Developing Assessments for Students with Intellectual Disability to Support Differentiation

Sarah Hopkins
Monash University

Richard O'Donovan
Monash University

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In this paper we describe the development of an online tool for assessing the foundational knowledge and competencies essential to understanding money and building financial literacy. We present findings from an initial study using the tool to (i) measure basic skills with money among secondary students with intellectual disability (N = 85) and (ii) test predictions regarding item difficulty. Item difficulty was explained using a system of 36 levels of complexity based on task type and variations in the number and combination of denominations presented. Implications of the results are discussed in terms of how sensitive assessments can inform practitioners about how they might adapt tasks to differentiate their teaching.

Keywords · financial literacy · money · disability · assessment · differentiation

Introduction

In preparing preservice teachers for inclusive classrooms we noticed how few educational assessments have been designed to match the full range of students' rates of learning, in particular, for students with intellectual disability. In this paper we explain the need for more assessments that reflect a quality we refer to as 'assessment sensitivity', to inform teachers about their practices regarding differentiation. We then outline the steps we took to design and test a sensitive tool for assessing the mathematical knowledge and skills required for making sense of money, an essential precursor to financial literacy.

Differentiated Teaching

Differentiated teaching (or differentiation) is defined here as a complex approach to teaching whereby teachers vary what they do within a classroom to respect differences in students' knowledge, skills, understanding, rates of learning, interests, and/or dispositions. We do not restrict the idea of differentiated teaching for students with intellectual disability to particular educational settings; rather, we expect that teachers need to vary their approach to respect student difference whether they teach in an inclusive classroom in a mainstream school or in a classroom located within a specialist school.

Our definition of differentiated teaching is compatible with most definitions used in the literature, but differs in three important ways that reflect some ongoing concerns with current practice (e.g., Anthony et al., 2019). First, we view the phrase 'to respect differences' rather than 'to address differences' as philosophically significant. Respecting differences places at the forefront the idea that differentiation is about supporting all students to reach their potential and is not about reducing differences, thus removing the potential misunderstanding that a teacher's job is to achieve equal outcomes amongst their students.

A second point of difference, which makes our definition incompatible with some others (e.g., Deunk et al., 2018), is that we specify differentiation as occurring within a classroom. In doing so, we rule out the practice of streaming or tracking (i.e., where students are organised into classrooms according to similar ability) as a differentiation strategy. In a sense this is an anti-differentiation strategy since it aims to limit the need for any differentiation, which of course is an impossible task as no two students are the same.

A third point of difference is with definitions that specify variations be made to match students' cognitive abilities (e.g., Roy et al., 2013). We recognise that differences in cognitive abilities may, or may not, well explain differences in educational outcomes given the many interacting factors that influence how differences in abilities are experienced (Broderick et al., 2005). Accordingly, our focus on educational outcomes is expressed in terms of differences in (i) knowledge (e.g., procedural and conceptual), (ii) skills (e.g., problem-solving and reasoning), and (iii) rates of learning. While there has been considerable discussion on student differences in terms of knowledge and skills, commonly referred to in the literature as differences in readiness (Prast et al., 2015), differences in rates of learning are often overlooked; yet, rate of learning is an essential consideration in assessment design. We explore the role of educational assessment in the next section.

Educational Assessment

Educational assessment can be viewed as a process of gathering student information (i.e., data) pertaining to educational outcomes and is closely associated with differentiation. Moon (2005) referred to a bidirectional relationship existing between assessment and differentiation, such that one informs the other and is mediated by a process of teacher decision-making. Roy et al. (2013) emphasised monitoring academic progress as a distinct component of differentiation. Tomlinson and Moon (2013) referred to assessment as "the compass for daily planning in a differentiated classroom" (p. 8). Given this close association between assessment and differentiation, it is imperative to explore what kind of assessments are most helpful for making decisions in relation to differentiation.

Before tackling this issue, however, it is important to clarify certain phrases common to assessment discussions. Newton (2007) argued that the language of assessment needs to be more precise and provided a framework for considering assessments at three different levels: the judgement level, the decision level, and the impact level. The judgement level involves considering the judgements to be communicated in terms of evidence of performance or educational attainment. These judgements sit on a continuum ranging from qualitative descriptions through to calculated summative scores. In between the two endpoints, the judgements expressed depend on combinations of description and summary. The decision level involves considering how the assessment is to be used, or the purpose of the judgement. And the impact level involves considering the intended results of making and applying judgements, or the outcomes of having the assessment system.

