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The role and positioning of *numeracy* in Australian universities – does it matter?

Lesley Wilkins

Learning Development, University of Wollongong, Wollongong, NSW, 2500, Australia

Email: lwilkins@uow.edu.au

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Numeracy has been problematic for practitioners. It has been difficult to determine a consistent definition of the term; moreover, there has never been real agreement on its role, or position, within society, or within higher education. Many students who find mathematics "challenging", but who need to pass a non-specialist mathematics subject in order to graduate, consult Learning Development lecturers in order to obtain assistance with mathematics. Students present with a variety of difficulties ranging from gaps in their schooling, especially senior school mathematics, through to more fundamental mathematics topics. Many students confess to being "bad at maths"; are openly negative about their mathematics ability; and perhaps do not realise that there are applications of mathematics in their everyday lives. What could be considered alarming, however, is that it can be observed that many students seeking assistance possess little or no obvious "number sense" or estimation skills, and have little knowledge and poor understanding of even the most straightforward addition and subtraction facts. Of these students, many are endeavouring to become Primary Education teachers, whose anxiety, lack of mathematical knowledge and/or lack of confidence may be passed on to their prospective students. Could there be a link between the ready acceptance, even at the higher education level, of negativity towards mathematics and the negativity shown by society – even to the point of apathy – towards mathematics? This paper proposes to open the discussion on whether there is a need – or indeed a responsibility – for Australian universities to embrace *numeracy*, not simply as one of the *academic literacies*, but as a hugely important component of their graduates' attributes, in its own right.

Key Words: numeracy; academic numeracy; literacy; academic literacies

1. Introduction

We have all heard the comments "I'm bad at maths"; "I hate maths"; I can't do maths". In Australian society it has generally been considered acceptable for anyone to confess this (Galligan, Wandel, Pigozzo, Frederiks, Robinson, Abdulla, & Dalby, 2013, p. 46). Moreover, the backgrounds of, and educational levels attained by people who may make such statements cover a wide range (Johnston, 2002, p. 4). The message can also be easily transmitted from parents to children (Pritchard, 2004) or from teachers to children (Bibby, 2002; Hodgen & Askew, 2007). Yet would these same people call themselves "innumerate"? Surely people would not publicly admit to being "illiterate". So why is it all right to be comfortable with not liking, or perhaps even avoiding anything to do with "maths"?

When asked if they use mathematics in their everyday lives, most people would readily admit that yes, they certainly confidently handle money, fill their car with petrol, look for bargains and discounts when shopping, are punctual for appointments, catch trains or buses on time by accu-

rately reading timetables, or understand some uses of statistics in news reports. Some, however, may need prompting to realise they are successful in using these mathematics skills suggesting that rather it is "common sense" (Coben & Thumpson, 1994, as cited in Johnston, 2002, p. 22). Indeed, many people are so anxious about "doing" maths that they develop barriers to learning it with the result that when it comes to passing a university course containing any form of mathematics they are unable to do so, possibly not just because of poor mathematical skills but perhaps, as well, as a result of the anxiety faced during assessment. This can apply equally to prospective teachers, nurses, financiers, scientists and engineers.

The recent call by the chief scientist, Professor Ian Chubb (Barrett, 2014) for more students to participate in Science, Technology, Engineering and Mathematics (STEM) courses inspired an Australia-wide project, with expertise from several Australian universities, to improve the levels of mathematics and science in Australia's school students (Inspiring mathematics and science in teacher education, 2015). But a brief internet search reveals that the majority of Australian universities do not possess a *numeracy* policy; in fact most do not mention anything to do with *numeracy* and/or *mathematics* in their policies dealing with the attributes or qualities that their graduates should possess. Does this mean that universities do not value *numeracy*? Does this in turn encourage society to feel comfortable with a lack of, or poor mathematical skills? Yet we are told that societies in which the vast majority of members are "numerate" will have better economic conditions than those without such a majority (Australian Curriculum, 2015; Bynner & Parsons, 2005, as cited in Tout, 2014) and that individuals themselves without such skills will be less well paid than those with better numeracy skills and training (Gleeson, 2005). In fact Gleeson (2005) states:

> Individuals with low numeracy skills are disadvantaged members of the workforce in terms of skill levels, and are least likely to be given opportunities for further training. When they are able to participate in programs, they receive positive and significant benefits. (p. 6)

This paper begins the necessary conversation about whether those Australian universities that do not possess a policy specifically ensuring that *numeracy* is an attribute of their graduates may unwittingly be helping to condone the Australian public's complacent attitude towards the poor mathematical skills of many in its society, but it also asks: does that matter? And if so, to whom does it matter? Beginning with the difficult task of accepting a definition of the term *numeracy*, it also looks at related areas such as *literacy*. It then discusses the apparent positioning of *numeracy* by Australian universities in their policies, and concludes with a discussion of the benefits and disadvantages of insisting that all members of Australian society – or at least its university graduates – embrace and demonstrate confidence in using *numeracy*.

