Mathematics and Numeracy in a Global Society

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Introduction

Numeracy is a contentious issue. There are multiple definitions; series of explanations that describe the relationship numeracy enjoys with mathematics; and even perspectives that interpret numeracy and mathematics as identical sets of skills, concepts and strategies (for example see Sullivan, 2011). Identified with literacy as one of the 'terrible twins' that underpin all educational endeavours, numeracy remains a rather confused and confusing concept for many teachers who are responsible for teaching mathematics skills, concepts and knowledge, and for supporting students' attempts to translate these into numeracy capabilities. It is difficult to determine exactly how this current situation has evolved; what is certain, however, is that overall, teaching and learning in numeracy in Australian schools. Historically speaking, it has not attracted the same degree of financial, social or academic attention as literacy, despite the two being tagged together in a number of government initiatives (Australian Government, 2011, 2013). This may be because literacy is perceived to be the single most important life skill for students and so matters more to parents and teachers. It may be because being innumerate is not thought to attract the same social stigma as being illiterate (Gregorian, Griffiths, & Cahill, 2008) or it may be simply that the relationships created by mathematics and numeracy are not always clearly delineated (Sullivan, 2011).

Irrespective of these considerations, it is proposed that numeracy is a worthy 'twin' to literacy, that it is equally important, and that it is increasingly necessary for students to be numerate in order to make meaning of their worlds and to become active, engaged and informed global citizens (Parsons & Bynners, undated). For the purposes of this writing, mathematics are the skills, strategies, concepts and cognitive capacities that are associated with more formal, content-knowledge

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development, while numeracy is conceived as the mathematical knowledge with bearing on other areas of learning, in all aspects of everyday life and in making meaning from personal experiences. Like two sides of a coin, they are indispensable one to the other. However integrated they are, though, they still look different and require different interpretations.

Numeracy

The simplest and most useful definition of numeracy for this text comes from Macmillan (2009 p. 1). She states, 'Numeracy is a social and cultural perspective for discovering and thinking about mathematical knowledge and applying it to fulfil the purposes of our everyday lives' (p. 1). Because it is part of everyday life, the application of mathematics to personal contexts and situations may not be explicitly conscious. There is a degree of automation about many daily interactions and personal actions, such as shopping, catching buses and trains, spending specified durations of time for lunch, etc. These become habitual, and, whilst they are the practical components of mathematics activities undertaken in everyday life, possessing skills at this level is not always sufficient to be identified as an individual who is authentically numerate in the twenty-first century. Currently, in order to be considered numerate, individuals need to have the capacity to make sense of mathematical concepts as they are applied to their personal contexts and needs in a wider sense, as global, national and local citizens.

What Does the Literature Say About Numeracy and Globalisation?

Globalisation itself is considered by some as the 'Americanisation' (Gidley, 1998) of the rest of the world, despite the fact that globalisation is orchestrated by international or non-national entities similar to those who have highjacked education in general to serve the economy.

Ethnomathematics

The advent and continued rise of technology has brought the rest of the world into Australian homes, classrooms and workplaces at an ever-increasing rate. It has broken down the historical barriers of time and place in terms of accessing, storing and retrieving information about local, national and international contexts. In turn, as recipients of this wealth of information, Australians, most especially young

people, are now able to understand themselves not only in terms of national identity, but also as part of a much more complex social structure: the world community. This membership of the world-wide community is commonly known as 'global citizenship', and it brings with it a complicated array of personal, political, social, cultural, ethical and financial dilemmas and responsibilities. Falk (in Atweh & Clarkson, 2010) describes two types of globalisation. One is globalisation from 'above' which is the spreading of consumerism and the involvement of huge transnational conglomerates which dictate business and political life. The other is defined as globalisation from 'below', and this is reflected in the transnational common concerns for human rights, the environment and end of poverty, oppression and the forces of collective violence such as war.

