MONASH University

M-cubed: Money, meaning, and mathematics for learners with cognitive disabilities

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Table of Contents

Introduction 2
Assessment of Money Skills for Learners With ID 2
Pocket Money 3
APPENDIX I - Background on Financial Literacy for All 4
Needs and desires of adults with disability 4
Challenges facing adults with ID 5
Educational needs of school aged students with ID 5
Financial literacy programs for adults with ID 7
APPENDIX II - Designing and Testing Pocket Money 9

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Introduction

There is growing acknowledgment that people with intellectual disability (ID) should have greater opportunities to make decisions and choices about their own lives and the services they receive. Carney (2013) suggested this can be achieved using a framework of decision-making supports provided through trusted family members, advocates, and significant others, or through a formal agreement with a guardian. These supporters find themselves in a complex space needing to juggle the "rights, practicalities and risks" for people with ID (Bigby et al., 2019, p. 396).

At the same time, people with ID require opportunities to develop certain knowledge, skills, behaviours, and dispositions that will serve them well and enhance elements of independent living, such as knowledge of financial literacy and capabilities with handling money. Worthington (2013) defined financial literacy as "the ability to make informed judgements and take effective decisions regarding the use and management of money" (p. 230). Similarly, the Programme for International Assessment (PISA) defined financial literacy as "the knowledge and understanding of financial concepts and risks, 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, 2019, p. 128). Most succinctly, Ali et al. (2014) described financial literacy as "a vital life skill for all consumers" (p. 336). For more details on the current research around Financial Literacy, see Appendix I.

Assessment of Money Skills for Learners With ID

The OECD (2014) highlighted the importance of a rigorous assessment to determine the effectiveness of financial literacy programs. They explained:

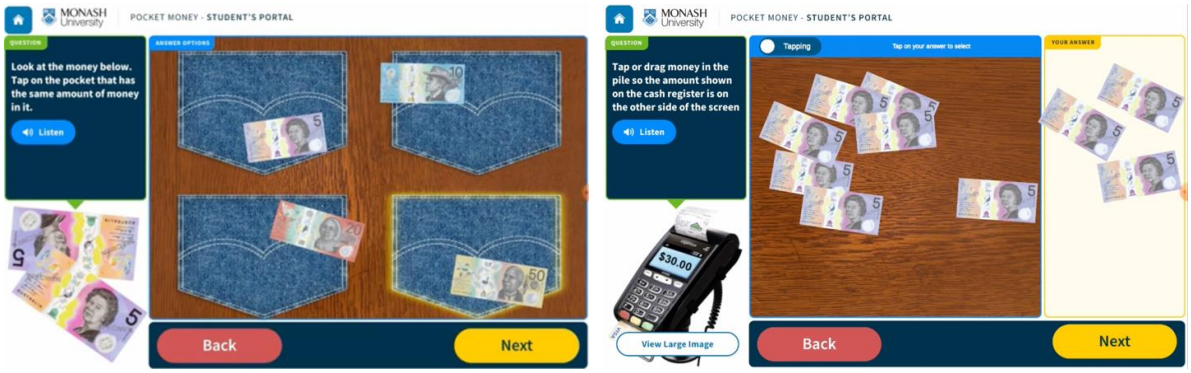
> A robust measure of the financial literacy of 15-year-old students provides information that can indicate whether the current approach to financial education is effective. In particular, it can help to identify issues that need addressing through schools, extracurricular activities or programmes that will equip students to make financial decisions in adulthood. It can also be used as a baseline from which to measure success and review school and other programmes in future years (OECD, 2014, p. 128)

Similarly, a suitable assessment is needed for people with ID. Currently, assessments for special needs students in Australia focus more on attitudes and competencies than the curriculum (Hordacre, 2016). Although Australian policy supports the notion that the curriculum should be adjusted and differentiated for these students, it is left to the teacher or school to determine how this occurs (Australian Curriculum Assessment and Reporting Authority, 2012). We believe that teachers and students would benefit from a purposely designed assessment for learners with ID around money skills that could span primary and secondary education, and the transition to post-school education. We called this assessment Pocket Money – for more information about the technical aspects of the development of this tool, see Appendix II.