2. Literature Review

2.1. Is there a difference between numeracy and mathematics?

In the past, and certainly in the 1990s, *numeracy* was considered as the lower levels of *mathematics*, especially within adult education; adult education institutions classified *numeracy* as the mathematics taught in so-called *Adult Basic Education* or *Foundation* courses, whereas *mathematics* was recognised as being within Year 10 and above courses (Coben, FitzSimons, & O'Donoghue, 2002, p. 4). Currently, it seems to be more acceptable to view *mathematics* as the tools or skills which need to be applied confidently and competently in order that a person may solve particular sorts of problems, and *numeracy* as the ability to make this confident, competent application of mathematics. The confusion between the terms remains, however, as a search of the literature confirms.

2.2. Definitions

2.2.1 Numeracy

It is apparent that it has been quite difficult to reach a consensus on the definition of *numeracy*. Johnston (1994, as cited in O'Donoghue, 2002, p. 54) argues:

> To be numerate is more than being able to manipulate numbers, or even being able to 'succeed' in school or university mathematics. Numeracy is a critical awareness which builds bridges between mathematics and the real world, with all its diversity. … In this sense … there is no particular 'level' of mathematics associated with [numeracy]: it is as important for an engineer to be numerate as it is for a primary school child, a parent, a car driver or a gardener. The different contexts will require different mathematics to be activated and engaged in.

Thus *numeracy* is an umbrella term that, in a way, means to be *literate* in mathematics.

The latest Australian Curriculum (2015) offering suggests that "Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully", and the explanation found on the New South Wales Department of Education and Communities (2015) website states:

> In New South Wales, we understand numeracy to involve using mathematical ideas efficiently to make sense of the world. While it necessarily involves understanding some mathematical ideas, notations and techniques, it also involves drawing on knowledge of particular contexts and circumstances in deciding when to use mathematics, choosing the mathematics to use and critically evaluating its use.

Each of these definitions of *numeracy* for use in schools appears to echo Johnston's (1994) original definition. But even that well-worked-out definition was later developed and altered so that its theme, "building bridges", became "to negotiate the world … through mathematics" (Johnston & Yasukawa, 2001, p. 291). Reflecting on their search for "a theory of numeracy", Johnston and Yasukawa (2001) add that "[there are] many numeracies, depending on the social contexts to which we are referring" (p. 291) implying that *numeracy* is mathematics used capably at *any* 'level', be it primary school or rocket science! Coben (2002) suggests that an individual is "numerate" if they are able to judge confidently the type of mathematics to employ in a given situation, how accurate that mathematics should be, and, especially, whether results obtained by using that mathematics are meaningful in that particular context. This complements Johnston's (1994) definition, and the New South Wales Department of Education and Communities' (2015) definition also seems to agree with Coben's (2002) and Johnston's (1994) definitions.

Higher education standards do not seem to actually define *numeracy*. The Australian Qualifications Framework (AQF), (2013, p. 11) interprets *numeracy* as a "generic skill" and as a "generic learning outcome" and states: "Generic learning outcomes are the transferrable, non discipline [sic] specific skills a graduate may achieve through learning that have application in study, work and life contexts" (p. 11). As well, AQF includes *numeracy* as "a fundamental skill … appropriate to the level and qualification type" (p. 11). The Tertiary Education Quality and Standards Agency Act 2011 (TEQSA) Higher Education Standards Framework (Threshold Standards) 2011 (Australian Government, 2011), however, makes no mention of *numeracy* or *mathematics*. There is simply mention of "skills" being equivalent to those outlined by the AQF.

Professional bodies such as the Australian Association of Mathematics Teachers (AAMT), do, however, offer useful definitions of these terms. According to its *Policy on Numeracy Education in Schools* (AAMT, 1998), "to be numerate is to use mathematics effectively to meet the general demands of life at home, in paid work, and for participation in community and civic life" (p. 2). The association has not chosen to improve on this definition; however, its reference point is the numeracy requirements of schools rather than of higher education institutions.

It would appear that a definition of *academic numeracy* is necessary, and Galligan (2011) offers one, suggesting that "academic numeracy" consists of three components: "mathematical competence" in the learner's chosen profession; a "critical awareness" both of the mathematics itself and of their own mathematical knowledge; and "confidence, highlighting its deeply affective nature" (p. 289).

Thus if the definitions of Johnston (1994), Coben (2002) and Galligan (2011) are combined, a useful working definition for *numeracy* at the higher education level is derived: in a given situation, an individual chooses suitable mathematics to use, at the appropriate level as required by the context, applies the mathematics competently and confidently, and ensures that the solution fits the situation.

2.2.2 Academic numeracy; literacy; multiliteracies; academic literacies

We often use the words *mathematics* and *numeracy* interchangeably but obviously they are not the same, especially if *numeracy* is taken in its original construction as a combination of the words *numerical literacy*. According to the New South Wales Department of Education and Communities (2015), "the term numeracy was coined in 1959 by a committee on education in the United Kingdom which said that 'numeracy' should 'represent the mirror image of literacy'. (Crowther Report)". It is debatable that this definition suggests that *numeracy* is simply a branch of *literacy*. But then, what *is literacy*? What are *multiliteracies* and why coin that term? Is there a difference between *multiliteracies, academic literacy, academic numeracy and academic literacIES*? As Johnston (2002) states: "It is one of the difficulties of tracing the history of developments in adult numeracy, that its conflation with literacy leaves a silence" (p. 25).