Newton (2007) highlighted the problem of using the terms 'summative assessment' and 'formative assessment' as if they were distinct types of assessment and convincingly argued why this distinction is spurious given each type is distinguished at a different level of analysis. 'Summative assessment' is often used to describe an assessment distinguished at the judgement level: that is, the purpose of a summative assessment is mistakenly thought of as expressing a summative judgment (calculation) without consideration of how the judgement is used. The complementary problem is that 'formative assessment' is often used to describe an assessment that is distinguished at the decision level: that is, formative assessment is commonly identified by its purpose (i.e., to inform teaching) without considering the nature of the judgement that is expressed.

We endorse Newton's (2007) line of reasoning and adopt three similar levels as a conceptual framework for framing discussion about assessments, but make a few adjustments to avoid some of the inevitable confusion around the terms formative and summative (see Figure 1). The judgement level of an assessment depicts the type of judgements made, which can range from descriptions to calculations. The decision level of an assessment depicts the purpose of the judgement, or the intended audience. At one end of the continuum, a purely formative purpose may be for a teacher wishing to monitor students' understanding of a concept to inform their teaching decisions; at the other end, a purely reporting purpose may be for an accrediting body to decide whether a person is qualified or not. Importantly, the same assessment, with the same type of judgements, can serve two or more purposes and thus inform decisions at any point along the decision level continuum. We have also modified the impact level to take into account the intended and unintended use of an assessment in terms of its capacity to improve teaching and learning (i.e., counter productive vs. beneficial).

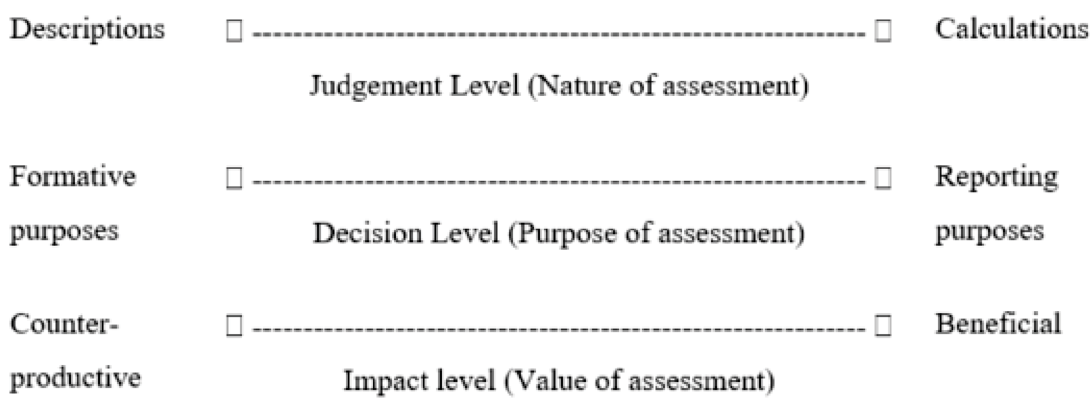


Figure 1. A conceptual framework for discussing assessment.

Drawing on this framework, we argue that an assessment designed for formative purposes will be most useful when it is sensitive enough to register changes that represent learning for the students it is used with, regardless of the nature of the types of judgements to be communicated (i.e., descriptions vs. calculations). It is the sensitivity of the judgement that is crucial, making it possible to monitor learning by administering it on two (or more) occasions separated by a 'reasonable' period of time. We canvass what may be considered reasonable spacing in the discussion section, but importantly, for assessments to have sufficient sensitivity – or in statistical terms, discriminatory power – they need to cater for students who exhibit different rates of learning. We illustrate this point in the following section where we describe the context and steps used in designing an assessment tool called Pocket Money that can be used to assess foundations in financial literacy for students with intellectual disability.

Developing a Financial Literacy Tool called Pocket Money

One of the educational impacts of the global financial crisis has been the appearance of financial programs in schools and communities in a bid to strengthen people's financial literacy (Appleyard & Rowlingson, 2013). Financial Literacy has been defined 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, 2012, p.13).

