

Teachers of MATHEMATICS or NUMERACY!

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Introduction

I have recently been following with interest the debate about the teaching of reading using a “phonics approach” or a “whole language” approach and find it quite fascinating to consider these two extremes. There are some interesting links with the teaching and learning of mathematics and the attainment of numeracy.

In this context I started to mull more deeply about the teaching and learning of mathematics in our schools and the contrast with where numeracy development is compared with the journey that literacy development has had both in Australia and overseas. I have no doubt that we will soon be embroiled in similar arguments.

There currently exist proponents of teaching mathematics using a focus on “basics” compared with a task-focussed approach. I would like to share with you some of my ponderings over this, particularly since many might argue the task-focussed approach may deliver better numeracy outcomes for students but not necessarily better mathematics outcomes. And after all, does it matter?

Definitions

Attempts to describe numeracy have generally focussed on:

- what mathematics people know — a “basic skills” approach;

- how well people apply mathematics to practical situations — a “choosing and using” approach; or
- how well they draw on mathematics when dealing with everyday situations in which mathematics is embedded — a “mathematical literacy” approach.

Being numerate involves aspects of each of these. You cannot be numerate unless you know some mathematics. You cannot be numerate unless you can apply mathematics to practical situations or draw on mathematics when dealing with situations in which mathematics is embedded. To assume that someone is numerate because they know some mathematics is a nonsense; knowing some mathematics is essential but not sufficient. Tests that measure mathematics understandings and knowledge at best measure individual potential to be numerate.

The Australian Association of Mathematics Teachers (1997, p. 15) has the following as a description of numeracy: “To be numerate is to use mathematics effectively to meet the general demands of life at home, in paid work, and for participations in community and civic life.” So being numerate involves a disposition or a confidence which must exist in order for people to choose to use mathematics. Teachers play a vital role in developing numerate behaviours in children and young people.

For the purpose of this discussion I will define numeracy as “the disposition and capacity to use mathematics to function effectively and fully at home and in society.”

Numeracy and mathematics

The range of definitions for numeracy and its connection with mathematics has resulted in a widespread misunderstanding about the nature of numeracy. If school leaders and teachers are unclear about how mathematics and numeracy connect they will not be able to effectively respond to the demands that developing numerate children and young people place on them.

There are some aspects of mathematics that are not necessary for numeracy. I would argue that having a grasp of the field of formal Algebra, for example, is not necessary in order to be numerate. Likewise, there are aspects of numerate behaviour that have little to do with mathematics (see Figure 1; not to scale). These aspects are about disposition and confidence which emanate from an attitude that says, “I can do this”. Clearly there are some who have this attitude who do not know or understand aspects of mathematics, but this does not stop them from using what mathematics they know even if it is not correct or appropriate in particular contexts. Application of incorrect mathematics may eventually reduce the level of confidence and diminish the application of numerate behaviours.

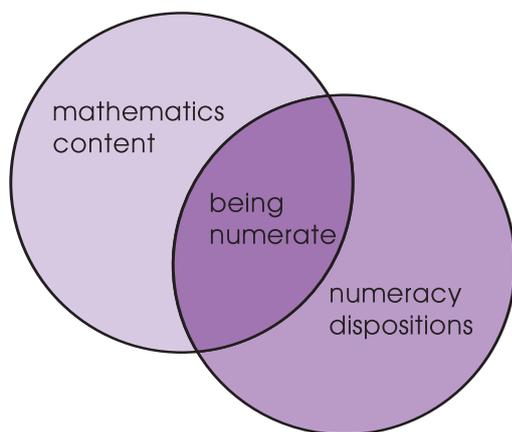


Figure 1

So, although numeracy is about the mathematics you know it is also about having a disposition and a confidence to use it; knowing some mathematics is essential but not sufficient for numeracy. However, knowing some mathematics must precede the choice to use it or not.