And so where is *numeracy* positioned in higher education? If both *numeracy* and *literacy* are recognised as "generic skills" (as for example in the AQF), then it is also necessary to define *literacy*. But there are many differing definitions of the term *literacy*. These definitions may be roughly categorised in terms of their historical and cultural perspective; the agency responsible for the definition; the various purposes of and reasons for the definition; and the context in which the definition is given. Several differing *types* of literacy are also often discussed, such as financial literacy, health literacy, and legal literacy (Balatti, Black, & Falk, 2009). Other terms that are often used are "digital literacy" and "statistical literacy", which especially apply in a higher education context and, as already discussed, "numerical literacy" equals *numeracy*. These loose categories and types of literacy may of course overlap. Lonsdale and McCurry (2004) state that "there is no universally accepted definition of literacy and ... each definition is a product of a particular, albeit often unacknowledged and unrecognised, world view" (p. 13).

Lonsdale and McCurry (2004) further suggest that there are differing conceptions of literacy driven by, firstly, a need to compare one individual's ability with another's, secondly "functional literacy" which is associated with workplace training, and thirdly a "sociocultural model" which is literacy used for everyday community purposes. Once considered to be the simple recognition and interpretation of written information, the meaning of *literacy* has expanded to "a range of more complex and diverse skills and understandings" (Lonsdale & McCurry, 2004, p. 14).

Kalantzis and Cope (1997) introduce the term *multiliteracies* by which they describe the change in the perception of, in particular, the English language, which they see as "crossing linguistic boundaries" (p. 3). They discuss the idea that English has assumed the role of a *lingua franca* while at the same time incorporating different "accents, national origins, subcultural styles, and professional or technical communities" (p. 3). Cole and Pullen (2010) extend this idea of *multiliteracies* in order "to give sense to the ways in which literacy practice is colliding with new technological modes of representation and shifting heterogeneous demographics" (p. 1). They point out that *literacy* is continually evolving, and is now very much dependent on constantly changing socio-cultural factors.

Perhaps because literacy is changing so very rapidly, the term *literacies* may also be an appropriate term. The basic idea of *literacy* referring only to the skills of reading, writing, (and possibly listening and speaking) has become outdated when put into the context of the multimodalities of the twenty-first century. In fact Leu, Kinzer, Coiro and Cammack (2004) use the term *new literacies* to describe, in particular, the different literacy strategies that are now required to use, for example, gaming software, video technologies, and, especially, the internet in all its forms – social, informational, global, political and so on. Skills required now include the interpretation of information, decision-making regarding the validity of information and the ability to read, interpret and comprehend information in forms other than text.

The Australian Curriculum (2015) document (for schools) includes *literacy* and *numeracy* as part of their required "General Capabilities" but *literacy* is seen as fundamental to all learning. The Curriculum includes confidence in using language for different purposes and in very differing contexts in its explanation of *literacy*. Other government versions of *literacy* (and those of international testing bodies), however, seem to be concerned very much with how it benefits society, in particular, human capital, which is defined by Hartog, (1999) as "the knowledge, skills, competence and other attributes embodied in individuals that are relevant to economic activity".

Both *literacy* and *numeracy* are often placed under the broad terms "Basic skills", "Generic skills", "Fundamental skills", "Key skills" or "Core skills". The Australian Curriculum (2015) places *numeracy* second only to *literacy* in its list of "General Capabilities", proposing very different skills involved in each, and *numeracy* skills are stated to include *Statistical literacy*. But *numeracy* is often seen as part of *literacy* (Townsend & Waterhouse, 2008); Whitin and Whitin (2008) also advocate the recognition of "numeracy as an essential part of literacy" (p. 433) and distinguish only between types of texts – literary or mathematical – suggesting that both need to be critically analysed by their reader.

Further, when testing adults for their *numeracy* ability, various agencies have only used *quantitative literacy* as the focus of assessment. Yet, as Johnston (2002) points out: "However numeracy might be defined, quantitative literacy is a very limited subset of it" (p. 16). As well, the familiar Google internet search-engine returns "do you mean *literacy*?" when the keyword asked for is *numeracy*, and when one searches for the phrase *numeracy and literacy* all the results are listed as *literacy and numeracy* except one site which actually belongs to well-known researchers into dyscalculia[1]!

The Open Universities' website (2015) offers a course called *Academic Literacy Skills – 2015.* Its description reads as follows:

> The unit focuses on developing your communication and written skills that are necessary to be successful in the university environment. The unit helps you develop the necessary skills you need for essay writing and research reports, summarising readings, editing your work, citing works and referencing of articles, journals and internet resources.

It would appear that any mathematics component is missing; however, Prince and Archer (2008) state that "the term 'literacies' refers to any form of social communication or practice that requires a semiotic code" (p. 65) which would surely indicate the inclusion of *numeracy* as one of those literacies.

3. Positioning of numeracy

A recent call for papers for an Association of Academic Language and Learning (AALL) symposium stated:

> Universities across Australia identify both literacy and numeracy as key graduate competencies; moreover, 29 universities include both literacy and numeracy together under the broader attribute of 'communication' in their graduate attribute statements … While every Australian university employs staff with expertise in language and literacy to support the development of oral and written communication, support for numeracy is far more fragmented, with learning centres often providing ad hoc, limited, or no numeracy support at all (Association of Academic Language and Learning, 2014.)

