What Financial Dilemmas Reveal About Students' Social and Mathematical Understandings

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Everyday financial dilemmas require us to draw on social, interdisciplinary, and mathematical understandings simultaneously and in synergy if we are to make informed financial decisions. Financial literacy is enjoying an elevated status across the *Australian Curriculum*. This paper reviews some of the literature on financial literacy, and describes aspects of a research project in which Year 6 students were presented with financial dilemmas to gain insights into their social and mathematical understandings and financial decision making. The findings suggest that teaching that provides meaningful contexts in which mathematical concepts are situated is critical to student learning.

Making informed financial decisions means drawing on social, interdisciplinary, and mathematical understandings simultaneously and in synergy. The *Melbourne Declaration on Educational Goals for Young Australians* stipulates the need for all young Australians to become confident and informed citizens during their formal education so that, as school leavers, they are positioned to live "fulfilling, productive, and responsible lives" (Ministerial Council on Education, Employment, Training, and Youth Affairs, 2008). The intention is to ensure that young Australians have the attitudes, values, knowledge, skills, and behaviours necessary to evaluate alternative options and make choices that can assist them in realising their aspirations while contributing to Australia's social and economic prosperity. One example is the ability to identify and evaluate alternative options involving earning, spending, saving, and sharing money, and make informed financial decisions that allow independence and financial well-being. Financial literacy education has become a "hot topic" in recent years – in Australia, the federal government invested $10 million in the *Helping Our Kids Understand Finance* policy initiative, led by the Australian Securities and Investments Commission (ASIC). Two key documents outline the agenda. The first is the *National Consumer and Financial Literacy Framework* (Ministerial Council for Education, Early Childhood Development and Youth Affairs [MCEEDYA], 2005) and the second is the *National Financial Literacy Strategy* (ASIC, 2011). While it has not been identified as one of the three cross-curriculum priorities, financial literacy is enjoying an elevated status across the *Australian Curriculum*. In the *Australian Curriculum: Mathematics*, "Money and financial mathematics" is a sub-strand of the "Number and algebra" content strand from Years 1-10 (Australian Curriculum Assessment and Reporting Authority, 2011).

This paper reviews some of the literature on financial literacy, and describes aspects of a research project in which Year 6 students were presented with "real life" financial dilemmas to gain insights into their social and mathematical understandings and financial decision making.

Research into financial literacy and financial literacy education

Longitudinal research into adult financial literacy in Australia has found that financial literacy levels differ depending on personal characteristics (ANZ, 2011). The lowest levels of financial literacy have been found to be among those educated only up to Year 10, those

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with low household income or whose main source of income is a government benefit or allowance, those who speak a language other than English at home and those of Aboriginal or Torres Strait Islander descent (ANZ, 2011). In various ways, these findings reveal the previous shortcomings in financial literacy education in Australia and highlight the need for further research.

For the purpose of the Programme for International Student Assessment (PISA), the Organisation for Economic Cooperation and Development (OECD) distinguishes between mathematical and financial literacies while acknowledging the relationship between the two (OECD, 2010). For example, students who can apply number sense, are familiar with various representations of numbers, can undertake strategies for computation, and use mathematical reasoning to solve problems are likely to be more financially literate. Then again, financial literacy can sometimes be demonstrated without even basic arithmetic processing. The working definition upon which the PISA financial literacy assessment has been based explains financial literacy to mean:

> knowledge and understanding of financial concepts, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life. (OECD, 2010, p.12-13)

While mathematical literacy (numeracy) is part of and contributes to financial literacy, financial proficiency relies on social and interdisciplinary understandings. Parents have been found to play a significant role in financial literacy teaching and learning (Danes, 1994; Shim, Barber, Card, Xiao, & Serido, 2010). However, the prior understandings children bring to school from home can vary considerably. Furthermore, in Australia, financial literacy education is the responsibility of teachers in diverse discipline areas – Business and Economics, Civics and Citizenship, and Mathematics. This means that while students may benefit from approaches that weave together social and interdisciplinary understandings, they tend to learn about money through observational, experiential, and direct teaching episodes that give snapshots of the puzzle, rather than an integrated view. So an individual's financial literacy at any one point in time is best understood as the melding of attitudes, values, observations, experiences, knowledge, skills, and behaviours that are complex, interrelated, situated in different contexts (home, school, and community) and therefore not easily or reliably measured.

