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The Contexts of Mathematics Tasks and the Context of the Classroom: Are We Including all Students?

Peter Sullivan  
La Trobe University  
Robyn Zevenbergen  
Griffith University  
Judith Mousley  
Deakin University

Mathematics teachers are encouraged to use realistic contexts in order to make mathematics more meaningful and accessible for all students. However, the focus group research reported in this article shows that decisions on the suitability of contexts are complex and multidimensional. Similarly, the way the task contexts are presented, and the way the tasks are incorporated into classroom routines have potential to alienate some groups of students. We suggest that teachers and researchers should be sensitive to difficulties that students might experience as a result of both the task and classroom contexts, and take specific steps to avoid or overcome the difficulties.

Introduction

In 2002, in the middle of round 4 of the Australian Football League competition, part of the ladder looked like this:

<table>
<thead>
<tr>
<th></th>
<th>Win</th>
<th>Loss</th>
<th>%</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>Fremantle</td>
<td>2</td>
<td>2</td>
<td>110.8</td>
<td>8</td>
</tr>
<tr>
<td>Sydney</td>
<td>2</td>
<td>2</td>
<td>107.8</td>
<td>8</td>
</tr>
<tr>
<td>West Coast</td>
<td>2</td>
<td>2</td>
<td>103.51</td>
<td>8</td>
</tr>
<tr>
<td>Kangaroos</td>
<td>2</td>
<td>2</td>
<td>103.45</td>
<td>8</td>
</tr>
<tr>
<td>Richmond</td>
<td>2</td>
<td>2</td>
<td>86.3</td>
<td>8</td>
</tr>
<tr>
<td>Carlton</td>
<td>1</td>
<td>3</td>
<td>66.5</td>
<td>4</td>
</tr>
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</table>

This is an example of a context that some Australian mathematics teachers might consider using in their middle years classes. The percentage for a team is calculated by dividing the total points scored by that team in that year by the total points scored by the teams opposing them, and multiplying the result by 100. The potentially interesting oddity in this case is that two decimal places were needed to separate two of the teams. It is an example of a context that could be considered as the basis of a mathematics experience for students.

Contexts are now used frequently in mathematics classrooms in order to make concepts and operations more meaningful as well as to show the usefulness of specific ideas and skills being studied. "Everyday mathematics" (Fraivillig, Murphy, & Fuson, 1999), "practical mathematics" (Lim & Ghani, 1995), and "realistic mathematics" (Freudenthal, 1973; Klein, Beishuizen, & Treffers, 1998) are recognisable themes in research and curriculum materials development in various parts of the world.

This article elaborates the argument, developed in Sullivan, Zevenbergen, and Mousley (2002) that before using such contexts, however, teachers need to make
judgments about their mathematical suitability, interest or relevance to the students, potential motivational impact, and the possibility of negative effects or tendency to exclude some students. The article extends this consideration to include pedagogical issues such as how best to focus the students' attention onto the goals of activity, the modes of working, and the types of solutions that are valued in the context of school mathematics.

It is recognised that students from socially and culturally divergent backgrounds are the most at risk of mathematical failure. It has been suggested that the very socio-cultural nature of mathematics and mathematics learning has led to a differentiation amongst learners between those who can engage with the presentations of the subject and those who are unable to do so (Burton, 1996; Dengate & Lerman, 1995; Salomon & Perkins, 1998). It follows that teachers should take steps to ensure that the very actions taken to make mathematics relevant and engaging do not have the effect of excluding some students, and any differentiation of pedagogy should be in the direction of including the previously marginalised students.

This article is a report of some data related to the use of contexts from the first phase of a project with a broader focus. In the project, Overcoming Structural Barriers to Mathematics Learning, we are exploring a range of such aspects of mathematics pedagogy. Our basic contention is that there may be some currently recommended approaches to mathematics teaching that improve the learning of most students, but that these very initiatives may be alienating for some groups of students, and teachers may need to adopt specific steps to avoid or overcome this alienation.

Theoretical Framework

The theoretical basis of this research is a construct proposed by Bernstein's (1990, 1996) pedagogic discourse. Bernstein claimed that through different methods of teaching, namely "invisible pedagogy" and "visible pedagogy", students receive messages about the overt and the hidden curriculum of schools. He suggested that middle-class students are able to make sense of invisible pedagogy more effectively than their working class peers, due to their familiarity with the embedded social values and norms; and hence they have more chance of success.