As conveyed by the writer of this call for papers, numeracy help available for Australian university students is frequently provided only as an adjunct, if at all. This may be because *numeracy*

[1] Put very simply, dyscalculia affects the ability to gain even simple arithmetic skills. Dyscalculic learners may find it difficult to understand even extremely simple numerical ideas that most people learn with ease (Landerl, Bevan, & Butterworth, 2004, p. 100).

is often hidden under the broad title of *communication*, and does not stand on its own, ensuring its place is one of relative unimportance. (It is doubtful that students seeking *numeracy/mathematics* help would know to ask for it if it is offered as assistance in *communication*.)

3.1. Australian Universities' Policies

As long as a definition of *numeracy*, let alone its positioning compared to *literacy* or *literacies*, remain undecided, it is perhaps understandable that the majority of universities in Australia pay little respect to its desirability as a quality to which their graduates should aspire. In fact a recent search of the websites of Australian universities found that, out of thirty-seven universities viewed, only two actually owned a policy that explicitly noted *numeracy* as one of their required graduate attributes. (The search was done by firstly locating each university's homepage, then using that university's internal search function with each of the following keywords: *numeracy*; *mathematics* (or *math*)*; policy*; *graduate attributes*; *graduate qualities*; and *policies*, until some relevant mention, if any, of *numeracy* was found. The table of results of this search is included in Appendix A.) If one looks closely, one can count five universities which do mention *numeracy*, not necessarily in its own right but perhaps as a component of another broader attribute. Pitman and Broomhall's (2009) paper also found that five out of thirty-four universities listed *numeracy*, but also noted that it appeared "as often as 'self-confidence' and acting as 'agents for change' but less often than, for example, 'open-mindedness' or 'leadership in the community'" (p. 446), which perhaps further places *numeracy* in a position of less importance.

In my own university (the University of Wollongong (UOW)), recently (January 2014) there was a call to develop an "English Language (& Numeracy) Policy for UOW" (email from Director of Learning, Teaching & Curriculum UOW, 15 January, 2014). The placing of brackets around "& Numeracy" could be interpreted as suggesting, again, that *numeracy* is only an afterthought and is less important than the rest of the policy, and may in fact be ignored. The overall feeling of the committee formed (all interested volunteers from various faculties and divisions of the university with strong representation from the Learning Development unit – all but one of whom were Academic Language and Learning (ALL) specialists) was that the committee should investigate the introduction of an "English language" policy, rather than an "academic literacies (and numeracy)" policy. The finished document states the following: "The purpose of this policy is to ensure the University's commitment to the preparedness of graduates and the quality of their communication skills, including English language proficiency" (University of Wollongong, 2014) and that, moreover, it was developed to meet the guidelines of the TEQSA Threshold Standards (Australian Government, 2011), the Australian Qualifications Framework (AQF), and, especially, that it recognises international students as one of its targets. From the first meeting of the committee, there seemed to be little interest in the *numeracy* aspect of the proposal and after just one presentation by one member of the policy committee on the available definitions of *numeracy* and the quality assurance frameworks (*numeracy)* to be followed, that part of the policy was abandoned. Why was there so little interest in *numeracy*? Were the members of the committee afraid of *numeracy*? Or did they feel that they did not know enough about it? From early observation, it was apparent that most members of the committee seemed to be focussed only on the standard of English held by their international students and the policy was perhaps hijacked by this majority. And yet, the committee's members were well qualified to discuss *numeracy* if we accept the above combined definition – were the committee members perhaps confusing *numeracy* with university levels of mathematics – in their minds, perhaps, specialist mathematics?

Many Australian universities seem to consider, as a graduate quality, the attribute of *problem-solving* as their version of *numeracy*. Surely, however, it can be argued that many problems in the world do not need or use mathematics and/or numeracy in their solutions and this classification does not recognise this fact. The other over-arching attribute is often listed as *communication*. Again, *numeracy* may make up a component of *communication* (and possibly vice versa) but they are by no means identical. To encompass one by the other is to do a dis-service to the dominated attribute, which, in most cases, is *numeracy*.

Interestingly, in 2016, the University of Technology, Sydney (UTS) will introduce a mathematics subject that will be compulsory for first year undergraduates "as it responds to growing concerns at poor levels of numeracy" (Australian Mathematical Sciences Institute, 2014). The course is called *Arguments, Evidence and Intuition* and it appears that it will focus mostly on statistical awareness. This is interesting in view of the fact that the search of universities' websites (conducted in July 2015) revealed UTS as having no mention of *numeracy* as one of its graduate attributes, even though the course is to have run as an elective in 2015. It would be useful and interesting to follow up how many students enrolled in, and completed, the elective, and to hear their comments on its perceived usefulness to them.