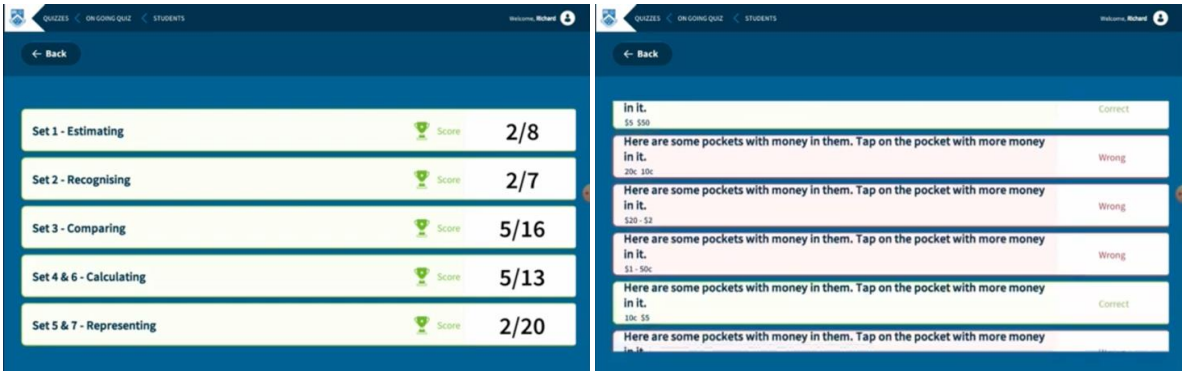
Pocket Money

Pocket Money presents a set of rigorously tested items that can accurately measure students' understanding and skills with money using an interactive app and interactive website, so that students can complete the assessment on a tablet or computer (see Figure 1).

Figure 1. Items from the Pocket Money Assessment App



Using the app, teachers can create accounts on the system and activate sessions for their students. They can then retrieve the results for each student and obtain an accurate score indicating their students' ability across the money maths curriculum areas of Estimating, Recognising, Comparing, Calculating, Representing, and Verifying. Teachers can also drill down to the individual questions to see exactly where students struggled most.



Pocket Money is a tool that can be used as a pre-test/post-test for teachers and as a way to help inform their teaching practice. The app-based assessment is available for download on android devices from the PlayStore, and the web version is available at https://www.pocketmoney.education/home.
An instructional video guide of the app is available on YouTube (https://youtu.be/0fveiuBCMV0), along with links to the app.

We hope to expand on this important work further by engaging with schools, community organisations, and parents to help them leverage this robust educational tool in assessing the efficacy of the many financial programs being used currently. We are also aware of the potential withdrawal of coins from circulation and increasing trend towards digital forms of currency, so we are hoping to start work on a version of this tool that can start to incorporate these newer forms and understanding of money, to ensure that children and young adults with ID do not fall through the cracks should the removal of tactile forms of money come to pass.

APPENDIX I - Background on Financial Literacy for All

In Australia, and internationally, programs have been designed to address a lack of financial literacy in the general population (Worthington, 2013). Following a review of existing financial literacy content around the world, the OECD (2014) reported that there were four main topics commonly included in these programs: money and transactions; planning and managing finances; risk and reward; and financial landscape. However, less is known about the content of the programs that specifically support people with ID. The section that follows highlights the needs/desires of adults with ID in regard to their own financial literacy, the challenges they face in obtaining this, and the educational needs of school age children with ID in this area.

Needs and desires of adults with disability

While we identified many studies about people with disability regarding their ability and need for learning about how to handle money, we found only a few that had incorporated the views and desires of those with disability. These are summarised below.

Abbott and McConkey (2006) held focus group discussions with 68 people with ID (aged between 21 and 82 years-old) in supported living or share group homes in the United Kingdom. The results identified four main barriers to social inclusion, as reported by people with ID. These were lack of knowledge and skills; role of the support staff and service managers; location of their house; and community factors such as lack of amenities and attitudes. In particular, the participants identified that skills with money were important for their participation in community life.