Cobb and McClain (1999) described a socio-mathematical framework where two complementary norms of activity in mathematics classrooms are delineated: mathematical norms and socio-cultural norms. Wood (2001) elaborated these, describing the mathematical dimension as the interplay of children's developing cognition and the structure that underlies mathematics. She also described the socio-cultural nature of children's learning and the way that rich social situations contribute, noting that a key element is the way that children try to make sense of the classroom culture.

Based on this work, we use the term "mathematical norms" to mean the principles, generalisations, processes, and products that form the basis of the mathematics curriculum and serve as the tools for the teaching and learning of mathematics itself. The "socio-cultural norms" are the usual practices, organisational routines, and modes of communication that impact on approaches to learning, types of responses valued, views about legitimacy of knowledge produced, and responsibilities of individual learners. We argue that it is important to make social norms comprehensible and communicable, not only to emphasise
the mathematics goals but also to ensure that the processes for achieving those goals are made available to all students. Relevant social norms that some students may struggle with do not exist only at the level of classrooms, but also at broader societal levels and within the micro-level of specific learning activities.

We are concerned with two levels of socio-cultural context. First, “task context” refers to the real or imagined situation in which a mathematical task is embedded. This embedding of the mathematics in some way is aimed at making tasks seem more realistic or understandable or at providing substantive information to support the posing of the task. The other form of context is the “pedagogical context”—the broader learning environment in which the mathematics is taught. This includes the ways that a teacher makes the mathematical goals of the tasks clear, describes the appropriate forms of response, the expected processes (such as discussion, experimentation and mathematical enquiry), and the need for creation of multiple solutions. Other relevant factors in the pedagogical context are the ways that social interactions communicate perspectives on factors such as the nature of mathematics and the way that it is learned, the expected roles and responsibilities of students, and the experiential backgrounds that teachers and students bring to the classroom. Reflecting this dual perspective, this article focuses on these two aspects of “context”.

**Contexts of Tasks**

The use of relevant situational contexts is an example of a commonly accepted aspect of mathematics teaching that, if not used carefully, has potential to restrict the mathematical development of some students. Borasi (1986) defined context as a situation in which a problem is embedded, and proposed that the role of context is to provide problem solvers with information that may enable the solution of the problem. Meyer, Dekker, and Querelle (2001) discussed the use of contexts in mathematics curriculum, drawing on examples from five recent curriculum documents developed in the United States, all incorporating “pervasive use of context” (p. 522). They suggested that contexts can be used to motivate, to illustrate potential applications, as a source of opportunities for mathematical reasoning and thinking, and to anchor student understanding. Meyer et al. (2001) argued that high quality contexts should support the mathematics and not overwhelm it; be real or at least imaginable; be varied; relate to real problems to solve; be sensitive to cultural, gender, and racial norms and not exclude any group of students; and allow the making of models.

Wiest (2001) studied the responses of 273 children in six Year 4 classrooms and six Year 6 classrooms to fantasy contexts. Equivalent problems had the same mathematical structure and demands on problem-solving skills. The sets were categorised as low fantasy, high fantasy, children’s real world, and adults’ real world. Wiest found that the context of problems affected a range of variables including the children’s interest in, attentiveness to, and willingness to engage with problems, the strategies they used, their effort, their perception of and actual success, and the extent to which they learned the intended mathematics. Fantasy contexts evoked stronger responses than other contexts.

While the general consensus among teachers is that the practice of embedding school mathematics into some “real” context supports learning, this consensus requires some further exploration. For example, in their comprehensive review of the national testing system in the United Kingdom, Cooper and Dunne (1998)
argued that contextualising mathematics creates another layer of difficulty for some students. They undertook a sociological analysis of learning tasks and children’s performance, concluding that contextualising tasks creates particular difficulties for working-class students, so much so that they performed significantly poorer than their middle-class peers on these tasks whereas performance on decontextualised tasks was equivalent. Drawing on a large sample, these findings are important as they pose a new dimension to understanding how practices in school mathematics—in this case contextualising tasks—create further barriers to success for some students. Lubienksi (2000) also found that contextualising tasks made the purpose of tasks less clear for the students she classified as being of lower socioeconomic status. Based on Bernstein’s position, Cooper and Dunne argued that the process of recontextualisation—whereby school mathematics is connected to another field, in this case the everyday experience and knowledge of students—creates a new set of demands previously not recognised. They proposed that students need to identify the recontextualisation process so that they recognise the demands of the task as being school mathematics in spite of its immediate appearance of being an everyday task.