As it is to be compulsory, this course, and its implied interpretation of *numeracy*, suggests how to determine UTS graduates' numeracy ability, but it is limited in its application, as it really covers one facet of *numeracy* only. In fact, how *do* we measure students' *numeracy*, and, for that matter, their *literacy*? Pitman and Broomhall (2009, p. 449) tell us that classifying *numeracy* as a graduate attribute enables universities to avoid having to assess university students' *numeracy* on entry and exit. *Numeracy* may be easier to assess if it is embedded in academic courses and/or subjects. However, how does one convince course lecturers to embed *numeracy* where its need is not obvious? In fact, is it possible to embed numeracy into many courses? Does this mean that many graduates would escape scrutiny of their *numeracy* ability? Even James Cook University (2015), one of the few to accept *numeracy* as a graduate attribute in its own right, in its guidelines to staff on implementing its *English Language and Numeracy Policy*, recognises that "Numeracy requirements vary across disciplines"; therefore a 'one-size-fits-all' assessment would seem inappropriate. If we accept the combined Johnston's (1994), Coben's (2002) and Galligan's (2011) definitions of *numeracy*, the level of mathematics needed may not be too high – but how do we decide what that means? And how does one ensure that a student who achieves a pass on a *numeracy* assessment task does so with confidence? Are the assessments contextual for students? How is it decided whether a particular context will suit each individual? As Johnston (2002) says, "If numeracy is not important in an adult's life then perhaps we do not need to measure it, or keep count of its levels and distribution in the population" (p. 62). However, she also makes the point that numeracy is important in individuals' daily lives and is essential for employment and safety issues, for instance, and from that perspective it is in society's best interest to keep track of numeracy achievement.

Have we considered our learners as individuals? In their minds, do they need, or want, to be "numerate"? Indeed, one must ensure that primary school teachers, nurses, financiers, economists, engineers and so on are competent and confident in applying the mathematics required in their chosen profession. Yet do we need to ensure precisely *the same* ability in all these, and other, professions, that is, do we need a standard? Should we perhaps develop the equivalent of a NAPLAN[2] for university students? It is quite likely that many students would be deterred from entering university when they realise they are to be faced with yet another maths test, and this could even include higher-achieving students (Boaler, 2012). Professional bodies (such as The Board of Studies, Teaching and Educational Standards NSW) associated with many graduates' careers now insist on their members possessing certain standards which are tested before the individual is accredited in the profession. It is therefore possibly redundant to expect that universities, which, in many instances cooperate in, and contribute to the composition of such assessments, also be responsible for assessing students for their *literacy* and *numeracy* ability.

4. Discussion

Is it likely that the view of the "(& Numeracy)" committee in my university is the same as that held in most Australian universities? Perhaps the feeling in Australian society as a whole may reflect this view? On the other hand, when the head of the School of Mathematics and Statistics at UOW was approached to obtain his views on the development of a *numeracy* policy, he re-

[2] NAPLAN: The (Australian) National Assessment Program – Literacy and Numeracy (school students only).

coiled at the idea of university students having a lower standard than 2 Unit Mathematics[3] at the HSC[4] level and was a firm believer that this was the minimum to give students an excellent grounding for university study. But would this work? Would this necessarily ensure that students would become more "numerate" by doing senior levels of mathematics, sometimes with little understanding of more junior levels, and with little confidence of applying even the most rudimentary concepts? Writer Jenna Martin (2015) assures us of her dread of mathematics, and, although a top student in other subjects, begs that mathematics not be made compulsory for the HSC: "Let me be clear, this is not about Maths vs. English. This is about the right to not be EXTRA miserable in the most painful, boring two years of your young life: years 11 and 12" (Martin, 2015). She confesses that, although she was very clever and "a nerd", she was not clever at mathematics and this had been reinforced to her by her teachers. Rice, Care, and Griffin (2012) add that "requiring students to meet hurdle requirements [exit examinations] in literacy and numeracy is unlikely to lead to major increases in student achievement" (p. 46). In fact, they further claim that these obligatory exit standards examinations in literacy and numeracy could be related to reduced student retention rates (p. 47), especially among certain groups of students (p. 48), and, as Steen (2001) states:

> Even students who have studied calculus often remain largely ignorant of common abuses of data and all too often find themselves unable to comprehend (much less articulate) the nuances of quantitative inference … it is not calculus but numeracy that is the key to understanding our data-drenched society. (p. 2)

If each Australian university had a policy on *numeracy* requiring that its graduates possess this "attribute", how would it be proposed to measure it? It is noted that James Cook University (JCU), one of the few that own a *numeracy* policy, actually requests that students undertake a diagnostic assessment of their mathematical skills. And yet, a relation of the author's who is currently studying Nursing at JCU stated that she was not required to do a diagnostic assessment, although this may have been because she obtained entry through prior study in one of the university's pre-tertiary courses. She added that the Nursing course has regular rigorous assessment of medical calculations, and, as far as she is aware, that is all that is required and it will not be necessary for her to undertake any further assessment in *numeracy*. This sounds absolutely sensible as it corresponds to the ideas contained in Johnston's, Coben's, and Galligan's definitions – although, again, how the level of confidence is ascertained is of course unclear. It is to be hoped that succeeding within a certain time limit is not seen to be the equivalent of a level of confidence.