Various programs have emerged targeting different groups of people who are considered vulnerable or more likely to make poor financial choices. These programs include community-based initiatives (Russell et al., 2017), university-led programs (Hordacare, 2017; Prendergast et al., 2017), programs offered by disability service providers, as well as school-based programs (Henning & Rodriguez, 2018). The problem with many of these programs is the assumption that participants already have a basic knowledge and understanding of money, which may not be the case. Even though people with intellectual disability – and their parents and teachers – place a high priority on developing competencies associated with recognising and counting money, and managing a personal budget (Abbott & McConkey, 2006; Cheak-Zamora et al., 2017; Dowrick, 2004; McCausland et al., 2010), many of these students leave school before developing such competencies (Eagar, et a., 2006).

To help address this issue, we developed the Keep on Learning (KoL) Program in partnership with a disability-service provider, Wallara, to support young adults who had completed compulsory schooling and wanted to continue learning about money. The KoL program involves pre-service teachers working in pairs to tutor young adults (18 – 25 years old) at university, once a week for a 10-week term (Hopkins & O'Donovan, 2019). KoL students often return to complete more than one term of the program.

Table 1. Content descriptions from the Australian Mathematics Curriculum.

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 KoL Program was designed to cover four levels of money related content from the Australian Mathematics Curriculum (see Table 1). As program leaders, we looked for assessments that pre-service teachers could use to monitor the progress of KoL students, but we could not find any suitable assessments - none were sensitive enough to register learning within levels, as opposed to between levels. Most assessments were either too easy or too difficult. 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). This is part of the requirement for an assessment to produce data that conform to the Rasch model of measurement (Andrich & Marais, 2019). This need led us to develop an assessment tool called Pocket Money.

To satisfy this 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 in special schools 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.

Designing and Testing Pocket Money

To cover the concepts within the curriculum levels, we planned that the assessment tool would include items relating to five types of money tasks, listed in order of predicted task complexity: recognising currency; comparing amounts of money; counting and representing money; and, verifying simple change. This ordering 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 currency 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 then 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

Note: Australian currency includes $1 and $2 coins; it does not include 1c or 25c coins, nor $1 notes. Items of the Representing type are paired as they capture two ways of representing the same value (see Figure 2).

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 is asking, or their ability to switch between different response formats, or to interpret stylised representations of money. We decided to use electronic tablets to collect data and 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 (see Figure 2). 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 (see Figure 3).

In our initial testing of the Pocket Money assessment tool, we investigated our predictions by correlating predicted item complexity with actual item difficulty, where 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).

Figure 2. Three items from the Pocket Money tool illustrating how pockets of money were used as the basis of items. Participants selected their answer by tapping a pocket, which then became highlighted with a yellow fringe.