To examine further the problematic nature of using contexts, consider the following examples drawn from authoritative sources of information about mathematics teaching. The National Council of Teachers of Mathematics (1989) argued that problems using contexts enrich the experience of learning mathematics. They gave an example of a contextual problem, supposedly arising from a social studies lesson about commerce between North America and Hong Kong. The problem is about a pilot for a major airline transport company being curious about the shortest route between New York and Hong Kong. This intended application of the great circle concept is ambiguous and the real situation is not only outside the experience of the students but also an oversimplification of the real problem. The context neither provides a rationale for exploring the mathematical problem nor in any way contributes towards clarifying the essence of the problem or making it more accessible. There may be some cultural bias in the context as well.

Another example is from Stern (2000), who used problems with multiple entry points as a way of being inclusive of all students without using ability groups. She presented, as an example, a problem related to an iced cake which, when sliced, had pieces with different numbers of faces with icing. Given the number of iced faces, the task was to infer the number of slices of cake. Again, the task is unreal in that no one ever works backwards from the appearance of slices of a cake to work out how many slices there are. The icing in no way contributes to understanding the mathematics or making the problem more accessible.

A further example is from Brinker (2000) who used contexts in a culturally diverse elementary school and concluded that all students are capable of learning significant concepts when they have the opportunity to explore the ideas in meaningful contexts. The example she provided is about teaching integers, using the process of ships moving from a canal filled with water at one level to a river that has a different water level. This context is also problematic. If students are unfamiliar with river shipping then it is no more meaningful than frogs jumping backwards on lily ponds. Even for students familiar with the context, the link to the mathematical concepts is somewhat doubtful. Water depth is not really a suitable model of negative integers, since the negative heights are only negative in a relative sense.
We stress that these problems are drawn from rigorously reviewed sources, indicating the complexity of selecting appropriate contexts. We hasten to add that this is not intended to be critical of teachers using such contexts, or these particular authors. Indeed we have used similar contexts ourselves, both in our teaching and our research. We are suggesting that there has not been enough critical examination of this aspect of current recommendations about mathematics teaching.

We are not arguing that contexts should not be used; indeed we believe that contexts have much to offer. The issue for us is that the teachers need to be fully aware of the purpose and implications of using a particular context at a given time, to choose a context that is relevant to both the problem content and the children's experience, and to have strategies for making the use of the context clear and explicit to the students.

Context of the Learning Environment

While the context of the mathematical task provides a particular set of issues that teachers must address, the classroom contexts in which such task contexts are posed can also influence the way that learners interact with the tasks. This aspect of context is what Cobb (1990) described to include personal interests, perspectives, interpretations, and purposes and much of the general nature of social location, situation, and interactions. These classroom contexts are "repeatedly experienced, personally ordered, and edited" (Lave, 1988, p. 151). A fundamental assumption of our project is that students judge teachers by their actions, and ascribe those values to mathematics and mathematics learning that teachers exhibit, rather than the ones they espouse. The context of the learning environment conveys critical messages.

This classroom learning environment context is similar to what Cobb and McClain (1999) termed classroom social norms. This notion arose from a classroom experiment that sought to explore children's learning processes in classrooms. The researchers had anticipated that the students would engage with the teacher and each other in "genuine mathematical discussions in which they explained and justified their mathematical reasoning" (p. 9). Cobb and McClain noted that the students acted as though their goal was to guess what the teacher was anticipating, rather than to describe their own thinking. The teacher and the researchers initiated a process they termed "renegotiation of classroom social norms" (p. 10). This included specific sessions in which issues such as explaining and justifying solutions, making sense of explanations given by others, indicating agreement or disagreement, and questioning alternatives became explicit foci.