Whilst globalisation itself is perceived in terms of various definitions, it is generally agreed to be the result of redefining, crossing and mobilising physical borders, which has made the world 'smaller' by increasing the consciousness of diverse populations to cultural, social and political challenges world wide and by delivering many of these challenges into hitherto relatively homogeneous or stable communities. The term globalisation is often used simultaneously with internationalism; however, this does not necessarily mean that they are synonymous terms. Atweh and Clarkson (2010) argue that they are undoubtedly related in that intense internationalisation may easily lead to globalisation, but they caution that while this may be happen in the larger picture, the issues that are at the centre of globalisation need to be considered in terms of local impact and context. It appears that context, always acknowledged as a factor in teaching and learning, is becoming increasingly important as globalisation demands that the increasingly diverse learners in classrooms are given access to learning in ways that allow full participation (Ingram, Seashore, & Schroeder, 2004). This has considerable implications for teaching and learning in mathematics (Atweh & Clarkson, 2010), as economic and political environments have considerable impact on pedagogy (Porter, in Thomas, 2010). This can be observed in the narrow focus of the current Australian mathematics curriculum and accompanying pedagogies, which heavily stress learning that supports the current climate of economic rationalism, to the detriment of individual learner difference and cooperative and collaborative pedagogical strategies.

Mathematics is considered by some to be superior to other forms of knowledge in modern society (Stillman & Balatti, 2010: 313). This claim may reflect the argument that mathematics education and democracy are closely connected (Skovsmose & Valero, 2010). It certainly reflects the importance of mathematical thinking, literacy and criticality in the contexts of national, non-national and global outcomes and economic needs in relation to technological and scientific advances. It also highlights the importance of numeracy in the context of personal mathematical fluency to better understand the role of mathematics in the rapidly evolving nature of society and culture. In acknowledging the political dimensions of mathematics teaching and learning, Skovsmose and Valero (2010) present the three theses or perspectives on this link between mathematics and democracy. The first is its intrinsic significance to participation in civic and political life. Mathematics

learning enables the development of logical, well-reasoned debate, and empowers individuals to participate fully in democratic discourse and processes.

Second, the perspective that places mathematics on the other side of the argument is that it is used in education to actually disadvantage students, in that teaching and learning in mathematics plays a significant role in excluding and segregating students who find mathematics difficult to understand. Consequently, individuals who are able to achieve high levels of mathematical thinking are valued in society, and they become the decision makers that accumulate significant economic, social and cultural capital (Bordieu, 2011; Bordieu & Passeron, 1990), which contributes to the role played by education in social reproduction and separating those who are able to make decisions about life's opportunities and those who are not. Indeed, historical episodes of exclusion, apartheid and marginalisation indicate that by preventing specific groups of individuals from engaging with mathematical teaching and learning, political regimes have prevented those groups from engaging in political and civic life in a democratic manner (Skovsmose & Valero, 2010).

The third perspective that links mathematics and democracy is that of critical relationship. This perspective dismisses the two other perspectives as absolutist, claiming instead that mathematical teaching and learning can be both the thesis of resonance and the thesis of dissonance. While highlighting the fact that the historical tendency to treat mathematics as a discipline area that remains untouched by subjectivity and social and cultural implications maintains the political agendas, beliefs, values and interests of those who perpetuate this viewpoint, Skovsmose and Valero (2010) emphasise the constantly evolving social nature and functions of mathematics in the increasingly complex circumstances that characterise modern societies. This environment means that mathematics are constantly changing, that the pedagogies associated with the teaching and learning of mathematics need constant revision, and that the social and cultural contexts of the students who are learning mathematics need to be taken into consideration.

If the purpose of mathematics education is to facilitate numerate, interactive citizenship and not just to create pure mathematicians, then all students need to able to make authentic links to the mathematics they learn in school and to the mathematical experiences they come into contact with in their own lives. What also needs to be considered is that mathematical experiences are found within other subject areas of the school curriculum (Skovsmose & Valero, 2010). The learning in any disciplinary area interacts with the leaning in another, either in a positive, supportive manner, or as a counteractive or counterproductive influence. The interpolation of all these contexts of mathematics learning is of critical importance for democratic, global, informed citizenship.

> Therefore, mathemacy should be a prioritized competence, allowing people to engage with mathematical questions and, simultaneously, with a critique towards the impact of mathematics in society. The association of mathematical education and critical citizenship should be both a theoretical and developmental issue to keep in focus (Skovsmose & Valero, 2010: 40).

However, the globalisation of society has resulted in considerable degree of diversity in classroom populations.