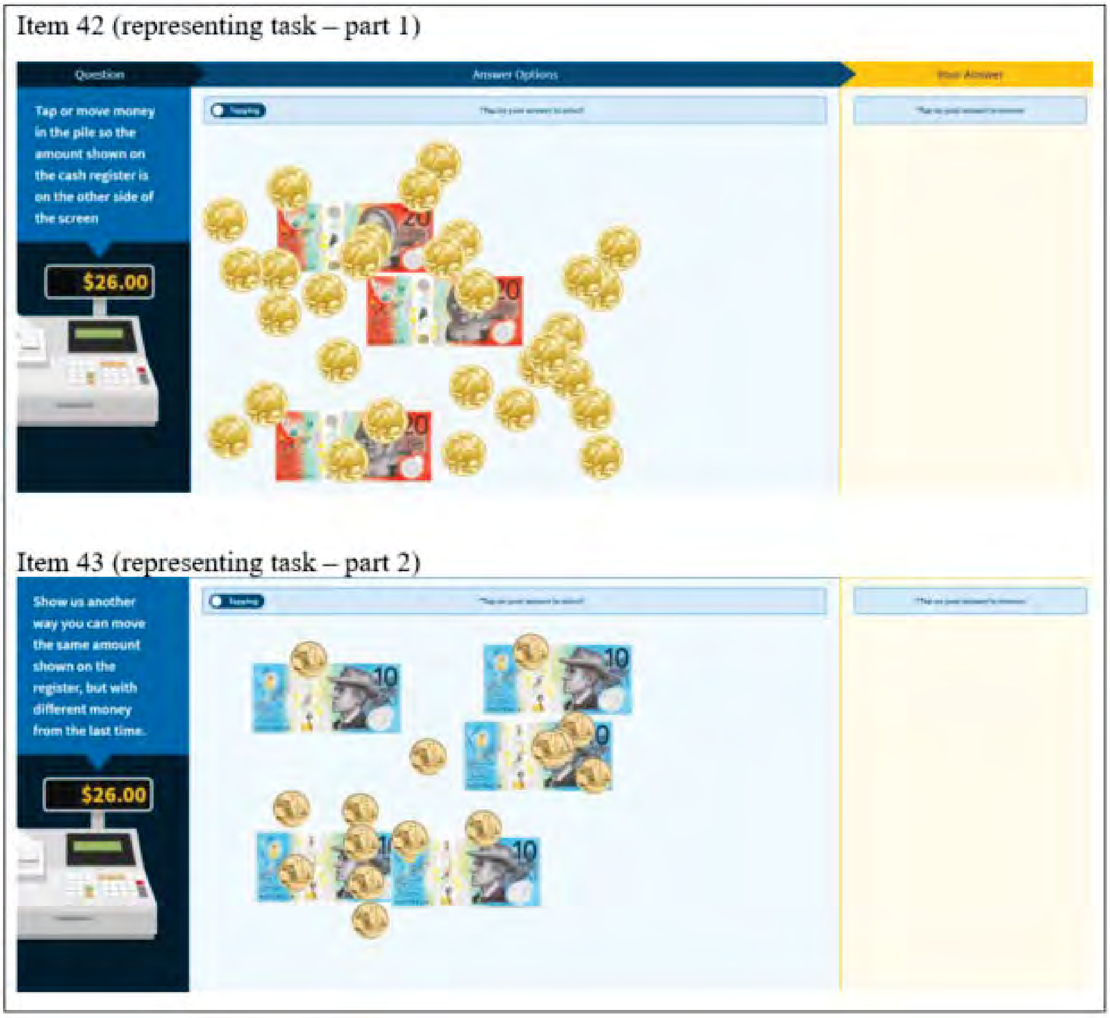


Figure 3. Two items from the Pocket Money tool illustrating representing tasks that are displayed using a cash register and money that can be dragged and dropped into the response panel on the right. Items are paired as students are asked to represent the same total in two different ways.

Participants

Participants (*N* = 85 students) were drawn from five specialist schools in the metropolitan area of an Australian capital city that catered for secondary students with intellectual disability. The sample included students from three schools that catered for students with mild intellectual disability (*n* = 60) and two schools that catered for students with mild to profound intellectual disability (*n* = 25). All participants were aged between 12 and 17 years, 29 were female (34.1%) and 56 were male (65.9%). Students and their parents were provided with a written explanatory statement and had returned a signed consent form to the researchers. The project was approved by the university ethics committee.

Procedure

The assessment was presented on a touch-screen tablet and was individually administered by a research assistant (RA) in a private room in the school, away from noise and distractions. The RA read each item aloud and students indicated their answer by touching the screen (the RA would assist if required, however, no participant required assistance). At the start, and at regular intervals throughout the assessment, participants were presented with a screen where they were asked 'Are you ready', whereupon they were required to touch a smiley face icon and tap a "Next" button if they were ready to proceed. The 55 items were presented in seven sets with planned breaks after Items 5, 17, 22, 32, 37, and 49 (see Table 2). Participants were encouraged to attempt all items in the set and to take as long as they liked on each item and between sets of items. The assessment was concluded if the participant indicated they didn't want to continue or if the RA noted a run of four or more incorrect answers. Each response was recorded in a database and subsequently scored 0 (incorrect) or 1 (correct).

Results

The percentage of participants who completed each of the seven sets respectively were as follows: 100.0%; 94.1%; 87.1%; 78.8%; 62.4%; 55.3%; and, 44.7%. Total scores ranged from 30.9% to 98.2%, with a mean of 78.0% (SD = 17.3). Item difficulty scores ranged from 5.9% (indicating 5.9% of participants answered the item incorrectly) to 83.5% (see Figure 4), with a mean item difficulty score of 46.3% (SD = 21.7). Overall there was a clear upward trend in item difficulty as the items progressed, with the first and last items being the easiest and hardest items respectively. Within each set of items there was also a fairly consistent upward trend in difficulty, except with the second set where item 11 was the most difficult item in the set.

