

Insights from a financial literacy task designer: The curious case of problem context

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As part of ongoing design-based research exploring financial literacy teaching and learning, ten tasks termed “financial dilemmas” were trialled by 14 teachers and more than 300 Year 5 and 6 students in 4 government primary schools in urban Darwin. Drawing on data related to two tasks - *Catching the bus* and *Buying bread* - this article explores insights into problem context and task design principles. The findings highlight that unfamiliar, novel, and imaginable problem contexts, while pedagogically demanding for teachers, are valued by students and have the potential to broaden their horizons.

Preparing numerate citizens who can confidently rise to the demands of everyday life beyond school is an important dimension of education. In Australia, the term numeracy is used to describe what the Organisation for Economic Cooperation and Development (OECD) refers to as mathematical literacy. The OECD Programme for International Student Assessment (PISA) defines mathematical literacy as:

... an individual’s capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions...

(OECD, 2013, p. 25)

The OECD argues that the PISA mathematical literacy assessment framework is intended to “encourage an approach to teaching and learning mathematics that: gives strong emphasis to the processes associated with confronting a problem in a real-world context; transforms the problem into one amenable to mathematical treatment; makes use of the relevant mathematical knowledge to solve it; and evaluates the solution in the original problem context” (Thomson, De Bortoli, & Buckley, 2013, p.16). The assumption is that if students can learn to do these things, they will be well-equipped to make use of their mathematical knowledge and skills throughout their lives, and standardised assessment provides an accountability mechanism to measure the extent to which this goal is being achieved.

While mathematical tasks in context are an important part of PISA, whether item context plays a role in students’ performance is contested. Jorgensen and Sullivan (2010) argued that while particular contexts may be realistic for some students, they are well outside the everyday experiences of others, and so create opportunities for ‘scholastic mortality’ among those who are already disadvantaged. Salgado and Stacey (2014) found that item context impacts students’ performance in variable ways, but when more familiar contexts are presented, students tended to bring personal information into their solution arguments rather than using a mathematical argument. Sawatzki (2014) found that the experience of financial hardship can limit disadvantaged students’ motivation and ability to connect with tasks involving money and financial mathematics.

These factors may help to explain Australian students’ results on the 2012 OECD PISA which showed that:

- one in five 15 year-olds are failing to meet International Proficiency Level 2 for mathematical literacy (indicative of mathematical literacy competencies to actively participate in real-life situations) (Thomson, De Bortoli, & Buckley, 2013); and

- there is a strong relationship between student socioeconomic background and financial literacy (students in metropolitan schools achieved more highly than students in provincial and remote schools, and non-Indigenous students significantly out-performed their Indigenous counterparts (Thomson, 2014).

Strengthening numeracy teaching and learning would seem to call for challenging contextualised learning tasks that interest and engage students in meaningful problem solving experiences. The question for teachers is whether it is preferable to use familiar problem contexts that might resonate with students or to choose problem contexts that are unfamiliar, novel, and imaginable in the hope that these might expand students' horizons.

Literature review

This study was critically informed by academic research related to numeracy and task design principles, of which a brief appraisal is provided below.

Goos, Dole, and Geiger's (2011) model for numeracy in the 21st century has been used to support if not enhance preservice and practising teachers' numeracy teaching and learning across the curriculum. The model describes five elements that contribute to numeracy: mathematical knowledge; dispositions; tools; a critical orientation; and context. Of particular relevance to this study, *context* refers to the situated nature of numeracy and the need to develop students' capacity to use mathematical knowledge in and beyond the classroom. In its visual form, the model places context at the centre of numeracy teaching and learning. In this way, it pays tribute to the importance of creating and/or selecting meaningful "real life" contexts to motivating students and showing them the usefulness of mathematics to making sense of the world.

In related work, Geiger, Goos, Forgasz, and Benison (2014) identified five design principles for developing numeracy tasks:

- the need for *fit to circumstance*;
- the need for tasks to be *challenging yet accessible*;
- the need to be *transparent* in relation to expected outcomes;
- the need to provide students with *opportunities to make decisions*; and
- the importance of *iterative cycles of design and improvement*.