This, in turn, has presented challenges in the teaching and learning of the critical mathematics perspective that is required for socially responsible participation in society. A considerable debate around the topic of ethnomathematics remains unresolved, with various contributors to the discussion reflecting their own theoretical perspectives and social contexts (for example see Graham, 1988; Pinxten & François, 2011). A critique of D'Ambrosio (1985, 2001), who regards formal mathematics as part of the power play of aggression, can be found, along with a critical evaluation of the arguments regarding the integration of mathematics as cultural practice (ethnomathematics), and mathematics that are part of the institutionalised curriculum in schools, can be found, for example, in Rowlands and Carson (2002) and an earlier discussion of different, culturally based mathematical notions in Bishop (1988). Other scholars (for Example, Barton, 1996; Boaler, 1993; Robyn Zevenbergen, 2004) have noted the richness of ethnomathematics and it potential to enable students to make meaning of their mathematics learning. The study of multiple mathematical models, would, necessitate that teachers develop new pedagogies that reflect cultural understanding, inclusion and respect for the practical needs and experiences that students bring to their classrooms. The student–teacher interactions, the sensitive selection of resources and materials and the successful learning of all students do need to become priorities in every classroom, in order to ensure that all young Australians are equipped with the mathematical skills necessary to take their place in the increasingly technological, multicultural environment of Australian society (Ministerial Council on Education, 2008).

The issues and responsibilities that today's students will face as global citizens will necessitate that they each develop mathematical skills and competencies that were hitherto not necessary for all members of society. Amongst these are capacities for critical thinking and analytical reasoning (Sparks, 2012). These cognitive capacities are not only vital for understanding numeracy, but are regarded as imperative for academic success and active citizenship in general (Afamasaga-Fuata'i, 2008; Ahana, 2014; Cottrell, 2003; Halpern, 1999; Lipman, 1987; Paul, 2005; Watson, 2008a, b). One example of how these critical thinking skills and capacities for analytical reasoning, which are heavily dependent on the logic and reasoning developing the study of mathematics, comes from Andreotti (2006). In her discussion of those societies who are globalised and those who do the globalising, Andreotti argues that critical global citizenship requires not empathy for others, but justice. In order to achieve this, individuals need to have the capacities to understand information that is increasingly presented in statistical and data based formats. They are required to have the competencies to evaluate what information is provided and what is excluded. They must know what figures and data reveal about underlying prejudices and bias, and ways in which information is managed in order to serve the purposes of the stakeholders. Individuals ought to be able to detect the means by which they are being subtly predisposed to make specific decisions and judgments.

Another example provides an insight into the ways in which school students not only are able to perceive themselves as global citizens, but also have opportunities to use their numeracy competencies to perform problem-solving activities as citizens in another society. Simmt (undated), created a fictitious society to which all her year five students belonged. The students were able to identify, strategize solutions and solve lifelike problems during citizenship lessons by using their numeracy competencies. At all levels of society, individuals will, in the future, need what is essential for competent citizenship in any context: That is, numeracy skills that have the capacity to inform their everyday practice, to detect the significance of seemingly ordinary things and to determine the hidden cultural significance of events and changes to dominant social practice.

What does this mean for you as a teacher of numeracy?

- Society is changing at an unprecedented rate, and for students to gain the skills to make meaning of their personal worlds and to become responsible, ethical members of local and global societies, they must have sophisticated capacities in mathematics and numeracy.
- Decisions made as global citizens need to reflect ethical personal values and belief systems. These can only be made in response to what is critically understood and evaluated as personally valuable and important.
- Responses to personal contexts and relationships require individuals to have the competencies to develop personal meaning and to understand their increasingly complex worlds in the contexts of both local and international citizenship.
- Critical mathematics, and its application in everyday life as numeracy competency, needs to become a priority in the teaching and learning of mathematics skills, strategies, and concepts.
- *For example: The Year Three Health lesson about healthy choices is a good beginning to the sorts of skills students will need as active citizens. It focusses on getting students thinking about their own choices in the context of a party which may have foods that were once an annual treat but which are now taken for granted, not so healthy choices. In this lesson the students may question traditional party food and substitute other foods which are better for their health.*