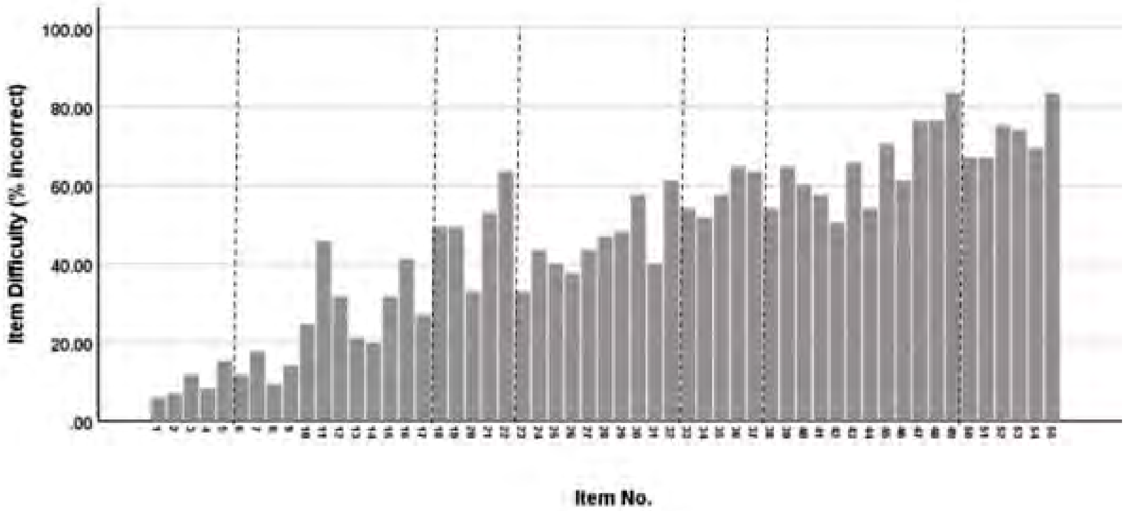


Figure 4. Item difficulty for each item on the Pocket Money assessment tool. Dotted vertical lines represent the break between each set of items.

Correlational analysis involved evaluating the strength of the association between item difficulty and item complexity represented by (i) task type (5 levels), (ii) stage (9 levels), and (iii) stage and currency combination (36 levels). A strong, positive association was found that was statistically significant for (i) difficulty and task type, with Spearman's ρ = .79, p < .001. Item complexity explained 62.4% of variance in item difficulty. A similarly strong, positive and significant association was present between item difficulty and stage, with Spearman's ρ = .90, p < .001. Here item complexity explained 81.0% of variance in item difficulty. The correlation between complexity represented by 36 levels and difficulty was strongest of all, with the complexity variable explaining 84.6% of variance in item difficulty (Spearman's ρ = .92, p < .001. Charts illustrating each of these analyses are shown in Figure 5 where it can be seen that the great majority of items fall within a narrow band, with only two items (Items 11 and 22 shown as asterisks in Step 3 of Figure 5) having proven more difficult than expected.

Discussion

The Pocket Money tool was designed to help pre-service teachers monitor the progress of individual students attending the KoL program. Our aim was to design a sensitive assessment with items ranging across a spectrum of nuanced complexity. Having devised a systematic way to vary item complexity by task, the number of denominations and the combination of denominations, we were able to develop 55 items which, based on the results above from an initial administration, appear to have achieved our goal of sensitivity with predicted item complexity explaining 85% of variance in item difficulty.

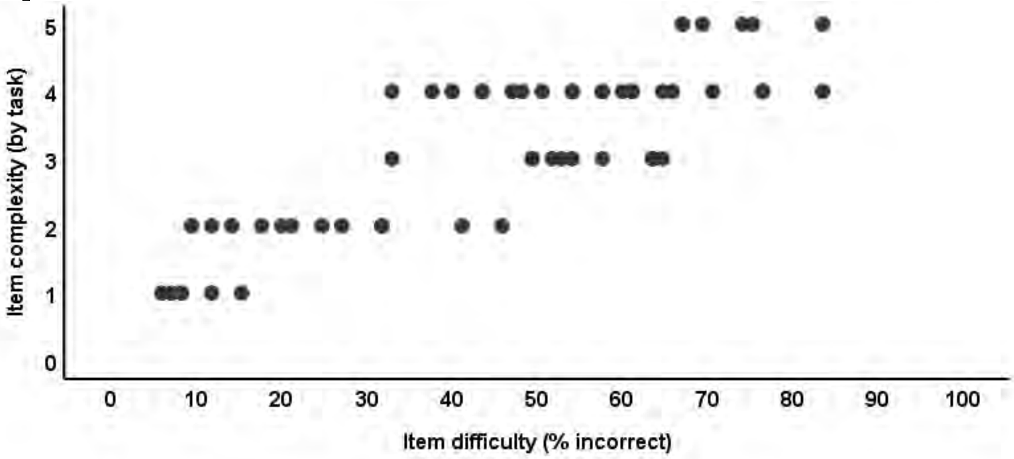
A limitation of the study was that we administered the assessment only once. To recruit a suitably large enough sample that could test our predictions, participants were drawn from a secondary school population and not from the KoL program. To fully investigate the sensitivity of the tool we will need participants to complete the assessment on at least two occasions - before, during, and/or after participation in the KoL program (or similar money program). Nevertheless, based on these findings we are optimistic about the utility of the tool in this regard.