Fit to circumstance is described as referring to various conditions and constraints including curriculum and resources. However, the phrase might be more broadly interpreted to involve the need to create and/or select problem contexts that give sensitive consideration to the sociocultural context within which teaching and learning will take place. This means seeking to understand not only students' local context, but their family backgrounds, characteristics and interests so as to design tasks that are experientially real as well as socially and mathematically meaningful.

To achieve *challenge yet accessibility* is by no means straightforward. It relies on predicting students' zone of proximal development (Vygotsky, 1978) and successfully posing tasks that might stimulate interest, cognitive activation and sustained efforts to problem-solve (Clarke, Roche, Cheeseman, & Sullivan, 2014; Henningsen, & Stein, 1997). Accessibility refers to how students relate to the problem context and identify what is required of them if they are to achieve expected learning outcomes. The extent to which a task might be considered accessible can depend on a range of factors. Students are the ultimate judge whether a problem is appealing enough to attempt to solve it, and they make this judgement based on the level of difficulty they perceive in the problem, their interest in it, and the importance they ascribe to it (Borasi, 1986). Essentially, getting the problem context, the level of challenge, and the level of accessibility right will generate opportunities to think deeply about and discover mathematics – activities that are critical to mathematics learning.

Developing, trialling, studying and refining challenging contextualised learning tasks has been an important part of the Encouraging Persistence Maintaining Challenge (EPMC) project. This article reports a snapshot of the EPMC project that explored the teaching of “Money and financial mathematics” through challenging, contextualised learning tasks termed “financial dilemmas”. The research questions were:

- What role (if any) does the choice of problem context play in mathematics teaching and learning?
- What are the implications for teachers?

The research context and methods

Since previous research highlighted the need for tasks based on realistic financial contexts that might better resonate with the everyday experiences of students from a low socioeconomic background (Sawatzki, 2014), schools servicing working class communities were sought to participate. Urban Darwin was chosen for its unique economic and sociocultural profile. Darwin is Australia’s main service centre for a wide range of primary industries including mining, offshore oil and gas production, pastoralism, and tropical horticulture. The Port of Darwin is the main outlet for Australia's live cattle export trade into South East Asia. The Darwin workforce also consists of high numbers of public sector and Defence Force personnel.

The Index of Community Socio-educational Advantage (ICSEA), created by the Australian Curriculum, Assessment and Reporting Authority (ACARA), was used to understand the socioeconomic profile of potential school communities. An ICSEA value below the Australian average of 1000 was a qualifying criteria to participate.

Data were collected from 14 teachers and more than 300 Year 5 and 6 students in 4 government primary schools. Table 1 consists of *myschool* data to describe each school’s size and student characteristics (socioeconomic background, identifying as being Indigenous, and being from a language background other than English).

Table 1. *myschool* data describing each school community

	Total enrolments	ICSEA value	Indigenous students	Language background other than English
School A	433	912	26%	14%
School B	397	983	9%	2%
School C	407	995	10%	14%
School D	270	935	24%	45%

These figures serve in some way to describe the diverse, often challenging communities within which the teacher participants work.

Being design-based research (Anderson & Shattuck, 2012), the study focused on the design and testing of an educational intervention. The intervention consisted of a series of ten challenging contextualised learning tasks referred to as “financial dilemmas” and a particular lesson structure that has been argued to enhance mathematics learning (see Sullivan, Askew, Cheeseman, Clarke, Mornane, Roche, & Walker, 2014). Financial dilemmas feature social and mathematical dimensions, involve multiple solutions, and invite students to share and explain their reasoning. These task characteristics are critical for creating awareness of alternative possibilities and stimulating higher order thinking. This is arguably essential if students are to learn the importance of identifying and critically evaluating multiple options as part of a problem-solving process that leads to informed financial decision-making. Financial dilemmas involve problem contexts that 10-12 year old children might be familiar with and/or interested in and/or able to imagine.

The financial dilemmas were brainstormed and created in Melbourne. Two of the ten financial dilemmas, *Catching the bus* and *Buying bread*, are presented below.