Other similar issues that could also become the focus of specific classroom discussion, in order to make expectations clearer, include the valuing of multiple answers, valuing different approaches or strategies, accepting errors as an essential part of the learning process, actively listening to other students, and developing awareness of where decision making on legitimacy resides. These collectively contribute to the values transmitted by the pedagogies adopted by the teacher.

This notion of making aspects of the classroom environment explicit has some support. Delgit (1988) had earlier argued that educators should teach their usually implicit values actively, because to pretend that schooling is democratic denies groups outside the mainstream access to opportunities that schooling is intended to provide. Stevenson and Stigler (1994) found that Asian mathematics teachers are
generally more inclusive because they spend considerable time making explicit aspects of classroom organisation. Dweck (1999) proposed that teachers influence ways pupils respond by being explicit about behaviours such as decoding of tasks, ways of persevering, seeing difficulties as opportunities, and learning from mistakes. She found it advantageous to explain purposes for the use of contexts, types of solutions sought, and expectations for modes of communicating these.

To give an example from our current project, it is common for mathematics teachers to invite pupils to work with a partner, yet seldom do they explain the purpose of collaboration; whether, for example, the intention is to come to a consensus about appropriate problem solving strategies, to learn from listening to others’ ways of thinking, to share the work, or merely to pursue their own investigation with access to occasional peer help. Pupils who are skilled at small-group communication and who understand reasons for this mode of organisation can use the collaboration to their advantage, but others are likely to fail to take advantage of the opportunities afforded. We found that teachers in the current investigation used group work in most lessons, and all were aware of such advantages, but that none articulated specific purposes of working in groups. We concluded that teachers need to be explicit about strategies that they use. Group work is only one of these.

It is this theme of explicitness that underpins our project. To differentiate our work from Bernstein’s invisible pedagogy, we use the term “implicit pedagogy” because we assume that making explicit particular aspects of invisible pedagogy will go some way to addressing the disadvantage experienced by some students. This “making explicit” could take two forms. First, teachers could seek to become more aware of specific, common aspects of teaching that may not be optimal for certain groups of pupils, and then address these when working at improving their typical patterns of interaction in mathematics classrooms. Second, aspects or approaches to teaching that they decide to use purposefully could be made more explicit to the children so that potential for confusion is reduced and reasons for using particular strategies are well understood.

**Identifying Potential Barriers to Mathematics Learning**

The data reported in this article arose from the first phase of a larger project exploring barriers to learning mathematics. The intention of the first phase was to collect information from a range of educators on what they saw as the challenges and opportunities of open-ended approaches to teaching, with the aim of articulating some specific teaching strategies that could contribute to the second phase of the project. In this first phase of the project we conducted three discussion groups: one comprised mostly of teachers, another consisting entirely of academics, and another group that was mixed (see Mousley, Zevenbergen, & Sullivan, 2001). Each of the groups included educators with expertise in aspects of minority-group pedagogy (e.g., Indigenous education, literacy for children with non-English speaking backgrounds). Some of the teacher educators involved were from mathematics education while some were from other fields.

Each of the groups was shown some short excerpts from videotaped mathematics lessons. We focus here on a particular excerpt from a single videotape that all three groups watched. The basic point of the Year 7 (students aged about 12 years old) mathematics lesson shown in the videotape snippet related to an open-ended task posed to the class:
The mean height of three people in the room is about 155 cm. You are one of those people. Who might be the other two?

The main purpose of the experience was to focus on different ways of examining the meaning of “mean” and ways of arriving at it. The basic task has two features that are relevant for our project overall. One is that the task was open-ended and so allowed a range of possible approaches, procedures, and answers for any student. It was intended that the openness of the task provide an environment for the learning of mathematics that emphasised the possibility of multiple responses, making explicit to the students that it was their own exploration that was required, and both valuing and learning from the range of responses produced. The second aspect is that it had a personal dimension, as the students were working in a practical context that was presumably directly relevant to them.

A related aspect of the lesson content was the estimation or measurement of the students’ heights. In order to establish a realistic context for this, the particular teacher on the video chose a poster that projected five people being presented as part of a police lineup, and invited the students to suggest ways in which people might be identified. In using this initial context, the teacher attempted to give some rationale or meaning to the context in which the estimation of height and the calculation of means would be enacted. It is this “task context” that was the focus of much of the discussions by the groups who viewed the videos.