McCausland et al. (2010) interviewed 75 adults (over 50 years-old) with varying levels of ID (from mild through to severe or profound). The study aimed to determine the greatest health and social care needs reported by the interviewees. Results indicated that basic education and budgeting were the two greatest unmet needs, however, there was some variation depending on the level of disability. The study concluded that “the high rating of basic education as an unmet need demonstrates a potential deficit in lifelong learning programmes” (p. 385).

Williams and Porter (2017) interviewed nine people with ID who needed support to make decisions and manage their personal budget. The results indicated that study participants who reported feeling they had greater choice and control over their finances, had “a more fulfilled life” (p. 105).

Cheak-Zamora, et al. (2017) interviewed 27 youths and young adults (aged 16 to 25) with Autism Spectrum Disorder (ASD) regarding the skills they needed for independence. The following common themes were identified:

1. They believed that adults on their own should be able to manage their own finances.
2. That they needed further education as they worried that they lacked the skills needed to manage their own finances.
3. They felt that potential lack of income created a barrier to them becoming independent and therefore exposing them to more risks.

Finally, a project conducted by RMIT University in which 16 adult individuals with autism were interviewed in focus groups, determined that “the autistic participants expressed a strong desire to learn more about money and viewed this as important for achieving or maintain their independence” (Russell et al, 2017b, p. 4).

In summary, many adults with disability would like to manage their own finances including budgeting, but believe they lack the skills to do so. They also believe that learning more about

handling money would contribute to their independence and that a lack of knowledge and skills around handling money can be a barrier to participating in society. We next outline some of the reported challenges adults with ID experience in relation to handling money and making financial decisions.

Challenges facing adults with ID

Students with ID do not transition to adulthood with the same possibility of employment outcome as those without ID. Nevertheless, a significant number of people with ID do participate in the workforce after leaving school. Specifically related to Australia, Russell et al. (2017) reported that the employment rate for people with ID was around 50% while the OECD average was 60 percent. Whether in employment or not, adults with ID will be faced with the need to make financial decisions.

Suto et al. (2005) reported that those with an ID (aged 18-64) in the United Kingdom, had more difficulties in making financial decisions than those without. Items were scored on the person's ability to identify the decision that needs to be made, understand the information relevant to the decision, reason about the information, appreciate who is affected by the decision, and communicate a chosen outcome. The authors reported that "not surprisingly adults with intellectual disabilities were found, in general to have weaker decision-making abilities than the general population" (p. 204).

Eagar et al. (2006) assessed over 1500 school leavers (aged between 17 and 24) in Australia, with a disability. Forty percent had an intellectual disability, 16% had a speech disability, 15% had a physical disability, and others had autism, sensory impairments, or neurological disorders and many had more than one disability. The assessment measured their domestic functioning, self-care, and behaviour to determine their capacity to work and their need for transition to work programmes. Results indicated that only 4.4% could manage money without assistance. They also reported that school leavers with ID lacked basic skills such as counting money, using money for a transaction or paying a bill. Doing shopping and dealing with their finances were two of the top three items in which these school leavers needed assistance.

In summary, adults with ID tend to have difficulty managing their money and making financial decisions without assistance. Often those who care for people with ID do not have the expertise or inclination to help people with ID develop their capabilities with handling money (Abbott & Mc Conkey, 2006). Next, we describe ways in which young children with ID are supported to learn more about handling money at school and the challenges they may face.

Educational needs of school aged students with ID

There is debate around the nature of the most appropriate curriculum for children with ID. Adding up coins and calculating change is typically taught in primary school and in specialist secondary schools. Hordacre (2016) described that the core competencies with money for students with ID should include recognising and counting money, valuing money (including valuing short- and long-term goals, and basic budgeting) and safety with money. Stith and Fishbein (1996) also recommended that the curriculum should cover the value of coins, adding the values of the coins, how to choose which coins equal a specific amount and ability to select coins efficiently.