Catching the bus

Ticket prices for bus travel in Darwin are presented in the following table:

Ticket options	Adult	Concession	Description
Single (paper ticket)	\$3	\$1.25	Unlimited bus travel for 3 hours from validation.
Daily (paper ticket)	\$7	\$2	Unlimited bus travel until the last bus service of the day.
Flexi trip (Tap & Ride)	\$20	\$7.50	10 single, 3 hour trips are pre-loaded to the card.
Weekly (Tap & Ride)	\$20	\$7.50	Unlimited bus travel for 7 days from the day of the first validation.

Adapted from <http://www.transport.nt.gov.au/>

Bonny will be catching the bus to get to and from Darwin Middle School next year. She will need to buy paper bus tickets or a “Tap & Ride” card. As a student, she is entitled to a concession fare.

- If Bonny catches the bus to and from school every day, what is the best ticket option for her? Explain your thinking.
- In Terms 2&3, Bonny will have netball training on the school netball courts from 4pm each Tuesday and Thursday, and her mum can pick her up from there on her way home from work. How will this affect what bus ticket Bonny should buy? Explain your thinking.

Buying bread

Baker’s Delight has a loyalty card. For every \$6 spent on bread, customers receive a stamp on their card. After five stamps, the customer can choose a free loaf of bread. Mum spends the following amounts in five separate visits: \$6.50, \$8.00, \$9.50, \$7.00, \$11.00.

- What do you think about Mum’s spending at Baker’s Delight? Explain your thinking.

Every effort was made to anticipate, if not ensure, that the tasks would be appropriately realistic, challenging and accessible to students. For example, the price table presented in *Catching the bus* was adapted from the Northern Territory Department of Transport website. I used Google Maps to check the proximity of Darwin Middle School to the participating schools, but also encouraged the teacher participants to change the school name if they felt it was appropriate to do so. The *Buying bread* task was based on the Baker’s Delight loyalty card, and I checked that this program was in-use in Darwin. I also used Google to check for Baker’s Delight stores operating close to each of the participating schools.

Catching the bus requires students to evaluate a price table where value for money depends on service usage. Many people pay “up-front” for purchases that they don’t end up using to the fullest advantage (a good example is gym memberships). The purpose of this task is for students to discover and discuss the importance of being realistic about likely service usage over time and the point at which paying “up-front” becomes worthwhile compared with paying as you go.

Buying bread was designed to promote multiplicative thinking alongside discussion about business marketing and customer loyalty programs. An important social dimension is whether price is an indicator of quality. It was anticipated that students would likely benefit from a role

play showcasing the stamp system at Baker's Delight – that is, stamps are most effectively accrued when customers spend as close to multiples of \$6 as possible.

Preliminary feedback on the ten tasks was sought from five Numeracy Leaders who have been involved in previous iterations of the EPMC project. These colleagues teach in outer urban and rural schools in Victoria and Tasmania. They trialled the tasks with Year 5 and 6 students in their respective schools and/or suggested minor modifications. The intention was that the financial dilemmas had undergone some quality controlling prior to being included in the intervention.

At the outset of the Darwin study, a pre-intervention teacher professional learning day was held to give the teacher participants the opportunity to see and experience the teaching approach being suggested through a modelled lesson and various other simulation activities.

The findings reported in this article are based on qualitative teacher and student data. The teacher participants completed surveys online and participated in a 1-hour focus group discussion as part of the post-intervention teacher professional learning day. The questions sought the teacher participants' feedback about the problem contexts, the social and mathematical dimensions of the tasks, the level of challenge, the lesson structure, and the pedagogies used.

Twenty-eight Year 5 and 6 students (seven groups of four students drawn from each of the four participating schools) participated in 20-minute focus group discussions where they shared insights into their experiences learning through the ten challenging, contextualised tasks. To refresh their minds, students were given a booklet of the tasks to refer to.

Teacher and student data were compared and contrasted to compile a critical and complete research story about the participants' experiences teaching and learning through the intervention. In the next section, *Catching the bus* and *Buying bread* are referred to in order to substantiate particular findings and arguments about the various problem contexts and each task's *fit to circumstance* and level of *challenge yet accessibility*.