It should be noted that even though the comments that follow seem to be critical of the teacher, in fact the teaching was exemplary and the full video has been used as a model for teacher development. It is not the choice of the task context per se that was seen as a problem, but its potential use with particular groups of students.

The focus groups viewed the videotapes and responded to the prompt: “Did you see any aspects of the classroom interaction or activity that may not suit some children?” The contributions that constitute the data for this phase of the project were audio recorded and the tapes were transcribed then entered into NVIVO software. The comments arising from the transcripts were categorised and grouped using a grounded theory approach (outlined by Richards & Richards, 1989; and described in Mousley, Sullivan, & Waywood, 1998) according to the main issues to which the comments referred. These main categories, termed nodes, were: Practices, Tasks, Linguistic issues, Organisational context, Social context, and Pedagogical context.

These nodes were refined progressively, and at the same time 65 sub-nodes were created and the data grouped into these sub-nodes. The process of categorising the data was as follows. Phrases that represented particular pedagogical ideas were used as the data units. All of the data were read and the main themes identified by each of the authors. These were then debated and a set of nodes was determined by consensus. One researcher then categorised all phrases according to the node and sub-nodes that were progressively created to allow unique categorisation within the one node. All of the data categorised within each of the sub-nodes were collated. A second researcher then examined the data for each sub-node and challenged the categorisation if necessary. Essentially, the data categorised within a node were examined to assure us that the data did indeed represent a coherent construct. The second and first researcher then negotiated on the meanings and categorisation. The third researcher then repeated the process. While the main benefit from these steps was that the researchers came to some agreed understandings of the scope of particular terms, the process does
assure readers that the grouping of the data was systematic, and that the nodes and sub-nodes are reliable in that others would group the data elements in the same sub-nodes. The authenticity of the data is a function of the way the comments arose: from the discussion of practitioners. The presentation of excerpts of the data for some of the sub-nodes allows the reader to make their own judgments on the authenticity of our interpretations.

We focus here on two aspects of context: one was a sub-node of Task termed Context and a sub-node of Pedagogical context termed Interactions. The data and associated issues are similarly rich for many of the other sub-nodes as well.

Perspectives on Contexts

The intention was to identify issues related to any aspects of high-quality teaching shown on the videotapes that practitioner and expert panels would raise in a group discussion. Of course we had prior conceptions of necessary considerations for such teaching, yet creating forums for discussion among educators introduced alternate perspectives.

The focus group covered many aspects of mathematics teaching, as illustrated by the nodes presented above, but the discussions here are restricted to the comments on the context in which the particular problem above was embedded (the task context), and the context of its teaching (the context of the learning environment).

The data presented below are grouped according to the issue addressed. The particular respondents are not identified, nor is the group from which the comments arose, other than in a few instances, since it is the issue we are seeking to elaborate rather than themes in the responses of particular individuals.

The Context in which the Problem was Embedded

The main focus of the lesson was the problem for each student of finding two other students so that together the group had a given mean height. Perhaps thinking that this problem would be unrealistic by itself, the teacher used a police line-up poster as a context, and it was this element of the lesson’s introduction that provoked the most critical comment from the focus group members.

Many of the participants affirmed the strategy of setting problems in realistic contexts. One participant commented that if contexts are not used:

the kids get a certain message about the nature of mathematics [that] it’s cut off from the world; it’s no use to anybody.

Some were concerned, however, about the appropriateness of this context. There were comments about the importance of awareness and sensitivity. For example:

Dad’s off in gaol or someone else has been arrested in the community, so they know about line ups. They know about the police, they know about the justice system by what’s happening to them. So you could use it if it wasn’t that sensitive. It comes down to knowing their backgrounds and the sensitivities for the children that you’re teaching.

In the same vein, one participant raised the issue of teachers’ knowledge of the familiarity of particular situations:

Should one always use a familiar context? It would depend on the relationship between the school, the community, the teacher, and those children. If the teacher knows what’s going on at home and ...
Others noted the potential ambiguity of the student responses to the prompt:

What I was concerned about (is) engagement in the task, because one of the students said, “Yes, we want to cooperate with the police, we want to find out the clues.” Other students, it could be their dad.

Some participants also discussed how children’s responses to the context might be related to socio-economic status, for example,

It’s a middle class thing—the criminal is more threatening and you have a vested interest in identifying them to police. If you are a student from working class (background), chances are you are on the operative side of things.