Dowrick (2004) investigated the desired learning outcomes for students at school leaving age who attended special schools. Groups of stakeholders (e.g., parents, teachers, principals, vocational and residential community representatives, and students) met several times to collectively identify important learning outcomes for students at their school. Stakeholders from three schools

participated. Students in School A had mild to moderate intellectual disabilities, in School B they had mild to severe intellectual disabilities, and in School C they had severe intellectual disabilities. The process included brainstorming ideas then ranking and voting on specific outcomes. This process elicited seven outcome areas: Communication; Community Living; Financial Management; Independent Living; Interpersonal skills; Literacy; and Personal Development. Schools A and B (but not School C) included four aspects of handling money that were indicators of financial management. These were, knowing the name of coins, recognising coins and notes, using small amounts of money, and, when tendering money, to be aware when change is needed. Additionally, School B included other indicators such as using an ATM, using a bankcard; and paying own bills, to name a few. School C identified 'handling money' as an important outcome but it was ranked the least important of the six highest ranked outcomes identified after a preliminary brainstorming of ideas. Overall, this study identified great variation in the types of outcomes about handling money that participants deemed important, and these seemed to vary depending on the severity of the disability. However, understanding the mathematics of money (e.g., tendering correct amounts of money and calculating change, etc) were considered desired outcomes by many stakeholders.

However, understanding the mathematics of money can be difficult for learners with ID. Faragher and Clarke (2014) reported that learners with Down syndrome experience difficulties with learning arithmetic. Also, Stith and Fishbein (1996) reported that American children (aged 10-18 years old) with Down syndrome and others with ID had difficulties recognising coins and counting the value of a set of different valued coins.

Faragher (2017a) argued that students with learning difficulties might benefit from a curriculum that focuses less on written calculations and using cash, and more on deeper concepts such as making financial decisions through realistic problems. She recommended that for people with Down syndrome, the focus should be on practical aspects such as paying bills, rather than technical aspects that are likely to change (e.g., the use of cheques, which have given way to online banking). Faragher (2017b) further argued that given the decrease in the use of cash in society and the availability of technology such as smart phones to do calculations, there is no need to devote "a great deal of curriculum time to fading skills and competencies such as tendering cash and calculating change" (Faragher, 2019, p. 210). She did qualify that understanding the concepts of mathematics (e.g., subtraction) was a "functional necessity" for people with Down syndrome but argued that "the ability to perform the operation is not" (Faragher, 2019, p. 215). Similarly, Meching et al. (2003) suggested that using a debit card is a feasible alternative for those who cannot count money or change. An American study by Henning and Johnston-Rodriguez (2018) endorsed five financial literacy curricula suitable for young adults with special needs. The analysis focused on five concepts: earning income, budgeting, saving, banking, and insuring. These were deemed important conceptual content for youth with disabilities. The authors claimed that "these five concepts all provide contexts for students to develop personal goals, engage in decision-making, participate in problem-solving, and take actions that will serve their best interests. They are crucial to transition planning as students prepare for adulthood" (p. 120). This study did not appear to feature content that included promoting skills around the mathematics of money.

Hordacre (2016) described addition and subtraction (and multiplication and division) as core competencies for financial literacy and argued, somewhat in contrast to Faragher (2017b), that a reliance on technology such as calculators or phones to calculate simple arithmetic "without underpinning it with 'common sense' may result in incorrect results being accepted. For example, if a calculator is used and an incorrect number is entered, the output can be significantly flawed. Without a basic understanding of maths this error can go unnoticed" (p. 15).

So, the debate about whether the use of technology by learners with ID to do basic arithmetic is ongoing and may be dependent on the level or type of disability. We acknowledge that some of these studies were written many years ago and the way in which we handle money today is rapidly changing. Still, given many school leavers with ID lack basic skills such as counting money, using money for a transaction or paying a bill (Cheak-Zamora, et al., 2017; Eagar, et. al., 2006), and that adults with ID have highlighted their desire to know more about handling money (Cheak-Zamora et al., 2017; McCausland et al., 2010), there is a need for programs that specifically address this need.

Financial literacy programs for adults with ID

Like people without disabilities, people with disabilities have a diverse range of financial literacy (Russell et al., 2017a) depending on their disability and the education they have received. Hence the need for programs that cater for the variety and complexity of needs of people with ID. However, few financial education programs are specifically designed for young people with ID.