Findings

Insights from teachers

The teacher data revealed two insights. First, the teacher participants identified that the problem contexts needed to be authentically situated within the realms of students' everyday observations and experiences in order to be accessible. According to the teachers, particular tasks were more "effective", "engaging" and "fun" because they met this criteria. Second, the teachers reported that role play and visual imagery were particularly useful pedagogies to introduce students to unfamiliar problem contexts and enhance task accessibility. These findings are highlighted through the accounts about teaching and learning through *Catching the bus* and *Buying bread* below.

During the focus group discussion, one of the teachers reported that the success of each lesson seemed to hinge on the students' ability to access and relate to the financial context posed. Another teacher concurred, and spoke about *Catching the bus* as highlighting this point. The conversation that followed revealed a number of ways and means by which I misjudged the local context when constructing this task. First, I assumed that students from a low socioeconomic background would be familiar with the public transport system. Second, I assumed that students might be thinking about catching the bus to Middle School in the future. Third, while the price table was adapted from the Northern Territory Department of Transport website, I assumed that student passengers would be eligible for concession fares. In these ways, I created a financial literacy learning experience based on middle class understandings that apply in middle class, metropolitan Melbourne – not working class, urban Darwin. I missed the fine-print that in the Northern Territory, school students are fully subsidised and so travel on buses for free. At the post-intervention teacher professional learning day, the teachers

reported that very few families are reliant on public transportation to get to school – students are typically driven, ride a bike, or walk to school. The teachers were concerned by this task’s *fit to circumstance*. Another thing the teachers did not seem to like about this task was the literacy demands. One teacher scolded, “Suddenly our maths lessons turned into literacy lessons.”

The teachers were asked if there were particular pedagogies they used that seemed to help make *Catching the bus* more accessible to their students. In response, the teachers discussed the importance of the lesson introduction. One teacher spoke about recounting to her students a personal experience catching the bus. Another explained to her students the benefits to understanding the public transport system if you ever venture outside the Northern Territory, perhaps on a family holiday. Others, who co-teach in a large open classroom, spoke about the potential for role-play to bring this particular financial dilemma to life. Another teacher explained drawing a picture to represent the scenario, and his belief that this modelled a useful problem-solving strategy. In these ways, the teachers identified and utilised appropriate pedagogies to activate students’ imaginations. While the teachers inferred that this was difficult work, and seemed unlikely to use the task again in the future, they also acknowledged that the lesson served to expose students to an unfamiliar financial context.

On the post-intervention teacher survey, teachers were asked, “If you believe that students’ financial and/or cultural backgrounds influenced their responses to the financial dilemmas, can you please give two stories / examples from your lessons to support your view.” One teacher reported that his/her students commented that the price of bread at Baker’s Delight was a waste of money and they would prefer to shop at their local supermarket where bread can be purchased at a fraction of the cost. This feedback was also raised during the teacher focus group discussion where another teacher explained that her students developed a social argument that Mum is spending too much money at Baker’s Delight. The teacher believed that students’ perceptions of value for money became a distraction to the mathematical dimension of this particular task. Another teacher agreed, and explained that the students who routinely go shopping with their parents, including to Baker’s Delight, found this task far more accessible than those who tended to stay at home. He described that they, “... didn’t care about the task. It was a lot harder to engage them.”

Role play was recommended as a useful pedagogy in the Teacher Participant Handbook and modelled as part of the initial professional learning day. Teachers were encouraged to explicitly instruct students that any transaction between \$6 and \$11.99 would receive one stamp only, transactions between \$12 and \$17.99 would receive two stamps, and so on... Again, those co-teaching in a large open classroom, reported that an entertaining enactment of the problem context seemed to help students to access the task. Another teacher reported drawing a picture on the whiteboard that depicted the story of Mum shopping at Baker’s Delight. In this way, he modelled a problem-solving tool that students might use in future mathematics lessons. This teacher commented that while his students had some difficulties accessing the problem context, he felt the mathematical dimension of the task was worthwhile. He expressed an intention to use the task again in the future but modify the problem context to involve a loyalty card for buying hot pies at the school canteen.