Clearly an important issue is that of choosing appropriate contexts. The tenor of discussion was to suggest that the context used in this case was inappropriate for some children, and different ones would be preferred. For example, when we asked participants to suggest characteristics of a context that might be culturally positive, the responses included:

Australian netball, and a football team. There you have gender equity and the netball teams are sort of a star team—or the cricket team. Cricket mightn’t be very relevant; maybe soccer [would be okay] and most kids have a knowledge of an AFL (Australian Rules Football) team.

It would be interesting to choose a context like several sports because the heights are so different. What do we think is the average height of a basketballer? How high might that be on the wall? And what about footballers and what about soccer players?

Drag in a few Year 12 girls. You’ll find none of them are six feet tall and yet every netballer is six feet tall. Who won gold medals for Australia at the Olympics? The Tai Kwon Do person was this big, and the rowers were that big.

The context needs to be close to the kids but not so close that it’s an emotive issue.

The inference here is that before being used a task context should be familiar to the students, culturally sensitive, and appropriate in terms of their socio-economic background.

We recognise here that it is difficult, especially within the usual time constraints on planning teaching, for an individual teacher to consider fully the ramifications of a variety of specific contexts, or to allow time for children to create their own relevant contexts especially with new mathematical concepts. The alternative may be to avoid some potentially interesting contexts and to use somewhat less exciting ones.

This raises, in turn, the related issue of whether mathematics teaching is politically or culturally neutral. On one hand there were arguments to the effect:

What would be the purpose of teaching? If it’s mathematics then your aim really isn’t to teach about the justice system or educate in that sense. It may come up but [the] aim is to teach about mathematics. The poster was just an introduction to the point of the lesson, which was estimation.

Another participant recognised the relevance of politically sensitive topics, although suggesting a cautious approach to their use.

Politics and issues of race and culture could enter maths classrooms, but you’ve got to recognise that it’s very dangerous stuff. A lot of teachers stay away from it
because they think they're going to get into trouble if they introduce those [issues] into their teaching.

A number of times the issue of linking the task context explicitly with the mathematical content of the lesson was raised, especially by focus group members who were not mathematics educators, for example,

I found it difficult to make the link. Sometimes when you use something like a picture of criminals as your stimulus and people might come from a background where a picture of criminals may remind them of their friends in jail or whatever, it makes it difficult for you to focus on the actual topic. The teacher is asking the students to estimate heights and it's not really related to the socio-political context of the picture of the criminals. Whereas in (the school subjects) English or Drama you may be able to address the issues raised by this picture. But that picture is like a red herring.

If the teacher began with “This lesson is all about measuring”, when I looked at the poster I would have to think about measuring. I liked the openness. I had some concerns about the language, but I like the openness of the fact that kids would be thinking, “This is a bit different from what we normally do, the pages of sums and so on. I wonder what this is about?”

It is also interesting that the need for setting mathematics in realistic contexts was seen to be partially related to socio-economic status, for example,

Middle class kids get turned on by open questioning or problem solving and working class kids don't. It may have more to do with [what they] believe in. Maybe with older kids, [they consider] “Do I really believe in a few years time that I'm going to come out of school with something [to show] for it? Or am I going to drop out and be a reject at some point? And my attitude to that will be commissioned by all kinds of attitudes, my family, my community towards this school.

Perhaps these participants are hinting that it is preferable that teachers avoid sensitive topics in mathematics teaching. In the case of the line up it is possible to argue that even students from a background where they may have had first hand experience with line-ups one way or the other would benefit from having them demystified. In any case it seems preferable that teachers make active decisions on the task context. These active decisions then directly impact on the broader pedagogical context, including the way the task is posed.

The Classroom Context

In the focus groups participating in the research, the teacher's actions in establishing and using the pedagogical context of classrooms were seen to be just as important as the mathematical aspects of classroom activities. The participants addressed a variety of perspectives on this, including teacher direction, the locus of control over the learning, body language, ways of linking the task context and the mathematics, and the teachers' use of language.

For example, there were comments expressing concern about the extent to which the teacher directed the students' thinking. Some respondents said:

It's one managerial sort of style.