Brenner's (1998) study highlights the need for schools and teachers to provide students with opportunities to consolidate what they have come to understand about money through observation, experiences, and direct teaching at home and in the local community with what is being taught and learned at school. Brenner (1998) examined how the inclusion of everyday mathematics into classroom instruction can make the curriculum more meaningful to students. She interviewed and observed Hawaiian children from preschool through to second Year, their parents and their teachers to understand their goals for children's acquisition and use of money concepts at home, while shopping, and in the classroom. Disparities were found between children's everyday understandings of money and what was being taught as part of the mathematics program at school. In fact, many of the children came to separate the two contexts as having different knowledge structures and values systems. This resulted in a lack of learning for the students and frustration for the teachers. Brenner (1998) successfully demonstrated the value in opening the lines of communication between parents and teachers to help teachers better understand the ways and means by which students have been learning about money at home and in the community.

Unfortunately, there have been few Australian studies focusing on financial literacy levels among young people or financial literacy education at school. One example is the *Australian Financial Literacy Assessment* (AFLA) commissioned by the Commonwealth Bank Foundation (CBF) in 2005 to determine the level of financial literacy of Year 9 and 10 students (14-16 year olds). AFLA was repeated in 2006 with 50,000 student participants from over 500 schools. AFLA consisted of 48 multiple choice questions requiring students to apply a range of knowledge and skills to everyday financial situations. The results revealed that, despite being active young consumers, this demographic lacked fundamental numeracy skills and basic financial knowledge. For example, many showed difficulties reading and interpreting a bank statement and around half were unable to critically compare mobile phone plans (CBF, 2006).

In 2003, *MakingCents*, a national financial literacy education program for primary school children aged 7-12 and their parents, was developed (NSW Department of Education and Training, 2009). Shortly thereafter, a financial literacy action learning project involving students, their parents and their teachers was undertaken to explore the complexities of financial literacy education in seven disadvantaged school settings. The project educated parents and involved them in teaching their children responsible money management. The project evaluation revealed that the most successful programs were in school communities where parents were actively engaged throughout the course of the *MakingCents* program (NSW Department of Education and Training, 2009). This finding reinforces the potential for parents and teachers to work together to improve financial literacy education.

As an extension to *MakingCents*, a financial skills assessment was designed to provide parents and teachers with information about student financial literacy levels and give a snapshot of financial literacy in Australian primary schools (Citibank Australia, 2009). A sample of 4,660 students aged 10-12 from more than 100 schools nationwide participated in the assessment. Eighty-two per cent of participants experienced difficulty converting simple mathematics calculations into concepts involving money (for example, calculating change, calculating an account balance and calculating mobile phone charges) (Citibank Australia, 2009).

Overall, these studies suggest that by adolescence many students do not understand some of the basic economic, consumer and financial principles of earning, spending, saving and sharing money, and have difficulty applying their mathematical knowledge and skills to "real life" problems on financial literacy assessments. And yet young people today are interacting in the economy as consumers of more sophisticated products and services from a younger age (MCEEDYA, 2005; ASIC, 2011; OECD, 2011). It may be that quantitative financial literacy assessments do not adequately capture and depict what financial decision-making in adolescence looks like.

Sullivan (2011) argued that mathematics has practical applications in everyday situations and decisions, and that students need to be able to apply different knowledge, skills, and understandings when faced with "real life" problems. So teaching and learning that provides meaningful contexts in which mathematical concepts are situated is critical. Financial dilemmas involving social and mathematical dimensions provide opportunities to explore students' capacity to do draw on these understandings simultaneously or in synergy. What students do and say when presented with financial dilemmas provides insights to help better understand adolescent financial literacy.