Numeracy as Social Practice

The ethnographic or cultural use of mathematical knowledge, skills and understanding, for specific, personal purposes in everyday interactions, is well documented (Baker, Street, & Tomlin, 2003; Kleemans, Peeters, Segers, & Verhoeven, 2012; LeFevre et al., 2009; Saxe, 1988; Street, Rogers, & Baker, 2006). Using the

insights into the multiple ways in which literacy is used in different cultural contexts, Street (2003) determined that teaching literacy in a manner which reflected only the dominant western culture, and which focussed on literacy as a culturally and socially neutral technical skill, was not only of limited benefit to many of the participants, it also did not automatically have an impact on other aspects of development such as social and cognitive practices (Street, 2003: 77). Identifying this model of teaching literacy as the 'autonomous' perspective, Street then developed a more culturally sensitive model of literacy which posited that literacy is always 'embedded in socially constructed epistemological principles' (Street, 2003: 77). This perspective was identified as the 'ideological model' of literacy. In different cultural and social settings, individual understandings of the nature of numeracy also vary in response to the purposes for and contexts in which they are implemented. Baker, Street and Tomlin (Baker et al.) investigated the strategies of a number of students in three different schools in order to establish the degree to which the social and cultural backgrounds of the students impacted their numeracy strategies. They concluded that these factors were of significant importance in the conceptual and strategies students used.

Social and cultural contexts have only been recognised as an area of importance for teachers of mathematics since the 1980s (Thomas, 2010), although there is no real recognition that there are other systems and practices around mathematics and numeracy that do not synchronise readily with the Western, scientific processes that decontextualized and depersonalise, and which are the basis of Australian curriculum and operations. Learning contexts are continuing to emerge as a fundamental focus for educationalists, as research into different ways of knowing and learning illustrates the critical nature of these diverse backgrounds with regards to student participation and engagement in the regular educational process (Burgoyne & Hall, 2007; Cassidy & Gow, 2005; Harris, 2013; Keddie, 2012; Matthews, 2008; Taylor & Sidhu, 2012; Wilkinson & Langat, 2012). This, in turn, has several implications for teaching and learning in numeracy, as many attempts by educationalists to improve the students' results had previously focussed on considerations such as the teacher expertise, pedagogies and school and educational structures. The impact of cultural differences in numeracy thinking and social conditions such as homeless and poverty had not routinely been considered in these attempts. Using the terminology developed by Street, but replacing literacy with numeracy, numeracy events can be observed as specific occasions in particular contexts which are experienced by students, and which are solved in socially and personally meaningful ways that reflect both the individual's social and cultural interpretation of the event and the ways in which they have derived meaning from it. Similarly, numeracy practice can be interpreted as the broader cultural and social way of doing mathematics and numeracy.

In an effort to develop suitable pedagogical strategies for the successful interaction of ethnomathematics and institutional mathematics, Street, Rogers and Baker (Baker et al.) investigated the mathematical practices of those engaged with this work. In one example, Street, Rogers and Baker (Baker et al.) found that ethnographic strategies helped teachers of women in rural India to support learning in numeracy. In the process of observing current practices and examining the

participants' strategies for counting and measuring and other numeracy skills, the teachers were able to develop suitable pedagogies based on the participants' epistemological knowledge. They indicated that:

> Developing such an approach involves helping the participants - in this case adult education trainers — to identify local cultural meanings in context, reflect upon their own assumptions and values, and then design curriculum and pedagogy that will build on such local knowledge. (Street et al., 2006: 33)

In this way, teachers and the women were able to share the common meanings that were used in this social context and use them to support further learning. Many of the pedagogies that are commonly implemented or recommended in programmes designed to support increased competencies in numeracy have the potential to reflect one type of cultural and social understanding of numeracy, whilst neglecting many others, unless teachers are able to design pedagogies that reflect the social and cultural knowledge that students bring to their classrooms. Developing a pedagogy that facilitates shared mathematical meanings is critical to meeting the mathematical and numeracy needs of diverse students. Without this, many students will not develop sufficiently robust skills to accommodate further learning and will be disadvantaged in the wider social and civic environments.