The positioning of *numeracy* as simply one of the many *literacies* – or even not at all – subjugates it so that funding for it as a speciality is not as forthcoming as it would be if it were considered important enough to stand in its own right (National Numeracy, 2015). For example, *dyslexia* has received a great amount of research and is quite well publicised and recognised as a disability, but the same cannot be said of *dyscalculia*. Mathematics as a discipline is a continuum and research is needed for dyscalculia as well as at the top level and thus it is important that it not be colonised by *literacy*. In fact, the question needs to be asked: Why *is numeracy* not as well funded as *literacy*? Is *literacy* considered more important than *numeracy*? If yes, why, when we are told that "numeracy appears to be a more potent predictor of social and economic outcomes such as health, employment, and higher salary, compared to literacy" (Tout, 2014)?

When faced with the prospect of needing to learn mathematics at university, even though that mathematics may have been covered in primary or junior secondary schooling, some students are extremely nervous. In fact, many of them may have what is termed "mathematics anxiety" (Taylor & Galligan, 2006), regarding their ability with mathematics as poor and having little confidence of succeeding in their course because of their perceived lack of skills. Some Primary

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[3] This is the lowest standard HSC mathematics course to include calculus as a unit of study.

[4] HSC: "The Higher School Certificate (HSC) is the highest award in secondary education in New South Wales" (Board of Studies Teaching & Educational Standards, 2015).

Education students may be especially anxious about teaching the subject. Referring to Buxton (1981), Hodgen and Askew (2007) claim that: "for many primary teachers, their relationship with mathematics is fraught with anxiety and emotion, much of it relating to their negative experiences of school maths" (p. 469). Hodgen and Askew (2007) also express apprehension that many of this type of potential teacher may tend to oversimplify maths for their own students in order to "protect" (p. 482) them from it, with the possible outcome that their students will find mathematics tedious and "irrelevant" (p. 482). This is a real issue, as many of these students may be allocated classes of children who are at the beginning of their formal learning, where a competent, confident and enthusiastic teacher is vital, because, as Bibby (2002) states: "if ... primary teachers' subject knowledge is mediated by powerful feelings rooted in their autobiographies ... then this will impact on the ways in which that knowledge is used professionally in the classroom" (p. 706), and the negativity may be absorbed and imitated by their young learners. Bibby also links the concept of "shame" (p. 708) to some teachers, where feelings of shame include threat to 'professional identity' as well as 'personal and social aspects of identity' (p. 708). During their course at UOW, these Primary Education students are faced with successfully completing a series of "Mastery tests": timed tests which require fast (or hasty) responses to a series of primary school level problems. But Boaler (2015) states: "Maths anxiety has now been recorded in students as young as 5 years old … and timed tests are a major cause of this debilitating, often lifelong condition" (p. 8). Students are allowed to re-sit the Mastery tests with extended time limits; it is interesting to see the different, successful results when they are not faced with the pressure of time and may thoroughly consider, and check, their solutions. Boaler (2015) tells us that stress tends to block the working memory which prevents the recall of mathematics facts, and this blocking especially happens with female learners. She argues that many learners also require time to "[focus] on sense-making and understanding" (p. 9) and that "automaticity should be achieved through thinking about number strategies" (p. 9). Boaler (2015) also notes that when teaching maths, importance should not be placed on speed, but rather on deep and careful thinking (p. 9).

Admitting to negative attitudes towards mathematics may be "socially acceptable" if only to give an individual the relief of hearing others agree, which may in turn improve their self-esteem which could otherwise be threatened. But there is the chance that those negative attitudes towards mathematics will permeate our society if we continue this emphasis. Do these attitudes mean that people in general, although they might realise the value of mathematics knowledge, just give up if they do not understand it up to Year 10? Does the fact that most universities in Australia do not have a specific policy on *numeracy* matter? Does it affect people's stereotypical view that mathematics really is "rocket science" – incomprehensible and unlearnable – and therefore they do not need to be bothered? And, in the end, does it really matter if someone is not as *numerate* as someone else, if such a comparison can be made?

Does the way in which mathematics topics are assessed – usually with timed examinations with no forms of assistance such as one's own notes or reference books – affect these attitudes? Surely if we are assessing for confidence and competence in applying mathematics "in the real world", then learners should not be restricted by a time limit, and should have access to relevant helpful materials, especially calculators and computers. This may also help people cope with anxiety levels (Boaler, 2015).

Perhaps it is the difficulties of working out exactly what numeracy is actually required by their graduates, and how to assess that numeracy, which has prevented most universities in Australia from defining *numeracy* as one of their graduate attributes. And yet, does that really matter? Will forcing students to undertake extra study in a subject that some of them are known to dislike intensely, and causes some to be genuinely affected by the anxiety it causes them, make them "better" graduates? Perhaps the answer is to ensure that courses which lead to particular professions that definitely require the use of mathematics be catered for and students must understand that they need to become competent and confident in the application of such mathematics, and its articulate transfer should they wish to become teachers. But for others, who have not chosen such courses, possibly deliberately steering away from mathematics, as long as they have access to numeracy skills needed in their daily lives, surely they need not be pushed fur-

ther into a hatred of mathematics. Martin (2015) tells us that "I tried harder at maths than almost anything in my life. But despite all my efforts, and all my extra hours of studying, I felt like a failure". Perhaps, instead, students should be supported to develop number sense rather than relying on memorising and rote learning, which is possibly how they were taught in school. As Boaler (2015) says, "Some students are not as good at memorizing [sic] maths facts as others. This is something to be celebrated, it is part of the wonderful diversity of life and people" (p. 8). She adds: "Mathematics already has a huge image problem. Students rarely cry about other subjects" (p. 9). Even the Chief Scientist (Barrett, 2014), agrees: when discussing whether students should be made to do a compulsory mathematics subject in years 11 and 12, he stated: "There's not much point making something compulsory if it's not actually attractive".