Perhaps the open endedness was partly lost by the teacher giving instructions.
I think you could have had a lot more engagement from kids if she'd said "Where do you think this poster has come from?" or something like that, and get kids in groups to discuss first and give a context to it.

There were also some specific comments about the way the teacher created an impression of openness by soliciting suggestions from the students but then built only on the specific suggestions that she had been seeking. For example, the following are some comments from three different participants:

There was an occasion actually, where [the teacher] collected three or four answers before she got the answer that she wanted, which was "Height". Then she virtually said "Good, now we can get on with the purpose of the lesson". I don't think that's an uncommon strategy to connect a context with mathematics.

She actually closes off the questioning twice, not only when it was height, but when one of the girls says something about estimation. She immediately closes it off and goes on to the next bit. "Got my answer, poom, that's the cue for me to move into the next bit". Now that can be problematic for some students. For other students, of course, they can be reading, "That's the cue and we've learnt with this teacher that that's what we zero in on". On the other hand, if this is the second year that they've had this teacher, most of them are already cued in, they've learnt what to expect.

The point is that [the teacher] gave the game away—that average is something to do with calculations—rather than leaving it wide open. For example, "What is an average? What is average height?" She killed it by saying "... and how you might calculate it?" There was a context to start off, but it's been lost. The teacher's going through a procedure to get to a certain point.

Such comments highlight the importance of considering the connection between the actual context of the task and the way it is to be used. The teacher can communicate to the students the sense that the task is to guess what the teacher is thinking by the way he/she deals with the students' responses. This is an example in which being explicit would perhaps assist both the students and the teacher.

One of the participants, from an Indigenous Australian background, gave a further perspective on the approach taken by the teacher. She focused on the teacher's body language and on her subtle control of the verbal interactions during the introductory segment:

[The teacher] is not a neutral person standing there. It's a woman who looks a certain way. There's no difference from her stance to that of a lawyer or a police officer and that would be very threatening to a lot of students, especially if they've had at high school previous contact with authority figures. There's no chance of anything spontaneous happening in there and no chance to talk with the other students. Her stance and body language almost sends a message that if you do something outside of what I want from you there'll be other repercussions. Now that may not be the case, but as an Aboriginal person, I'd find her way of teaching quite offensive.

Another participant also commented on body language:

Body language is a very big thing in teaching. She's sending a very clear message: "Don't ask me anything else. Don't talk about it. Give me the right answers and I'll nod; but I'll go on to somebody else and if they give me the right answer I'll nod to them, but nothing else. We're on this one-way track and we're steamimg along quite nicely". The problem is, of course, that there are kids for whom that environment is very safe. You know who's in charge, you're safe, everything's organised.
It is interesting that the teacher seemed to be gentle and sensitive although she had a tendency to stand erect with her chin high, which may have been the stimulus for these comments. This again highlights the need for consideration of the full range of factors associated with student interactions, and for the teacher to be aware of, and explicit about, the messages being communicated.

There were many comments on the need to make language explicit and especially to consider language demands of task contexts:

Children of non English speaking background, or some Aboriginal/Torres Strait Islanders, for example, Koorie1 kids, walk into a maths class and they’re going to expect sums. Suddenly [the teacher is] introducing a lot of language before [the students] know anything, [and this] makes it difficult for them. To ground the students and to bring them into a maths space would be better. The teacher might start by saying, “Today we’re going to do measuring, or estimating, or what ever...”, so that the kid can think [about the content]. If you have children for whom English is not their first language, then you need to reinforce: “Tell me what I mean when I say estimating?” or “Where are some things that you estimate?” Ground it in their world because for a child for whom English is not their first language, if there are numbers they’ll be right, but if you say “estimating” they won’t have a clue what that might mean ... They might have been estimating one day with apples and then they might have been estimating another day with roads or speeds of cars and now [the teacher is] introducing something entirely different. For an effective maths lesson you’d need to bring in the maths of it first.

If you haven’t got the language then you’re going to have no idea of what you are doing. A child with limited English is not going to know the word “tattoos”, they’ll know what tattoos look like, but they mightn’t know the word. Similarly, they won’t know the words “scars”, “facial”, “line up”; and the term “police station” has a whole lot of negative connotations ... as indeed do “criminals”.

