Embedding numeracy within the course content

The theoretical background leading to the operational implications distributed by TEC state:

> Embedding literacy and numeracy in provision such as vocational training is considered to be the most effective and efficient way to provide direct, purposeful instruction in contexts (setting) that allow both the initial opportunity to learn new literacy and numeracy knowledge and skills, and plenty of scope for practicing them (TEC, 2008a, p. 4).

This raises the question: ideally, who should teach the numeracy – the discipline or Trades content teacher, a numeracy expert, a learning development lecturer, or a specialist Foundation maths teacher? Research findings show that:

> Learners are motivated when they see the value of learning for their own goals. Adults are more likely to be motivated to engage with literacy and numeracy learning when it is embedded within a vocational or leisure course which is their primary motivation (TEC, 2008a, p. 13).

A Learning for Living Strategy was released by the Government in 2004 with an overall goal of ensuring improved literacy, language and numeracy in NZ. This built on the first TEC 2002-7 strategy, the NZ Adult Literacy and the Adult ESOL Strategy. The Adult Numeracy Initiative is part of the first phase of this Learning for Living Strategy (2004) and it is the first time numeracy has been given the specific focus in a foundation learning initiative in New Zealand. This initiative is mainly about upskilling and training tutors with the aim of improving the quality of the teaching. This could be done individually or as team teaching with a combination of experts working together (Thomas as cited in Benseman, 2008, p. 138). Other research supports a form of team teaching:

A joined-up approach between two sets of tutors is more effective than expecting individual lecturers to provide both key skills and vocational training. It's asking too much. Vocational teachers prefer, understandably, to teach in their areas of expertise. Literacy and numeracy teachers would be equally out of their depth if they were to try to teach an unfamiliar vocational skill (Casey as cited in Marsden and Shackleton, personal communication, September 30, 2008).

Full embedding (one teacher being responsible for both the vocational subject and the Learning Literacy and Numeracy [LLN]) is the option being promoted by TEC in preference to separate content and numeracy tuition with another teacher, as this would reduce the amount of uncontextualised provision (away from regular class).

However, there is an argument for a combination of the two i.e. team teaching, even though this is labour intensive and therefore more expensive. It is already recognised that “Embedding should not be seen as a cheap option” (Casey, Cara, Eldred, Grief, Hodge, Ivanič, Jupp, Lopez and McNeil, 2007, p. 32), and I believe we need a shared vision of merging vocational and LLN lecturers into a shared responsibility for teaching and learning.

This paper finishes with a visual depiction (Figure 4) of a great feat of engineering and advanced drainlaying that has survived the tests of time for centuries. It would be wonderful if those of us involved in academic support for our vocational students could also help to build a similar ‘Maths LDL Bridge’, a pathway over shallow, deep and sometimes unfathomable learning gaps, which is supported by arches of metacognitive awareness, study skills, numeracy, knowledge, and experience. As students walk this bridge, they collect their tool kit of learning and practice to transform themselves from a student to a practitioner. Learning development lecturers can also help provide the scaffolding for students to build their own bridge brick by brick, step by step, a bridge from theory to practice, from institution to site, from apprentice to expert.

Figure 4. Pont du Gard bridge and aqueduct

References

Ashcraft, M. H. (2002). Math Anxiety: Personal, Educational, and Cognitive Consequences. Current directions in psychological science: a journal of the American Psychological Society, 184.

Benseman, J. & Sutton, A. (2008a). Facing the Challenge: Foundation Learning for Adults in Aotearoa New Zealand. Wellington: Dunmore.

Benseman, J. & Sutton, A. (2008b). Foundation learning in New Zealand: An overview. In Benseman, J. & Sutton, A (Eds.), *Facing the Challenge: Foundation Learning for Adults in Aotearoa New Zealand* (pp. 11-28). Wellington: Dunmore.

Benseman, J., Lander, J., & Sutton, A. (2008). How we teach: A study of literacy and numeracy teachers' teaching. In B. Sutton (Ed.), *Facing the Challenge. Foundation learning for Adults in Aotearoa New Zealand* (pp. 155-164). Wellington: Dunmore.