In terms of the conceptual assessment framework outlined earlier, the Pocket Money tool would produce a set of almost purely calculative judgements, either in providing a total score as an overview of a person's money knowledge, skills, and understanding; or providing scores for subsets of items on the assessment. In this capacity it can be utilised for formative and reporting purposes. We discuss the possible impact of the tool (i.e., the value of the assessment in terms of improving teaching and learning) in the next section.

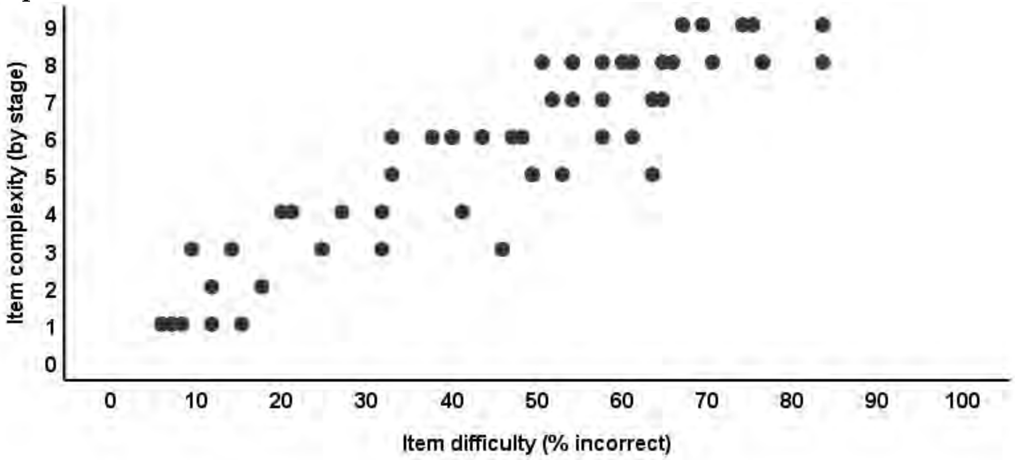
The Impact of Pocket Money

We expect the Pocket Money assessment tool will be helpful for informing and guiding teaching in the KoL program as well as for evaluating the program. Furthermore, pending further testing and refinement, the assessment tool will be made freely available to teachers and the public, as we envision it will have broad applicability for formative and reporting purposes in schools and among community groups, and possibly be used for other purposes. It could, for example, be used to ascertain how well school systems are preparing all students for life beyond compulsory schooling. It is noteworthy that the assessment of Financial Literacy administered by the Programme for International Student Assessment (PISA; OECD, 2014) has the baseline level of competency set too high for most KoL students to be assessed on. The exclusion of students with disability from large-scale assessment systems is often referred to in the literature, but mostly in relation to ensuring that suitable test accommodations be made, such as making changes to the setting, time permitted, scheduling, presentation, and mode of responding (Niebling & Elliot, 2005). However, we would like to see further debate on why large-scale assessments are made too difficult for some students to participate in at all, and to see large-scale assessments better adapted to respect all students' differences.