Mathematics and numeracy in school

It is interesting to contemplate the history of teaching mathematics in school and the focus on mathematics and numeracy by education systems over the last hundred years. I believe that that word “numeracy” was first used in the late 1950s, and this is an interesting fact in itself. This implies that it was probably not even recognised as being a necessary outcome for students prior to that. This would make sense. School mathematics traditionally focussed on calculation and it was about the time of the increasing availability and access to computational tools (albeit in the '50s, a slide rule) when the focus started to shift from computation to higher-order thinking skills, estimation and judging the appropriateness of answers in contexts. Advances in technology meant that the need for people to transfer their mathematics understandings to everyday life became greater: different forms of public transport required people to interpret more complex bus timetables; maps became more complex, people started to deal with greater amounts of money and cash registers and adding machines meant that even over-the-counter transactions no longer focussed on pen-and-paper accounting.

From this point on, the teaching and learning of mathematics in schools began to change to accommodate these new ways of operating and computing. I can remember going to school in the '60s and it was the role of the classroom teacher to turn me into a walking, talking calculator, since the handheld calculator had not yet become available to the average person. Hours were spent practicing computation through procedures and algorithms that made sure we all used the same methods and the teacher could find “our mistakes”. These “mistakes” unfortunately usually pointed to problems with memorisation rather than to mathematical understandings.

As time went on and technology became more available in the form of cheap and ubiquitous calculators, the focus on school maths increased from a whole-of-school and in particular, whole-of-government perspective. Increased accountability for the spending of public funds meant that the general public

wanted to know how well their children were being prepared for further schooling and life in general. The focus consequently switched dramatically to “numeracy” but because the links between numeracy and school mathematics were not clearly understood many put their faith in their children knowing mathematics as opposed to what it really meant to be numerate and to be able to confidently use their mathematics outside of the mathematics classroom. This was largely because it was easier to “measure” mathematics knowledge than to measure the ability to transfer and apply it.

Many teachers did not know what to do about the impact of increasingly available computational tools such as calculators; I had a teacher say to me a few years ago, “If I gave all of my Year 3s a calculator, what mathematics would I teach them?” and so they continued to focus on teaching their students to be calculators instead of to use them effectively. Parental pressures to do the same have perpetuated and exacerbated the problem and hence, even now, many teachers still focus on a basic computational model of teaching mathematics believing erroneously that unless students can do the things a calculator can do, they do not understand mathematics. Educational systems have unintentionally contributed to this problem through lack of the provision of quality professional learning programs needed to inculcate the paradigm shifts needed by teachers.

The focus instead, I believe, should be on using the technology both to enhance the learning of mathematics concepts and to take the burden and tedium out of computation. Hence teachers need to be focusing on teaching students how to compute mentally and how to estimate in order to understand the numbers they expect to obtain when using a calculator so that they can critically determine their appropriateness. This is probably more about numeracy in one sense, since it should be the context that largely determines the appropriateness. The degree of accuracy required by the context determines which numbers in the display need to be recorded as having been obtained; which can be rounded or truncated.

So what we have is an increasing focus in school mathematics on numeracy. What

underpins this however, is the understanding of numbers and mathematical “codes” and hence the major responsibility for developing students’ numeracy lies with the Mathematics Learning Area.

Two approaches

As stated in the findings of the National Inquiry into the Teaching of Literacy, although the direct, explicit, systematic, teaching of phonics is a necessary condition, it is not a sufficient condition for the teaching of reading: “The strengths of a whole-language approach, as I see it, are its insistence on a print-rich environment to stimulate a child’s desire for reading” (DEST, 2005, p. 12).

Parallels can be made here with the teaching and learning of mathematics. The teaching and learning of basic mathematics understandings and skills is essential for numeracy — no one would doubt it. What frequently happens however, is that the teaching and learning of mathematics often becomes the teaching and learning of mathematics skills in some classrooms. What is missing is the environment that stimulates a child’s desire for using mathematics. This in turn means that confidence needed for numeracy is not being generated in some classrooms because of the fact that the focus is on mathematical knowledge, procedures and skills with minimum attention being paid to their application.