One perspective that clearly illustrates the means by which individuals are advantaged or marginalised in schools, and by which the social stratification is replicated by mainstream education, is found in the work of (Bourdieu, 1986, 1990; Bourdieu, Passeron, & Saint Martin, 1994). The framework developed by Bourdieu is frequently used by researchers and others to determine the degree of access specific groups of students in schools have to the teaching and learning interactions in classrooms. Bourdieu theorised that there are four different types of capital that impact the relationship between social class and education, and subsequently on social class and career opportunities. Economic capital is exactly what its name suggests. This form of capital is about money, possessions, property and other monetary advantages. It is obvious that money can play a part in educational opportunity and success. The other types of capital are not directly related to monetary wealth; however, Bourdieu posits that they also have a direct impact on educational opportunity and success. Cultural capital is about the attitudes, social habits, perceptions, language usage and even personal presentation that indicate the social class of students' backgrounds. He terms this *habitus.* In society generally, both individuals and institutions such as schools learn to read these clues and are able to readily discern the social class to which individuals belong. Bourdieu identifies three types of cultural capital: embodied cultural capital, including linguistic capital; objectified cultural capital and institutionalised cultural capital.

Embodied cultural capital is not confined to the ways in which individuals present themselves physically; it also refers to the types of customary practices and leisure time activities in which individual of specific social classes typically engage. A significant part of embodied cultural capital is linguistic capital, which is not only represented in vocabulary use, but also in patterns of communication, inferred and interpretative meaning and degree of linguistic sophistication. Much of his thinking

about linguistic capital is supported by Bernstein's (1990) work on linguistic codes. Bernstein argued that students from working class backgrounds do not always include complete information in their communications; instead they rely heavily on some taken-for-granted, shared understandings and meanings. Bernstein indicated this type of communication was a restricted code. In comparison, students from middle-class backgrounds have the capacity to use elaborated codes, where they provided all the necessary information in their communications. It is reasonable to state that the most effective manner in which to communicate in school settings is to use elaborated codes. By default, therefore, restricted codes have the potential to disadvantage students at school.

Objectified cultural capital refers to the physical things that give people status. In school settings, this may mean the latest technological tools, sports equipment and so forth. In the wider community, it may refer to cars, jewellery and other items of value which can easily be exchanged for economic capital. Institutionalised capital is about the connections that individuals have to institutions. One example would be the school that an individual attended or the particular university from which they obtained a degree. This cultural capital is also readily exchanged for economic capital in the terms of job or career opportunities. Social capital is the connections that people have to others. A wide network of influential people, who have themselves considerable economic and cultural capital, gives the individual social power and can provide needed opportunities that cannot be accessed by those without these connections or memberships to exclusive groups or clubs. Symbolic capital is about prestige within groups.

In a year-long study of two primary classroom mathematics interactions, (Zevenbergen, 2010) found that students who came to school with the appropriate linguistic 'habitus' (Bourdieu, 1986, 1990) were able to talk and generally interact in ways that were understood and that were congruent with the ways in which teachers in classrooms interacted verbally with the students. Conversely, students who did not have the linguistic habitus of school interactions were marginalised by the classroom pedagogical practices. It was found that the triadic dialogue that was commonly used in both classrooms was engaged with readily by the middle-class students, as they appeared to comply with, and participate in, this for of dialogue. Triadic dialogue is described by Lemke:

> Triadic dialogue is an activity structure whose greatest virtue is that it gives the teachers almost total control of the classroom dialogue and social interaction. It leads to brief answers from students and a lack of student initiative in using scientific language. It is a form that is overused in most classrooms because of a mistaken belief that it encourages maximum student participation. The level of participation it achieves is illusionary, high in quantity, low in quality. (Lemke in R. Zevenbergen, 2010: 206).

The working class students, however, had difficulty, resisted engaging or did not appear to understand the structure and meaning of the triadic dialogue. As this dialogue was used extensively in the introductory part of the mathematics lessons, both to allow the lesson to progress smoothly and to introduce more mathematical content, the working class students were effectively excluded in some degree from

the mathematical content and from the opportunity to mentally prepare for the activities which were to follow. These students were all aged 10 to 11 years and in the second to last year of primary schooling, and so this situation also had another impact. As this dialogue is extensively used by secondary teachers, the working class students were further marginalised by the lack of preparedness they would have for learning mathematics in secondary contexts. In this pedagogical dialogue, students from particular cultural and social background are advantaged, to the detriment of the learning of those from other social and cultural backgrounds. In this way, certain common pedagogical strategies fail to prepare many students to play their part in civic life in this technologically advanced society.