The research context and data source

This paper presents a snapshot of findings of individual face-to-face interviews with a small sample of 11-12 year old students towards the end of their time in Year 6, the final year of primary school. The students attended a small government primary school in Melbourne, which is best described as servicing a culturally diverse middle class population. Of twenty-eight Year 6 students across two Year 5/6 composite classes, the teachers identified twelve they assessed as performing at or above VELS Level 4 in Mathematics (i.e., these students had demonstrated achievement of the knowledge and skills necessary to attempt the financial dilemmas). Eight parents (four from each class) returned the Consent Form agreeing that their child could be interviewed, and that the interview could be audio-recorded.

The student interview protocol was designed to explore students' observations about and experiences with money, and to work with them to solve a series of seven "real-life" financial dilemmas focusing on earning, spending, saving and sharing money. The student participants were told that the purpose of the interview was to investigate how they tackle mathematical problems involving money.

This paper explores how the students approached one financial dilemma, "Understanding fuel economy," which is representative of the other financial dilemmas posed to students during their interviews.

"Understanding fuel economy," was designed to find out how students read and interpret simple numerical information, including comparisons made in a table. This problem was open and challenging – the idea was to see what students did with the information available to them, how they interpreted the goal to save some money, and what understandings informed their financial decision-making. It was presented as follows:

> Frank and Nellie own two cars. Each weekday, Frank drives to the closest train station, and takes the train to work in the city. He drives a total of 20km each week. Nellie, on the other hand, drives to and from work each day. She drives a total of 100km each week. Frank currently drives Car B. Is there a way for Frank and Nellie to save some money? Explain how.

	Car A	**Car B**
Size	Large	small
Total running costs	30c per kilometre	15c per kilometre

The students did not seem to see this as a mathematical problem. They drew on social, rather than mathematical understandings, and often had to be refocused on the available information and/or encouraged to undertake mathematics. This resulted in students suggesting multiple alternative options. The audio recordings of the student interviews were transcribed for data analysis. The eight students interviewed made a total of seventeen suggestions how Frank and Nellie might save some money. Each suggestion was able to be organised into one of seven categories (A-G), presented in Table 1. Only three suggestions made by three students involved mathematics (indicated by X).

Table 1
The range and frequency of responses to "Understanding fuel economy"

	A. Nellie takes public transport	B. Nellie walks to work	C. Nellie rides a bike to work	D. Frank walks to the train station	E. Nellie drops Frank at the station on her way	F. Frank and Nellie swap cars	G. Sell the large car	Total number of responses per student
Samantha		X					X	2
Lara						X		1
Isabel	X		X					2
Calvin	X				X			2
Tayla		X		X	X		X	4
Bruno				X			X	2
Justin	X				X			2
Elizabeth	X				X			2
Total	4	2	1	2	4	1	3	

"Understanding fuel economy" elicited fascinating and unexpected responses that showed the students had sophisticated social understandings which they drew on more readily than, and often instead of, their mathematical knowledge and skills. Suggestions A, B, C, D, E, and G involved saving money by not using one car. It seems that these suggestions were made based on social understandings, without the students engaging in any mathematics.

For example, students who suggested that Nellie take public transport (A) did so despite there being no information about the availability or cost of public transport to Nellie included in this financial dilemma. They seemed to be operating on a preconceived idea that public transport is generally cheaper than driving.

Similarly, students who suggested Nellie walk to work (B) reported the health benefits associated with doing so. However, they had not fully engaged with the numerical information presented in the financial dilemma – if Nellie is driving 100km to and from work each week, she would be driving around 10km each way, a distance that is too far to walk.