I would claim that a basic skills approach to understanding numbers is a necessary but not sufficient condition to the development of numeracy. This is because it generally will not instil in students a love of mathematics or a disposition to choose to use mathematics.

Let us look at the other end of the spectrum: a task-centred (or application) approach to the teaching and learning of mathematics. For those who may not be familiar with this approach the lesson or group of lessons springs from the need to examine or inquire about something such as, “How many students bring sandwiches to school for lunch?” or “How fair are taxes?”. Students then work together or independently to find answers and along the way are taught some mathematics that they need to use to do so.

They might also be taught some broader skills such as how to undertake research, how to talk and write about what they are doing, how to make choices about the strategies and methods to use, and so on.

There is widespread evidence to support the success of this approach, particularly for engaging students in the middle years. There is still an important need to teach some mathematics however, and many teachers would argue it is impossible to teach all the mathematics deemed essential using this approach.

Here then, is where it gets interesting. Clearly the latter approach results in more students having some control over their learning and thus being more confident about using mathematics in their lives; that is, the task-centred approach can more than likely better produce numeracy outcomes than the basic skills approach which, I would argue, focusses on achievement of mathematics content outcomes.

Numeracy or mathematics; Numeracy and mathematics

It would appear that with the increasing need for students to stay on at school longer, our approaches to teaching mathematics in school have changed (or need to change) in emphasis from a focus on pure mathematics to a focus on mathematics as the fundamental prerequisite for numeracy. Whereas in the past we had mathematics throughout schooling for all students and very little focus on numeracy, perhaps the context has changed to the point that the focus and emphasis now has to be on numeracy for all children throughout schooling (see Figure 2).

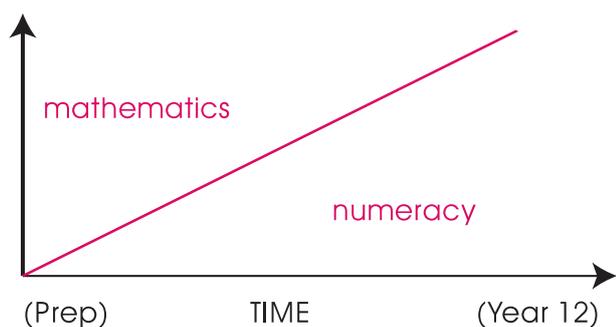


Figure 2

I believe that current “gaps” in our syllabus may be a symptom of the lack of a focus on numeracy in our schools. For example, the current “hype” over the need for financial literacy, some might argue, is really identifying a context for critical numeracy in our curriculum.

Clearly there is still a need for both pure mathematics and numeracy and that some mathematical understandings must come first, but what are those understandings? Can a person be numerate without having learned much mathematics? There are certainly people in society who are very numerate from a functional perspective without having studied much mathematics; they can for example read a map, read a timetable, make sense of graphs and tables. They do, however, need to have some understandings about numbers and how they work. I would argue that a deeper level of mathematics is needed for critical numeracy.

Describing this visually in a network diagram might result in Figure 3:

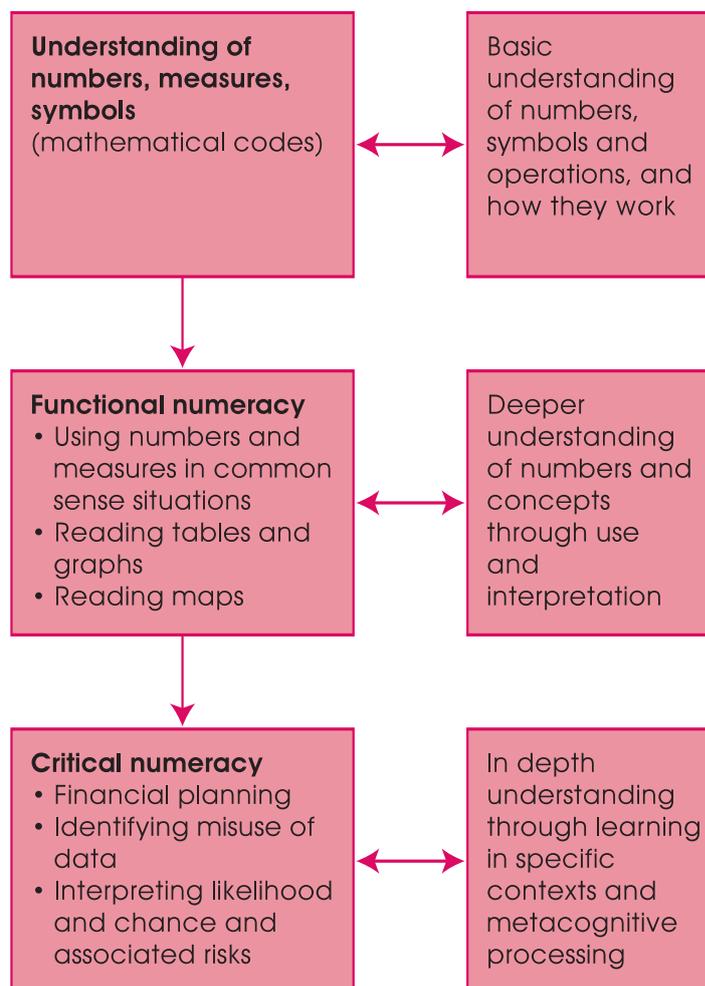


Figure 3

Reframing school mathematics and numeracy

In the context of the above discussion it might be helpful to think about how mathematics/numeracy are being “done” in schools. Many teachers are now teaching mathematics from a “task-centred approach” and thus attending more to numeracy outcomes than mathematics ones. We might say that these students are more numerate as a result. Many teachers are teaching pure mathematics with a focus on right and wrong answers and as a result students are not developing the confidence to be numerate. For some students confidence diminishes as a result of continued incorrect answers and this frequently results in their being “turned off” mathematics.

Perhaps teachers of mathematics need to rethink: are we primarily teachers of mathematics or teachers of mathematics for numeracy? This is a serious question and one which I believe needs to be asked by the profession. Are we able to call ourselves teachers of mathematics anymore in the current cultural and social context of schooling?

Lessons from literacy

Currently, and as a result of long discussion and debate over time, as well as increasing accountability through availability of data, pressure has been placed on teachers of English to become greater teachers of literacy. Teachers who want to retain their identity as teachers of English have moved toward the teaching of English literature while for others there has been a deliberate “blurring” of the lines between English and literacy outcomes.

Some teachers of mathematics are trying to hold onto the notion of being “teachers of pure mathematics” and are still able to do that because the differences are not yet clearly understood by the general populace. This is exacerbated by the fact that our national “numeracy” tests are primarily mathematics tests.

In conclusion

The solution to the “phonics versus whole language” debate over the teaching of reading I believe, is balance and a focus on the needs of all students.

There is similarly a need, in developing numerate young people, to focus on the teaching and learning of mathematics and mathematics skills some of the time, and on application and tasks some of the time (not necessarily at discrete times). Clearly the balance needs to be flexible and dependent on the particular needs of any group of students at any particular time. Inappropriate balance, that is too much mathematics and not enough application or too much application and not enough mathematics will result in students who are not numerate.

In this context, I believe that all teachers of mathematics must also explicitly see themselves as teachers of numeracy. A colleague of mine once said: “I’m a calculus teacher; I don’t do student relationships.” Unfortunately, in order to develop the dispositions needed for students to be numerate, it is extremely important for all teachers of mathematics to have strong relationships with their students and powerful pedagogies that build these in order to develop risk-taking dispositions necessary for numeracy. The days of teaching pure mathematics are, I believe, well and truly in the past in the context of schooling.

Reference

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