Step 1



Step 2



Step 3

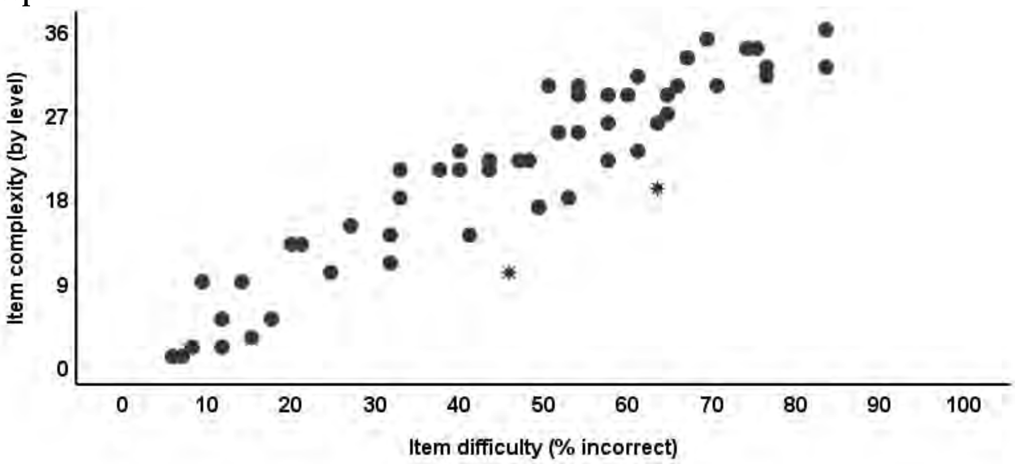


Figure 5. Steps taken in the correlational analysis between task complexity and item difficulty. Asterisks in Step 3 correspond to Items 11 and 22.

In considering the impact level of the assessment, it is also important to consider unintended uses of the assessment tool. At this stage of its development, Pocket Money is designed to be an assessment tool and not a teaching tool. There is an approach to assessing the growth of students' basic skills in reading and mathematics known as curriculum-based measurement (Burns, 2002; Deno, 2003; Fuchs et al., 1993). This approach originated in special education (Deno, 2003) and involves assessing students on a regular (e.g., weekly) basis to determine student growth and to visually display a student's progress. While it is beyond the scope of this paper to provide a review or critique of this approach, we contend that if Pocket Money is used this frequently, it becomes a teaching tool rather than an assessment tool, which is beyond its intended use.

One last point, in addition to considering the value of the assessment tool, we would like to draw attention to the value of the assessment findings. These findings revealed that variation in difficulty was achieved and explained using a specified set of levels. We believe this empirically supported way of generating item difficulty is valuable for guiding teachers in their efforts to vary and adapt learning tasks that respect student differences and elaborate this point in the final section below.

Supporting Differentiation

As predicted, the assessment findings indicate that recognising and comparing tasks were generally easier than counting and representing tasks, which were themselves easier than verifying-change tasks. Differentiating teaching by varying the types of money tasks students work on within a classroom is, perhaps, an obvious way teachers can vary their approach, but doing so limits opportunities for engaging students in whole-class mathematical discussions that can arise after students have worked on a shared task (Stein et al., 2008). An alternative approach is for teachers to instead create different degrees of difficulty within a common task all students engage with, but there is little research to empirically validate how this may be achieved. Our findings reveal that within money tasks, varying the number of denominations and/or their combinations within a task, are appropriate ways of varying task difficulty. This approach to adapting tasks is illustrated using two examples.

The first illustration comes from a 'challenging task' called Managing your Change (the original task is shown in Figure 6), which was created to encourage student persistence (Sullivan, 2018). This task is a non-routine task and an open task (with more than one possible answer), and depicts a realistic situation that also requires children to communicate their thinking. It is likely most suitable for children who can work on it without instruction from the teacher, either individually or in small groups, but who still find it of sufficient challenge to invest time and effort into addressing the problem. Sullivan et al. (2006) discussed the idea of 'enabling prompts' as guiding questions or simplified versions of a task that scaffold students to enable them to eventually engage with the main task. In a similar way this task could be adapted to respect the differences of less autonomous students by making small changes to some of the details in the problem statement that do not remove any of the quality features of the original task (see adapted task in Figure 6). Adapting tasks in this way, either as an enabling prompt or as an alternative task, increases the likelihood that students will be better able to learn from a whole-class discussion after engaging with the task.

The second illustration comes from our own work in designing a money game involving spinners that targets the curriculum relating to counting money (Hopkins & O'Donovan, 2019). This game is for two or more players and involves a spinner, notes and coins, and dice. Players take it in turns to make a spin and collect money from a 'bank', depending where they land on the spinner (see Figure 7). One of several dice types can be incorporated as a way to vary the number of coins or notes collected. For example, if the spinner lands on a one-dollar coin with a star, the selected die is rolled to determine how many one-dollar coins are collected. After a certain number of turns, each player counts how much money they have collected and the player with the most money wins. Findings from the Pocket Money assessment provide a clearer picture of how to vary the spinners to specifically create different, more sensitive, degrees of difficulty.