Many financial literacy programs have been designed by providers including government, banks, community organisations, financial planners, and employers for people in the general population. For example, Financial First Steps (Westpac); Start Smart (Commonwealth Bank); You're the boss and Be the boss (Salvation Army) to name a few. However, we found some programs had been designed with the primary audience being young adults with an intellectual disability, to help them build independence around tasks such as handling money when shopping and paying bills. In Australia, for example there is, 1. Money Minded (ANZ/Brotherhood of St Lawrence); 2. Making Money Easy (Participate Australia); 3. Work Pay$: Everyday Money Skills (The Wyatt Trust / Bedford Group School) and 4. Money Matters (Cheltenham Community Centre). Some information on each program is provided below.

1. The Money Minded Program was designed for adults and young adults with and without ID. They reported that around 15% of participants had a disability (Russell et al., 2017b). Topic covered included:

- Know yourself
- Spend wisely
- Clarify your goal
- Create a budget
- Bank smart
- Avoid dangerous debt
- Watch out for credit cards
- Superannuation

A study was conducted to explore the financial impacts of disability and the role of financial education in supporting people to access disability services. The report (Russell et al., 2017b) included an analysis of financial literacy for those with autism, and reported on the ways in which they preferred to learn about finances. One example was through a user-friendly workbook or an app. One of the most common recommendations from the participants with autism and their carers was that financial education should be provided earlier to younger children.

2. Making Money Easy is a financial literacy course for people with mild to moderate intellectual disabilities. It is an online web-based program with ten modules structured in three levels. The levels are described as:

- Basic: Understanding how to count, how to do simple maths and how to identify and count money.
- Intermediate: Focuses on money calculations and shopping.
- Advanced: Focuses on how to budget for everyday life, how to use online shopping and to gain a better understanding of banking services.

3. The Wyatt Trust/Bedford group conducting the Work Pay$: Everyday Money Skills program received funding for a pilot and a literature review of the financial literacy education offered to young people (16–21-year-olds) with disabilities (Hordacre, 2017). An evaluation of the program found that participants were better able to (i) differentiate between needs and wants, (ii) know what to do if they received the wrong change or could not pay for a bill, (iii) compare prices, and (iv) know how to save money.

4. Money Matters is an adult education course to help those with mild ID to improve their numeracy skills with a particular focus on handling money. The course content includes budgeting and saving, making change and comparing prices.

These four Australian programs were generally suitable for school leavers or young adults with ID and only two of these (Money Matters and Making Money Easy) specifically focused on the mathematics of money (e.g., calculating money totals, calculating change). Neither of these programs were evaluated using an assessment involving the mathematics of money. The problem with programs designed for people with ID is the assumption that participants already have a basic knowledge and understanding of money, or that they develop this knowledge and understanding, which may or may not be the case.

APPENDIX II - Designing and Testing Pocket Money

The challenge in designing an assessment for learners with ID was to create one that was sensitive enough to register learning when learning may occur in small increments over time. While an assessment needs to include easy items and difficult items, to be a sensitive assessment, the bulk of items need to be evenly spaced along a continuum of difficulty ranging from one endpoint (easy) to the other endpoint (difficult). To satisfy a stringent sensitivity criterion, we devised a systematic way of creating items for Pocket Money that varied in terms of complexity. By specifically designing items to represent nuanced degrees of complexity, the objectives of the study were to both generate and explain variance in item difficulty. We then administered the assessment to secondary school-aged students with ID in specialist schools (N = 85) to test how well these objectives had been met. The steps taken to design and test the Pocket Money tool are outlined below, along with our findings.

To cover the concepts within the curriculum levels for Year levels 1 – 4 (outlined in Table 1), we planned that the assessment tool would include items relating to five types of money tasks, listed in order of predicted task complexity: recognising money; comparing amounts of money; counting and representing money; and, verifying simple change.

Table 1. Content descriptions from the Australian Mathematics Curriculum (version 8.4)

Level 1	Level 2	Level 3	Level 4
Recognise, describe and order Australian coins according to their value	Count and order small collections of Australian coins and notes according to their value	Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents	Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies

The ordering of task complexity reflects that each of the money tasks are largely dependent upon familiarity or mastery of the earlier ranked tasks: for instance the first two types of tasks are dependent in that recognition of money is required in order to be able to compare different amounts of money, while the last task type, verifying change, depends upon skills in counting, comparison, and understanding that similar amounts can be represented in different ways, and so on.