5. Conclusion

This paper has suggested questions for our Australian universities to ponder. It has not attempted to supply solutions to the questions but merely sought to begin the discussion that is necessary if we accept that our Australian society would be better off with the large majority of its population being numerate. The questions of defining *numeracy* and measuring the numeracy capacity of university graduates have been discussed, as well as the perceived importance ascribed to *numeracy* by Australian universities. Many more questions need to be asked and answered, however. Perhaps the role of universities is to emphasise the importance of *numeracy* without insisting on a standard requirement that all students must display. For many students such a standard would set an impossible level of mathematics comprehension. As McNaught (2013) argues: "A 'universal standard' for numeracy is inherently problematic" (p. 9). If we wish our universities' graduates to be numerate, then policies need to be developed, but more research is needed on how to frame these policies, and how to assess students' numeracy, especially so that prospective learners will not be alienated.

We are told that a more numerate society helps to position that society as an economically competitive one, especially in today's technological world (Human Capital Working Group, Council of Australian Governments, 2008). The positioning of *numeracy* by universities may or may not contribute to Australian society's acceptance of mathematics being thought of, by many (if not the majority) as an anathema. University students could be encouraged, but not forced, to pursue more mathematics-based courses, only if they are either genuinely interested in them, or if those courses provide essential knowledge for the student's chosen career. Study of such courses also needs to be of benefit to the individual student, not just to the economic competitiveness, or human capital, of that society.

> Australia's productivity and competitiveness is under immense pressure. A key way to meet the emerging challenge of developing an economy for the 21st century is to grow our national skills base - particularly the Science, Technology, Engineering and Mathematics (STEM) skills of our school leavers. Our relative decline of STEM skills is holding back our national economy and causing real frustration for employers. (Australian Industry Group, 2013, as cited in the Office of the Chief Scientist, 2013, p. 10)

Perhaps the answer to the negativity is to encourage people we hear saying "I hate maths" to try to change their tone – especially around children. But, in fact, we need to start at the beginning learners' level, not wait until they reach the adult learners' stage, when it is possibly too late, and use dynamic, enthusiastic, realistic and non-threatening methods of teaching and assessment which encourage and invite students to enjoy mathematics, not deter them from it.

Appendix A. Australian University Policies: Search Results

After a website containing the names and websites of all Australian universities[5] was found, a search was then applied to each university, using its own Search facility, under *numeracy*; *policy*; *policies*; *graduate attributes*; and/or *graduate qualities.* The following table reflects the results of these individual searches. Notes which describe Numeracy policy are highlighted in yellow in the table.

University	**Policy Document**	**URL**	**Numeracy? Mathematics?**	**Notes**
University of Sydney	Academic Board Resolutions: Generic Attributes of Graduates of the University of Sydney (1993, reviewed 2004)	http://sydney.edu.au/law/learning_teaching/learning/graduate_attributes.shtml	No	Information literacy; communication
University of Melbourne	?	?	?	?
Monash University	Monash Graduate Attributes Policy (2011)	http://policy.monash.edu.au/policy-bank/academic/education/management/monash-graduate-attributes-policy.html	No.	Easiest to find. Problem-solve; communicate. English Language requirements on entry
University of Queensland	Graduate Attributes – Policy (2011/2014)	https://ppl.app.uq.edu.au/content/3.10.05-graduate-attributes		Communication
University of New South Wales	Assumed knowledge	https://www.unsw.edu.au/future-students/domestic-undergraduate/assumed-knowledge		Lists desirable maths needed for courses. All students are required to be "competent at communicating in both written and spoken English"
Griffith University	The Griffith Graduate (2014)	http://www.griffith.edu.au/learning-teaching/student-success/graduate-attributes		"Effective communicators"; problem solvers
RMIT University	Learning and Teaching Graduate Attributes	http://www1.rmit.edu.au/teaching/graduateattributes	No.	"TEQSA's regulatory requirements and the Australian Qualifications Framework mean that it will be important for the university to be able to measure and capture information about graduates' acquisition of generic learning outcomes as part of their program of study."

[5] https://www.google.com.au/search?q=Australian+universities&ie=utf-8&oe=utf-8&gws_rd=cr&ei=fuixVdD2CYSkyASM1bmICA