It is foreseeable that the changes in cultural and social practices that are resulting as technology advances and reaches every household and public space will present problems for citizens who are not authentically numerate. This is because the social and cultural changes are rapid and complex. Individuals who do not understand the foundational principles of mathematics will not be able to adapt and change their numeracy practices as effectively or as efficiently as those who do. The defining characteristics of numeracy that may need to be adapted, revised or renewed to be effective in a changing social context may be described as follows:

- It is a personal, social and cultural activity; and as such is unique to the user.
- Practices may differ from individual to individual depending on need. For example the numeracy needs of a truck driver would be substantially different from the numeracy needs of a teacher. These vocational numeracy competencies may also differ from the everyday numeracy needs of living in society in general. It is accepted that all teachers are teachers of numeracy and literacy (Australian Association of Mathematics Teachers, 1997).
- It requires an understanding of the concepts, strategies and knowledge of mathematics.
- It can be developed in tandem with formal learning in mathematics and in informal contexts of everyday interactions.
- What it is to be numerate is, as always, a constantly evolving capacity. It is not a static competency for all contexts and all times, although individuals who have robust knowledge in numeracy are more likely to respond more easily to the changing demands of personal, social and cultural numeracy skills than those who do not.

What does this mean for you as a teacher of numeracy?

- Teachers need to know about the backgrounds and culture (Aunio, Aubrey, Godfrey, Pan, & Liu, 2008) of their students because community knowledge and home language mediate the use of mathematics as numeracy practice, especially in the context of social justice numeracy (Diez-Palomar, 2006; LeFevre et al., 2009; Spielman, 2009).

- Students do not automatically learn numeracy skills in mathematics times in classrooms; they need to have multiple opportunities to develop competencies in numeracy by solving real problems.
- Informal school contexts such as playing games on the playground and shopping at the canteen are all sound opportunities for students to develop their numeracy competencies.
- Other, more formal contexts include engagement with other areas of learning. These all provide opportunities for the development of numeracy skills.
- Individual strategies and actions are always acceptable in numeracy practices as students interpret the contexts and construct the accompanying numeracy actions that are necessary to make personal meaning. There is no one correct way.
- Numeracy practices can be explained, shared, justified and enhanced by engagement in discussions that are logically constructed.
- Some traditional pedagogies such as triadic dialogue do not encourage quality participation in ways that are equitable and inclusive of all students.
- *For example, the Year Five/Six lesson in Visual Arts which examines Frank Stella's work 'Untitled' give students multiple opportunities to interpret and describe the work in any mathematical terms that they can use appropriately and to explain their interpretation in ways in which the can 'show what they know' as individuals.*

Anticipating Change and the Role of Numeracy

As a reaction to the changing nature of society in America of the 1970s, Steen (1987, 1990, 1997, 2001a, 2001b), foresaw the impact of an increasingly technological, global society. He proposed that numeracy was the 'new' literacy that needed for Americans to survive and make decisions in a society where information was becoming increasingly available, larger in volume and more quantitative in nature. He argued that only one in ten adult Americans had the numeracy skills to solve problems of two or more steps, understand the economic implications of a standard tax rate or explain the complications involved in the research to find a cure for AIDS. He also notes that numeracy means different things to different people, that it has many different functions, that it is linked inextricably with literacy and that it both 'shapes and is shaped by society' (Steen, 1997: 2). What is most interesting, however, is that while Steen argues that numeracy, quantitative literacy or mathematics—whichever term individuals use for these capacities—is a fundamental artefact of any society, he also posits that, towards the end of the twentieth

century in America, such little progress was made in the teaching and learning of numeracy simply because, apart from the basics, there were no consensual goals relating to the numeracy needs of the future or the directions in which they needed to be developed. To some degree, that situation no longer exists in Australian schools.