Degrees of complexity within money task types were first varied using different combinations of currency (see Table 2), enabling us to create items within nine distinct stages of complexity.

Table 2. Pocket Money item categories organised into five types and nine stages of complexity

Type of task and stage of complexity	Predicted order of complexity	Item No.	Number of items
1. Recognising Tasks			
1.1 Same denomination	1	1-5	5
2. Comparing Tasks			
2.1 Same denomination	2	6 - 7	2
2.2 Different denomination (single)	3	8 - 12	5
2.3 Different denominations (multiple)	4	13 - 17	5
3. Counting Tasks			
3.1 Counting - same denomination	5	18 - 22	5
3.2 Counting - different denominations	7	33 - 37	5
4. Representing Tasks			
4.1 Representing - same denomination	6	23 - 32	10
4.2 Representing - different denominations	8	38 - 49	12
5. Verifying Tasks (involving simple change)			
5.1: Different denominations	9	50 - 55	6

To further increase the variety of item complexity within each stage, items were created to include different combinations of currency: Level 1A included notes only; Level 1B included cents only; Level 2A included dollars only (including notes and coins); Level 2B included coins only (including cents and dollars); Level 3 included a mixture of notes and all coins; and, Level 4 included money expressed in decimal format (see Table 3). This strategy enabled us to create 55 items representing 36 levels of complexity (9 x 4 levels).

Table 3. Pocket Money item categories organised into five types and nine stages of complexity

Currency Combination	Predicted order of complexity	Item No.	Number of items
Level 1A: Notes only $5, $10, $20, $50, $100	1	1, 6, 8, 13, 18, 23-24, 33, 38-39, 50	11
Level 1B: Cents only 5c, 10c, 20c, 50c	1	2, 7, 9 ,14, 19, 25-26, 34, 40-41, 51	11
Level 2A: Dollars (coins and notes) $1, $2, $5, $10, $20, $50, $100	2	3, 10, 15, 20, 27-28, 37, 42-43, 52	10
Level 2B: Coins (cents and dollars) 5c, 10c, 20c, 50c, $1, $2	2	4, 11, 16, 21, 29-30, 35, 44-45, 53	10
Level 3: All 5c, 10c, 20c, 50c, $1, $2, $5, $10, $20, $50, $100	3	5, 12, 17, 22, 31-32, 36, 46-47, 54	10
Level 4: Decimal	4	48-49, 55	3

It was important to adopt a simple way of presenting items to increase the validity of the assessment; that is, to ensure items assessed mathematical knowledge relating to money and not extraneous factors like a person's ability to comprehend what the question was asking, or their ability to switch between different response formats, or to interpret stylised representations of money. We found the idea of pockets with money proved a useful metaphor, so a pocket icon was

used within a multiple-choice response format to display four of the five types of money tasks. Representing tasks required a different response mechanism and utilised an amount displayed on a cash register along with a variety of notes and/or coins for the participant to select from in order to represent the amount of money on the cash register prompt.

With our initial testing of the Pocket Money assessment tool using the online version, we investigated our predictions using data collected individually from 85 students in specialist secondary school settings, and correlated predicted item complexity with actual item difficulty. Actual item difficulty was calculated in terms of percentage incorrect (100 x number of incorrect answers ÷ number of participants). Spearman's rank-order correlation was used to measure the strength of association between item difficulty and item complexity organised according to (i) task type (5 levels), (ii) stage (9 levels), and (iii) stage and currency combination (36 levels). Findings revealed we had achieved our goal of sensitivity with predicted item complexity explaining 85% of variance in item difficulty (see Hopkins & O'Donovan, 2021).

We then made some adjustments to items, including adding 15 new items (bringing the total no. of items to 70) and worked with the app developers to be able to administer the assessment via a tablet. Developing the app-based assessment allows teachers to customise Pocket Money and securely access their students' results. The final testing of the Pocket Money assessment tool involved the app version and 26 students in a new specialist secondary school setting. Our focus here was to administer the assessment to classes of students (rather than individually) and, in doing so, test the clarity of how tasks were presented and explained. Numerous modifications were made to task instructions and new features were added, like the option to listen to the instructions being read.

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