Casey, H., Cara, O., Eldred, J., Grief, S., Hodge, R., Ivanič, R., Jupp, T., Lopez, D., &McNeil, B. (2007). National Research and Development Centre for adult literacy and numeracy. SUMMARY REPORT. "You wouldn't expect a maths teacher to teach plastering…": Embedding literacy, language and numeracy in post-16 vocational programmes – the impact on learning and achievement. Retrieved November 5, 2008, from http://www.nrdc.org.uk/download.asp?f=3550&e=pdf

Ciccone, D. (2007). Carnegie Launches First Math Programme for Exit Exam Remediation. *Electronic Education Report,* Sep. Retrieved October 6, 2008 from the Ebsco database.

Clemons, S. A. (2005). *Brain-Based Learning: Possible Implications for Online Instruction.* Retrieved June 5, 2008 from http://www.itdl.org/Journal/Sep_05/article03.htm

Coxford, A. F., & Shulte, A.P. (Eds.). (1988). *The ideas of algebra, K-12. 1988 yearbook.* Reston, VA: National Council of Teachers of Mathematics.

Daniel, R. (2008). *Plumbers, Gasfitter and Drainlayers Board Examiners Report November 2007 Examinations*. Retrieved November 5, 2008, from http://www.pgdb.co.nz/index.php?sh=04&h2=08&pic=04&screen=01-chief-examiners-report

FitzSimons, G. (2002). Adult Numeracy and New Technologies of Learning, 1-6. Retrieved October 21, 2008 from http://www.avetra.org.au/abstractsandpapers2002/fitzsimons.pdf

Hoffer, A. (1988). Ratios and proportional thinking. In T. Post (Ed.), *Teaching mathematics in grades K-8: Research based methods* (pp. 285-313). Boston: Allyn & Bacon.

Lesh, R., Post, T., & Behr, M. (1988). Proportional Reasoning. In J. Hiebert & M. Behr (Eds.) *Number Concepts and Operations in the Middle Grades* (pp. 93-118). Reston, VA: Lawrence Erlbaum & National Council of Teachers of Mathematics. Retrieved August 17, 2008 from http://www.cehd.umn.edu/rationalnumberproject/88_10.html

Mardle, D. (2007). Plumbing online. Retrieved September 24, 2008 from http://plumbingonline.unitec.ac.nz

Ministry of Education. (2001). *Curriculum update 45: The numeracy story.* Wellington, New Zealand: Author

Ministry of Education. (2007). Tertiary education strategy 2007-12 Incorporating Statement of Tertiary Education Priorities, 2008-10. Wellington, New Zealand: Author

Nunan, D. (1996). Towards Autonomous Learning. In R. Pemberton, E.S.L. Li, W.W.F. Or & H.D. Pierson (Eds.), *Taking control: Autonomy in language learning* (pp. 13-26). Hong Kong: HKUP.

Parsons, S., & Brynner, J. (2005). Do*es numeracy matter more?* London: NRDC.

Pemberton, R., Li, E. S. L., Or, W. W. F., & Pierson, H.D. (Eds.). (1996). *Taking Control: Autonomy in Language Learning.* Hong Kong: HKUP.

Plumbers, Gasfitters and Drainlayers Board. (2007). *Registration examination November 2007: Drainlaying* . Retrieved November 5, 2008, from http://www.pgdb.co.nz/download/forms/exams/2007/november/9197.pdf

Plumbers, Gasfitters and Drainlayers Board. (2008). Registration *examination June 2008: Drainlaying.* Retrieved November 5, 2008, from http://www.pgdb.co.nz/download/forms/exams/2008/june/9197-questions-june-2008.pdf

Tertiary Education Commission. (2008a). Embedding literacy and numeracy: Theoretical framework and guidelines. Version1: Sept 2008. Wellington: Author

Tertiary Education Commission. (2008b). Teaching Adults to Make Sense of Number to Solve Problems: Supporting the Learning Progressions. Wellington: Author.

Thomas, G. (2008). The Adult Numeracy Initiative: Its place and value in foundation learning. In J. Benseman, & A. Sutton, *Facing the Challenge: Foundation*

Learning for Adults in Aotearoa New Zealand (pp. 136-142). Wellington: Dunmore.

Unitec. (2008). Unitec Academic Policy 02c Academic Literacies. Retrieved September 25, 2008 from https://docushare.unitec.ac.nz/dsweb/Get/Document-289/Acad+02c_Academic+Literacies_policy+v.15Dec08.