Australian curriculum documents are prefaced with rationales that include notions relating to teaching for the skills that students will need to live as active, productive citizens in the future. While the impact of these documents on schools, classrooms and on the capacities of students themselves remains to be seen, the documents relating to the nature of numeracy itself (ACARA, undated-b), its purpose in terms of the Goals of Education for Young Australians (Ministerial Council on Education, 2008) and a developmental sequence of mathematical concepts, knowledge and strategies (ACARA, undated-a) have, at the very least, provided some common national goals and understandings for Australian educators. However, in order to fully support educational endeavours across the diversity of Australian social and cultural contexts, a paradigm that includes these notions of numeracy as personal and social practice, numeracy as complex critical thinking in local and global environments and numeracy as opposed to, yet part of, mathematical learning, needs to be explored.

What does this mean for you as a teacher of numeracy?

- Numeracy skills exist in every cultural and social context as an integral part of its fabric.
- Numeracy, like literacy, is fundamental to students' capacities to make meaning of their world.
- The increasing representation of information as quantitative in nature means that students need to have the competencies to verify, analyse and evaluate the information that they are learning about in a variety of contexts.
- Social practice indicates that numeracy is a very personal capacity and reflects the needs of the user.
- Numeracy will have different meanings for different students, depending on their numeracy experiences at school, at home and in other contexts in which they interact.
- Social and cultural factors both influence and are influenced by understandings of numeracy, so students from diverse cultural and social backgrounds will have various ways of using their numeracy strategies and explaining their thinking about numeracy concepts.
- The technological society that is part of many Australians' lives has changed the nature and complexity of the numeracy skills that are needed to participate in this society.
- This diversity needs to be accepted and accommodated in teaching and learning contexts.

- It may be difficult for teachers who have very different backgrounds to those of their students to support the development of students' numeracy competencies in ways that are meaningful to the students—it will require some thoughtful reflection.
- Observing, conferencing and supporting students' own strategies (applications and procedures) and correctly developed conceptual understanding has the potential to be more powerful in supporting increased competencies in numeracy than any other pedagogical strategies that may be used.
- *For example, the Year four lesson in Technology focusses on 'Increasing Classroom Functionality'. It provides students with opportunities to use both the practical skills of mathematics as numeracy skills in their development of a model or a full size example of their design and the logical thinking skills that underpin their design and its effectiveness in solving the perceived problem.*

Conclusion

This chapter has sought to clarify the nature of mathematics and numeracy competencies in the context of an increasingly technological and globalised world. It has emphasised the political, social and cultural advantages of engaging with numeracy competencies to inform, clarify and resolve the everyday challenges and encounters in the specific contexts in which individuals live and work. It has highlighted importance of all these considerations in teaching and learning, most specifically in regards to viewing numeracy as social practice. Mathematics and numeracy are, like culture, never static; they are always evolving in response to the ways in which people need to use them in their everyday contexts. The current rate of change and technological advances has resulted in a greater need for numeracy competencies in order for people to participate and contribute fully in personal, social and civic life. It has also created a deepening awareness of the contextual uses of mathematics as numeracy competencies, and of the need to develop pedagogies that support both the ethnomathematical contextual knowledge and practices and the integration of institutional mathematical competencies as fractured, conceptual tools.

Mellin–Olsen (in Thomas, 2010) regarded literacy and numeracy as the important structures with which young people could overcome the difficulties of life and understand, build, change and shape society. If this is to be achieved, then numeracy must demand as much attention in educational contexts as literacy has received in the last 30 years. It is not only a tool with which individuals can create the society in which they aspire to live, but also a means by which Australia can

maintain its economic status in the dying days of its industrial capacities and diminishing natural resources, and the increasingly global nature of Australian society. Students and young people engaged in education are the key to Australia's fiscal survival, in addition to being the catalyst for social and personal change, improvement and sustained development. However, they can only do this if they are competent mathematicians with sophisticated numeracy competencies and the capacity to use them in the societal and cultural context in which they live. This will entail providing equitable opportunities for all students, irrespective of individual differences, to gain access to the capabilities to make meaning from the mathematics education that they receive from home environments, schools and the multiplicity of encounters in their daily routines. The challenges then, are for educationalists to recognise the impact, both negative and positive, ethical dilemmas and potential of ethnomathematics in the teaching and learning of institutional mathematics (Carraher, Carraher, & Schliemann, 1985; Stillman & Balatti, 2010), to develop equitable pedagogies that allow all students to make meaning with numeracy across the school curriculum key learning areas and to make powerful links to their everyday lives.

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