Figure 6. A challenging task involving money (from Sullivan, 2018) and an adapted version.

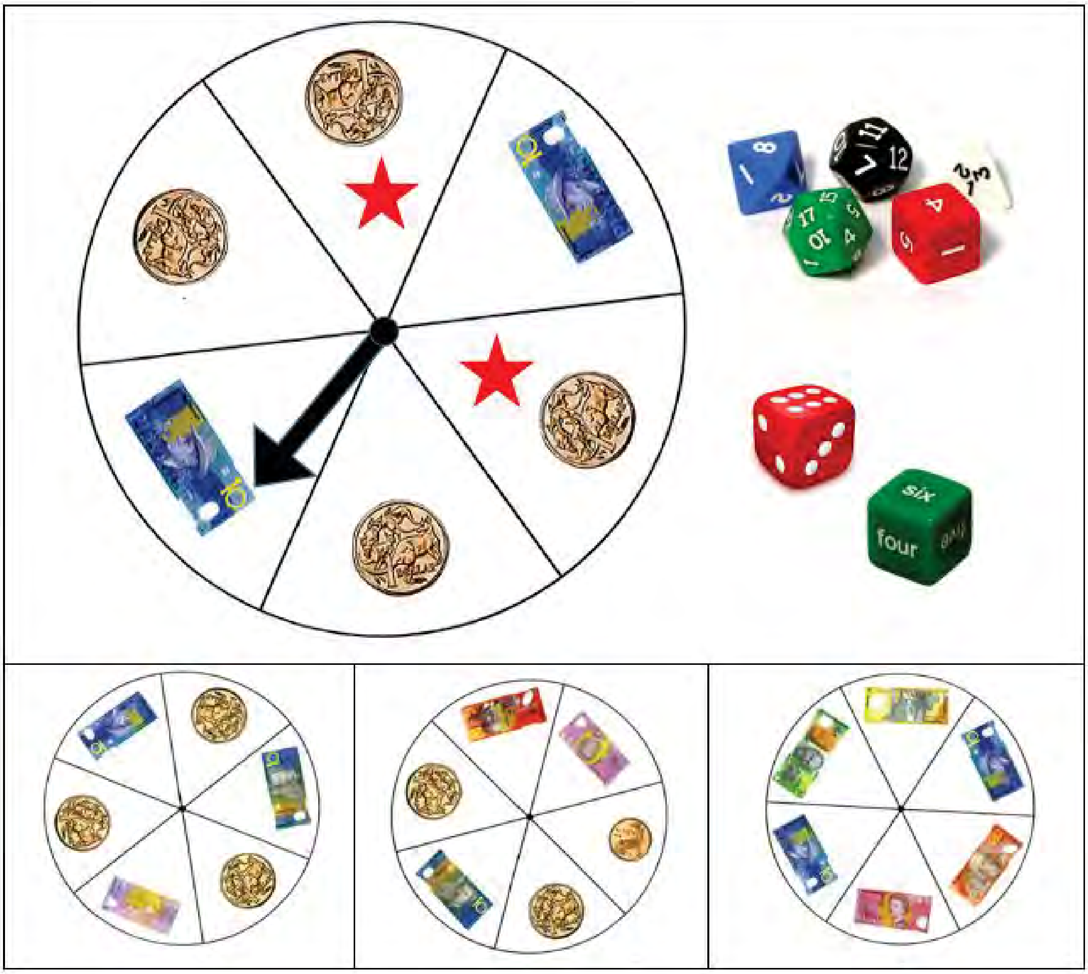


Figure 7. A money game involving a spinner and dice (from Hopkins & O'Donovan, 2019). Difficulty levels can be adjusted by varying the money shown on the spinner and by using different dice.

In closing, it is important to point out that the assessment findings should not be viewed as supporting the idea that students need to show mastery at one level before moving onto the next. We believe this is an outdated view of how people best learn, which has now been replaced with a more comprehensive and insightful view of teaching and learning. Assessments can have many purposes, but rarely are assessments valued for what they can tell us about what makes an item or task more difficult. We believe this line of research will provide valuable information for making differentiation easier for teachers and thereby maximise learning opportunities for all students.

Acknowledgements

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Authors

Sarah Hopkins
Monash University
Wellington Road, Clayton, Victoria 3800, Australia
email: s.hopkins@monash.edu

Richard O'Donovan
Monash University
Wellington Road, Clayton, Victoria 3800, Australia
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