Interestingly, Nellie riding a bike to work (C), Frank walking to the station (D), and selling the large car (G) are plausible suggestions beyond the confines of the problem that I had not considered or predicted. The suggestion to sell the large car (G) would actually raise money for the household – through the liquidation of the large car as a saleable asset. Perhaps this suggestion reveals sophisticated financial understandings – when cutbacks and savings need to be made, behaviour needs to change, and there are things that can be sold to raise money.

To elaborate that what students do and say when presented with financial dilemmas provides insights to help better understand adolescent financial literacy, consider this conversation with Tayla, who made four suggestions how Frank and Nellie might save some money. This conversation typifies the students' approach to this problem, and the extent to which social understandings were relied upon to make financial decisions:

Tayla: Well, they could both share the same car.
Interviewer: How would that work?
Tayla: Well, Frank and Nellie both drive to the train station, [Nellie] drops Frank off and then Nellie could drive to work, and then after work she… could pick Frank up…
I: Ok. Is there any other way they could save some money?
Tayla: Well, Nellie could walk to work and Frank could… walk to the train station. They could walk more and do more exercise and not get so fat.

I: But gee, Nellie's driving 100km to work each week. That's a long walk.

Tayla: Well, Nellie could drive the car, drive the small car and Frank could walk to the station, cause it's the closest train station.

I: And then what would they do with the large car if they're not using it?

Tayla: Sell it or rent it out if that works.

Tayla seems to understand that people sometimes need to change their behaviour in order to save money. Implicit in her response is the view that a second car is a luxury Frank and Nellie can do without. However, she did not use mathematics to find or defend any of her suggestions.

Only three students could be persuaded to do some mathematics: Lara, Calvin, and Elizabeth. However, lack of mathematical precision impacted their ability to make informed financial decisions. Consider this conversation with Lara, a student being extended in mathematics:

Lara: Well, they could swap cars.

I: Could they?

Lara: Yeah, that would save money for Nellie and Frank; 30 by 300, 3,000 – that's not right. Have you got any paper I can use?

I: Yeah. Right here, see.

Lara: I probably know the answer though. Sometimes I hate these sums. I was right. It is three thousand. That's a lot <working> So, that's <working> So, he pays three hundred a week – three hundred dollars a week… for petrol - is that right? … Whereas <working> that one…

I: Just talk me through what you've done there. Which one's Frank and which one's Nellie?

Lara: I don't actually know what that is.

As Lara had written some workings out (Figure 1), I was trying to make sense of what she had done. She seemed to have forgotten that she was working in cents, and needed to convert her answer to dollars and cents:

I: So Nellie's driving 100 kilometres and she's paying 30 cents per kilometre.

Lara: Yeah, that's three thousand a week.

I: Three thousand what per week?

Lara: Three thousand dollars.

I: Ok.

Lara: 15 by a 100 <working>. Does that make sense? <working> Yeah, so she would only pay fifteen hundred if she were to use Car B. Whereas he only pays - oh my gosh - sorry, I love maths.

I: Yeah, good on you.

Lara: He would pay six hundred if he was to use the large car and she would only pay fifteen hundred [to use the small car].

I: So, if they swapped cars, he would then only pay six hundred what?

Lara: Six hundred dollars.

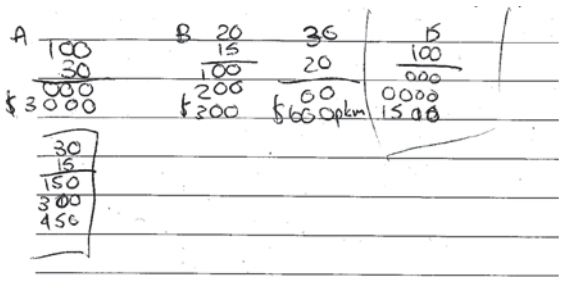

Figure 1. "Understanding fuel economy" - Lara's workings.

Lara made a critical error not converting cents to dollars and cents. She did not seem to realise that the figures she was citing – running costs of three thousand and six hundred

dollars - were nonsensical. While it is hard to tell whether social or mathematical reasoning led Lara to suggest Frank and Nellie swap cars, she used mathematics to check and then reason that her suggestion was plausible. While he made a different suggestion (that Nellie drive and drop Frank at the train station), Calvin's problem-solving followed a similar pathway.