There was no language built into that lesson and that’s a really crucial thing. If you can convince maths teachers to teach effectively they need to be building language all the way through. As a language teacher you would have written all those words on the board, you would have written up scar, tattoo, height; because then the child who is learning language is supported, they can follow: Now I’ve heard the word, there it is.

This explicit attention to relevant aspects of language is not often emphasised in advice to mathematics teachers. There is also the related issue of being explicit about the mathematical content being covered. It makes sense that being clear about the words, phrases, meanings, and foci will facilitate communication of both the mathematical and the socio-cultural norms.

**Conclusion**

This article used the term “context” in two ways: the choice of the situation in which the mathematics is embedded and the learning environment in which the task is used.

In the example of the idiosyncrasy of the AFL ladder suggested at the start there is a potentially interesting prompt for students who are engaged in Australian Rules Football in particular (or sports generally, as the same situation could apply in ladders for netball, basketball and rugby just to name a few examples). The context allows for potentially useful discussions about decimal

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1 The term *Koorie* is preferred by the Indigenous Australians who live in Victoria.
place value and the uses of percentages as well as the setting of a number of different open-ended tasks. However, there would no doubt be students and teachers who would be uninterested in this context or even repelled by it. Thus on one hand there may be students who are interested in little else but sport and may be stimulated by such a prompt, on the other hand there are others who would be alienated by it. We stress that the use of this example here is precisely because of the obvious ambiguity. The relevant point is that if the teacher did choose it because it may be interesting for some students, the teacher also needs to find a way to engage the students who are not attracted by such a context.

Similarly, the use of a poster as a task context was seen to be problematic for some groups of students. With respect to the choice of the context in which the height task is set, the participants were concerned about appropriateness of task context, particularly considering sensitivity to the socio-cultural background of the students, whether there is an inherent class bias in the context, and whether it is a positive or negative example, what is the purpose of the mathematics learning, whether and in what ways sensitive topics could be used. As an aside, the misconception that the lesson was about estimation of height was common. It is reasonable to assume that the children experiencing the same introduction would also see it as a lesson on estimation, although the focus was the notion of "mean". This illustrates how contexts can add layers of complexity that need to be both anticipated and addressed.

We suspect that avoiding the use of potentially ambiguous contexts is not the solution. The potential difficulties in specific contexts are often not obvious. Hence, while we agree with the mainstream belief that contexts can be useful, it is clear that teachers need to develop sensitivities and take appropriate steps to avoid selecting contexts that have the potential to be alienating, excluding, or exacerbating of disadvantage.

The same applies with regard to the development of inclusive pedagogical contexts, including patterns of interactions between classroom participants. Subtle aspects of social interaction also need teacher awareness and sensitivity. The participants in the focus group discussions were concerned about the way that some norms of mathematics classroom interaction were used. In particular, comments related to lack of openness in regard to students' suggestions, the potential for differential responses to the tasks being based on socio-economic factors, the extent of the teacher's direction of the students' thinking, the potential for unconsciously using alienating aspects of body language, the importance of explicit explanation of the mathematics, the active teaching of relevant language, and the consideration of the orientation to schooling of the students.

Our project has now moved on to working with teachers who will use open-ended and contextualised questions as the basis of units of work as part of their regular curriculum. We are using advice arising from the focus groups about the aspects of pedagogy that may not be clear to all students, with the deliberate intention to make those pedagogies more explicit—first to teachers and through them to all of their students. We are also proposing, though, to examine something more substantial: whether there is a need to be explicit about some aspects of pedagogy only for some students. We call this differentiated explicitness. For example, there may be aspects of pedagogy, such as those above, that are obvious for many pupils but must be addressed for others. We found in the current investigation that not only do teachers not seem to differentiate the pedagogy for students based on their background, but the teachers studied argued that they
should not. Our intention is to measure the way that such actions affect learning.

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Authors

Peter Sullivan, La Trobe University, PO Box 199, Bendigo, VIC 3552. E-mail: <p.sullivan@latrobe.edu.au>

Robyn Zevenbergen, Griffith University, PMB 50, Gold Coast Mail Centre, Bundall, QLD 9726. E-mail: <R.Zevenbergen@griffith.edu.au>

Judith Mousley, Faculty of Education, Deakin University Geelong, VIC 3217. E-mail: <judym@deakin.oz.au>