University	Policy Document	URL	Numeracy? Mathematics?	Notes
RMIT University (cont'd)				"Work ready" "Graduates of RMIT University will have an appropriate level of English language proficiency." Plus problem-solvers
Australian National University	?	?	No.	English language admission requirements
Macquarie University	?	?	?	?
University of Adelaide	?	?	?	?
University of Western Australia	?	?	?	?
University of Western Sydney	Graduate Attributes.pdf (*Graduate Attributes Policy Statement*)	http://www.uws.edu.au/learning_teaching/learning_and_teaching/strategic_projects/graduate_attributes	Yes. Numeracy, separate from "communication skills", "information literacy" and "technology literacy" in category "…literacies"	Numeracy is defined as "[a graduate] applies appropriate numerical skills to understand, interpret and solve problems"
Latrobe University	?	?	?	English Language entry requirements
Australian Catholic University	Graduate attributes	http://students.acu.edu.au/office_of_student_success/career_development_service/for_employers/employ_acu_studentsgraduates/graduate_attributes	No.	"demonstrate effective communication in oral and written English language and visual media"
Deakin University	?	?	?	?
Queensland University of Technology	Graduate Capabilities	http://www.mopp.qut.edu.au/C/C_04_03.jsp		Effective communication
Curtin University	?	?	?	?
University of Notre Dame	University of Notre Dame Graduate Attributes Statement	http://www.nd.edu.au/qmad/gradattributes.shtml	Yes, but…	"Generic graduate attribute" = "communication" and its equivalent "graduate ability" is "The ability to communicate effectively in all domains within a range of contexts, using oracy, literacy, numeracy and information skills"

University	**Policy Document**	**URL**	**Numeracy? Mathematics?**	**Notes**
University of Wollongong	Graduate Qualities Plus English language (5 Dec 2014)	http://www.UOW.edu.au/about/teaching/qualities/problemsolver/index.html http://www.UOW.edu.au/about/policy/alphalisting/UOW187817.html	No.	Problem-solver. That links to *Statistical literacy* modules
University of Technology Sydney	English language entry and development of proficiency	http://www.gsu.uts.edu.au/policies/english-language.html	No.	
University of Canberra	Attributes of UC Graduates of Coursework Courses	https://guard.canberra.edu.au/policy/policy.php?pol_id=3344	No.	Information literacy skills. Generic skills; communicate; solve problems
Swinburne University	?	?	?	?
University of Newcastle	English language proficiency policy	http://www.newcastle.edu.au/about-uon/governance-and-leadership/policy-library/policy#teaching-and-learning	No	
University of South Australia	Graduate Qualities	http://w3.unisa.edu.au/gradquals/default.asp	No	problem-solver; communicates
University of Tasmania	Policy on Generic Attributes of Graduates of the University of Tasmania	www.utas.edu.au/__data/assets/pdf_file/0003/66234/genericattributes_grads.pdf	Demonstrate oral, written, numerical and graphic communication	problem-solving skills; information literacy;
Victoria University	VU Graduate Capabilities	https://policy.vu.edu.au/view.current.php?id=00074	No	language; communication; problem-solve
James Cook University	English language and numeracy policy	http://www.jcu.edu.au/policy/allatoh/JCU_114776.html	Yes. But does a diagnostic assessment of all new students	Numeracy proficiency "Numeracy involves… using… mathematics… to achieve some purpose… in a particular context" (Australian Numeracy Education Strategy Development Conference, 1997, p. 13); or "the ability to generate, calculate, interpret and communicate numerical information in ways appropriate to a given discipline" (JCU Graduate Attributes- Undergraduate).

University	Policy Document	URL	Numeracy? Mathematics?	Notes
James Cook University (cont'd)				"JCU has a responsibility to ensure that all students develop key graduate attributes including a level of English language and numeracy proficiency that will allow them to participate effectively and productively in their courses and subsequent employment."
University of New England	Graduate Attributes Procedures	http://www.une.edu.au/policies/academic-policies	Only as complying with AQF	
Central Queensland University	Core graduate attributes	http://policy.cqu.edu.au/Policy/all_policy_list.do		"Generic skills" = "communication"; "information literacy", … . "Intellectual nurturing" = "Problem solving",…
Murdoch University	"Graduate attributes at Murdoch University" There is also a separate English Language Policy but no "Numeracy policy" as such	http://our.murdoch.edu.au/Educational-Development/Preparing-to-teach/Graduate-attributes/	Yes	"Numeracy" is classed as a "sub-attribute" of "communication" (which is an "attribute")
University of Southern Queensland	Qualities of a graduate policy	http://policy.usq.edu.au/documents.php?id=13420PL	No	Written and oral communication; digital literacy; problem solving
Federation University	See notes	http://policy.federation.edu.au/learning_and_teaching/academic_programs_and_courses/statement_of_graduate_attributes/ch01.php	No (see notes)	Not in graduate attributes (problem solving, communication are) but in a minutes of a Learning and Teaching committee meeting there is talk of diagnosis
Southern Cross University	Graduate attributes policy	http://policies.scu.edu.au/view.current.php?id=00091		"(10) SCU Graduate Attributes and the contextualised Course Learning Outcomes encompass the AQF Generic Learning Outcomes, namely: a. 'fundamental skills, such as literacy and numeracy appropriate to the level and qualification type b. people skills, such as working with others and communication skills c. thinking skills, such as learning to learn, decision making and problem solving d. personal skills, such as self-direction and acting with integrity' (AQF, 2013, p. 11)."

University	Policy Document	URL	Numeracy? Mathematics?	Notes
University of the Sunshine Coast	Learning and teaching Academic policy: Graduate Qualities	http://www.usc.edu.au/explore/policies-and-procedures/learning-and-teaching-academic-policy	No	Communication; Problem-solving (= generic skills)
Flinders University	?	?	?	?
Charles Darwin University	? No search facility	? No search facility		? No search facility
Bond University	?	?	?	?

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