Elizabeth demonstrated a d ifferent approach to financial decision-making - she engaged in mathematics and then used her findings to guide and inform a financial decision:

I: Is there any maths that you'd like to do?
Elizabeth: Well how much is the – thirty cents per kilometre… Okay, so he drives twenty so <working> so it's twenty times – we had this one yesterday <working>. So – then twenty one dollars for him to fill up his car.
I: So he's paying?
Elizabeth: It's fifteen cents every kilometre, and there's twenty kilometres, so it would be twenty one dollars for him, and then she's paying thirty. So thirty times 100 i s <working> three thousand. Three thousand dollars. Thirty dollars.

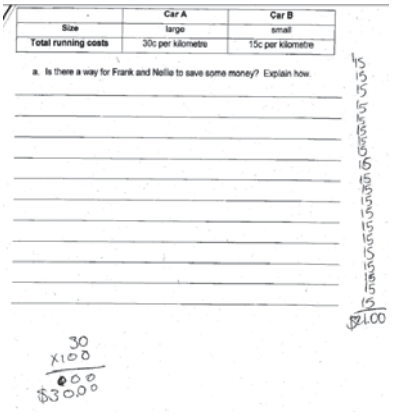

Figure 2. "Understanding fuel economy" – Elizabeth's workings.

Using repeated addition instead of multiplying distance by cost (Figure 2) probably contributed to Elizabeth's error in the total cost to Frank being $21, r ather than $3. As Elizabeth did not check her workings out, a mathematical error led her to make and explain a financial decision that would save some money, but not as much as possible.

Conclusion

On the one hand, the students in this research project made insightful comments that revealed mature social understandings about earning, spending, saving, and sharing money. However, they did not draw on t heir social and mathematical understandings simultaneously or in synergy when faced with "real life" financial dilemmas. A reluctance or inability to do this would seem to be counterproductive to making an informed financial decision.

Figure 3 is a proposed model that represents the problem-solving pathways students took in order to make financial decisions. Students preferred to engage in social reasoning, drawing on c onsumer, economic, and financial understandings when making financial decisions. Most of their financial decisions were made without the use of mathematical calculation or reasoning, although the dotted lines indicate some students took these pathways when encouraged to do s o. This model provides a focus for further data collection and analysis.

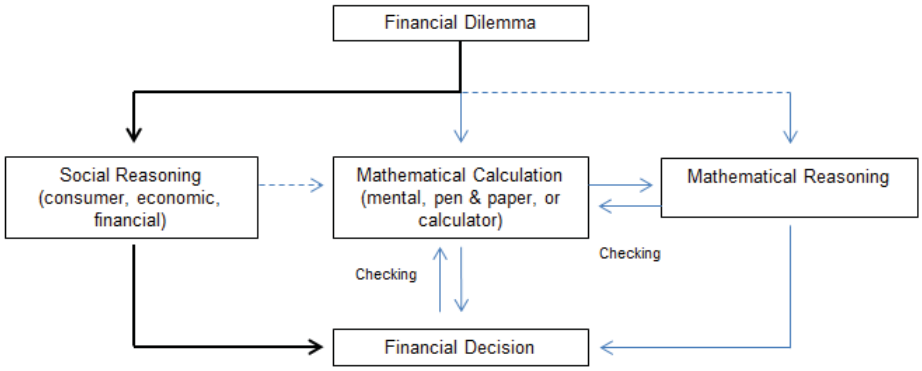

Figure 3. The social and mathematical pathways to students' financial decision-making.

These findings support that teaching that provides meaningful contexts in which mathematical concepts are situated is critical to student learning, and further research is needed to explore pedagogical approaches teachers might use to develop students' ability to apply different knowledge, skills, and understandings when faced with "real life" financial dilemmas.

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