Insights from students

The student focus group discussion data revealed important insights how students viewed and experienced the tasks, but also what they value in mathematics lessons. These findings are highlighted through the students’ accounts of the ten tasks, with a particular focus on *Catching the bus* below.

When asked what words they would use to describe the ten tasks, “interesting,” “enjoyable,” “exciting,” “challenging” and “fun” were common responses. When asked to

elaborate upon these responses, the students made comments that highlighted what they value in mathematics lessons. For example, students tended to describe what they saw as positive task attributes - being based on realistic financial contexts that aligned with their everyday observations and experiences with money, being challenging, and being useful. One student explained why she felt these things were important saying, "In life, not everything's gonna come easy. It's good to figure out hard things so then you know what to do when you grow up." The students also seemed to see merit in learning to apply mathematics through problem-solving experiences, as underlined by these explanations:

Student 1: This is a new way to learn maths... you had to decide what maths to do with that task...

Student 2: [The tasks] made you put all your skills together and that's kind of a new skill."

While students seemed to prefer tasks that were immediately relevant to their everyday observations and experiences with money, they also valued learning about unfamiliar problem contexts. This finding is a fascinating paradox to the teacher data. For example, students who attended the school that was located in closest proximity to Darwin's Laser Tag centre were animated in their praise for the task that required them to evaluate Laser Tag pricing. However, students who attended the school that was located furthest away from any such entertainment venue found the context to be novel but imaginable. Interestingly, despite the issues and concerns reported by the teacher participants, several students across the four participating schools nominated *Catching the bus* as their favourite task. The students seemed to see merit in learning about bus ticketing and appreciated being challenged by the literacy and numeracy demands of the task. Several students explained that learning to read, interpret, and make decisions with reference to the price table was valuable saying, "When you grow up, if you have to catch a bus, it's really useful." One student commented, "I think I learned more about literacy than money." He was among a number of students that reported learning the meaning of the term "concession" through *Catching the bus*.

Conclusion and implications

The Darwin study confirms the value of design-based research and its collaborative, generative processes in developing, trialling, studying and refining quality classroom tasks and revealing powerful insights into teaching and learning.

The findings suggest that the extent to which a problem context might be considered *authentic yet imaginable* is an important but elusive aspect of the task design principles Geiger, Goos, Forgasz, and Benison (2014) describe as *fit to circumstance* and *challenge yet accessibility*. While the teacher and student participants reported that problem contexts that are authentically situated within the realms of students' everyday observations and experiences were more immediately relevant and accessible, students also valued learning about unfamiliar, novel, and imaginable problem contexts they deemed useful to their life beyond school. The examples of *Catching the bus* and *Buying bread* demonstrate this point. Because students could imagine themselves using public transport in the future, they found *Catching the bus* to be realistic and meaningful. By contrast, because some students could not see themselves ever paying a premium for bread, questions about the problem context's *fit to circumstance* distracted from the intended mathematics learning associated with *Buying bread*.

There are three implications for the teaching profession:

- Using unfamiliar, novel, and imaginable problem contexts is essential to broadening students' horizons. However, getting the problem context right is a complex pursuit.
- In a country as diverse as Australia, "one size fits all" or "off the shelf" tasks are fraught. It is the job of teachers to create and/or select and/or modify contextualised learning tasks that 10-12 year old children might be familiar with and/or interested

in and/or able to imagine based on their knowledge of their local context and students' family backgrounds, characteristics, and interests.

- Using unfamiliar, novel, and imaginable problem contexts is inevitably more pedagogically demanding for teachers. A strong lesson introduction involving the use of role play and/or visual imagery (drawing pictures) can enhance task *accessibility* and make mathematics more meaningful and fun for students.

The Darwin study reminds us to consider whether quality teaching and learning means working comfortably with the familiar or somewhat uncomfortably with the unknown. The insights and implications signal a need for teacher professional learning. Engaging teachers in classroom research has the potential to provide authentic, impactful professional learning, with positive outcomes for schools, teachers, and students. Such opportunities are particularly important for teachers working in low socioeconomic areas, since students living in financial hardship have very limited observations and experiences with money from which suitable financial contexts for mathematics teaching and learning might be drawn.

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