

Design and use of an assessment to observe emergent numeracy skills in young children with additional needs

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Education and Training



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Intention of this presentation

- Introduce the ABLES/SWANs assessment program
- Explain the steps followed to develop a numeracy assessment for use with students with disability
- Give you time to plan for student learning using the numeracy progression
- Reflect on use of the progression to inform your planning

Introducing the ABLES/SWANs assessment program



Design principles for developmental assessment





Introducing SWANs/ABLES

- SWANs/ABLES is an online assessment program SWANs (Students with additional needs) and ABLES (Abilities Based Learning Education Support)
- It draws on teacher observation of student behaviour/skills in the classroom setting
- There are nine assessments aimed to describe foundational skills
- Assessments are appropriate for students regardless of age, year level or setting



The ABLES portal





Each assessment includes

SHOWING AN INTEREST

Q1. Responding to and greeting ot

A set of assessment items (written as observations) that assess every student

A list of teaching

strategies (matched

- Acknowledges others when they a current activity)
- Greets others or responds to another's greeting when prompted by a familiar adult
- Independently greets others
- Adjusts greeting formality to suit context and relationship with other
- Is moving towards but has not yet achieved these skills/behaviours

Social Processes

Level 5 : The student is learning to participate independently and cooperatively, and to negotiate most routine social situations without adult assistance.

- · Encourage your student's positive participation and perseverance in group activities. Acknowledge the student's contributions to the group and provide construct
- Provide opportunities for the student to observe and lear
- Provide opportunities for the student to try out and partic practise social skills in a wide range of contexts (e.g., vis sporting venues, work experience placement).
- to student level) Explicitly teach your student about responsibilities to a te magazines, online resources, and class discussions to explore and expand on topics related to team membership, collaboration, group cohesion, and responsibility.
- Explicitly teach the student to recognise and resist encouragement of misbehavior by others. Explicitly teach the student conflict resolution practices and coping strategies to deal with bullying or provocation.
- Set aside some time for a review of the day with your student. Teach the student to use visual cues and

Learning Readiness Report

Student name:	
Student code:	1234
Student class:	A
School code:	9999
Assessment:	Social Processes
Period:	Period 2 2016
Date:	8 September, 2016



Pathway

5. The student is learning to participate

adult assistance

A learning report (describing student level)

independently and cooperatively, and to negotiate most routine social situations without 4. The student is learning to use contextual cues to guide their behaviour and participation in familiar social environments.

3. The student is learning to independently participate in simple familiar and/or personally valued social activities

> 2. The student is learning to participate with the support of familiar adults who direct and regulate the student's involvement.

1. The student is learning to focus attention on others and acknowledge their presence.

The student is estimated to be at this location

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How is it suited to you in your context?

- The assessments describe approximately four learning levels prior to Foundation (e.g., A-D of Victorian Curriculum)
- Most assessments reach into Level 2 or 3 of the Victorian Curriculum
- The assessments were trialled with students with disabilities, and therefore are 'validated' for this population
- However, teachers sometimes choose to use the assessment for student who 'sit outside the expected range' for their age or grade

Explaining the steps followed to develop the numeracy ABLES assessment



The numeracy assessment aimed to measure student ability to "Use symbolic representation of quantity, shape and pattern to bring order to the world"

Using phenomena – applying rules and operations to bring order to the world

Describing phenomena by language and symbol to establish shared meaning of the world

Noticing phenomena – quantity, shape and pattern in the world



Documents that informed the instrument

Document	Relevant content
Australian Curriculum (Australian Curriculum and Assessment Authority, 2017)	Numeracy general capability Mathematics learning area
Victorian Curriculum (Victorian Curriculum and Assessment Authority, 2017)	Mathematics Level A-3
Mathematics Learning Pathways for Children from Birth to Five years (Department of Education and Early Childhood Development, 2014)	Individual skills described in developmental sequence Typically developing children from birth to five.
Learning Trajectories Approach and RMA Real Maths Building Blocks Curriculum Clements and Sarama (2009a, 2009b) & Clements and Sarama (2007)	Individual skills designed from empirical studies of typically developing children from birth to five years



Review the

curriculum

documents

literature and

Design and trial of the instrument

Steps proposed by Wolfe and Smith (2007a, 2007b)

1. Review the purpose of the measure and define the construct

 Draft a pool of items with subject matter experts

3. Panel/revise the items

Conduct workshops with teachers of numeracy to students disability to write items

Review of items by experienced assessment writers 4. Pilot the items with intended users

Review of

items by

intended

users

5. Trial items in schools

Trial of items in schools 6. Analyse data and calibrate to identify the learning progression

Use Rasch (1980) analysis to review the statistical properties and calibrate the measure



Writing and reviewing the pool of items

Research activity	No. of participants	Expertise of participants
Workshop 1 Define/review the construct of emergent numeracy	7	Developmental psychologists from the area of numeracy
Workshop 2 Review construct and define capabilities	17	Teachers experienced in numeracy instruction for students with disability
Workshop 3 Write performance criteria and hypothesise difficulty	16	Teachers experienced in numeracy instruction for students with disability
Panelling the items	7	Experienced assessment developers, psychometrician, numeracy expert, three doctoral researchers
Piloting the items in schools with intended users	16	Teachers of numeracy to students with disability in two schools

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An example item

	Assessment Research Centre Demo Mathematics 12341234 Exit	
INSTRUCT typical pe	TIONS: For each question, please choose ONLY ONE response. The response you choose should be the closest match to this student's erformance. If you feel the student performance falls between two levels, select the lower one. This will indicate that the student has achieved that level but has not reached the higher one.	
Q1.	. Counting using number words (e.g., one, two, three, four)	
Noticing	Attends to counting by another person (e.g., looks, listens, turns towards)	
Describing	Connects number words to up to three objects (e.g., says or signs numbers up to three whilst touching or looking at each object)	
Using	Counts to find the total when asked 'how many?' for four or more objects	
0	Is moving towards but has not yet achieved these skills/behaviours	
	01 02 03 04 05 06 07 08 09 010 011 012 013 014 015 016 017 018 019 020 021 022 023	



23 numeracy items

- Counting using number words
- Retaining the number of objects
- Recognising quantities
- Ordering numerals
- Dividing an object
- Diving a collection of objects
- Describing a change in quantity
- Adding items to a group
- Subtracting items from a group
- Skip counting
- Differentiating common 2D shapes
- Completing written number patterns

- Comparing length of common objects
- Comparing the size of common objects
- Sorting objects into categories
- Describing relative position
- Recognising and making patterns
- Using ordinal number
- Predicting outcome of events
- Interpreting representations of information
- Working with concepts of time/duration
- Identifying/naming Australian coins
- Working with place value



Schools that participated in the trial

Type of school	Number of schools
Special schools	15
Specialist schools	12
Special developmental schools	18
Mainstream schools	8
Schools for students with physical impairments	4
Schools for students with Autism Spectrum Disorder	5
Schools for students who are deaf or hard of hearing	1



Students that participated in the trial

1818 assessments, 63 schools		
Represented students	Special settings 96% Mainstream 4%	
Gender	70% male 30% female	
Autism spectrum disorder	49%	
Physical Disability	20%	
Vision impairment	8%	
Severe behavior disorder	7%	
Hearing impairment	5%	
Intellectual disability	72%	
Severe language disorder with critical educational needs	25%	



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Wright map and reliability statistics

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	X
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XXX |

Person separation reliability 0.99

Item separation reliability 1.0

Cronbach's Alpha coefficient 0.98

Item fit range 0.71 – 1.31

Planning learning for a student using the materials



Learning progression and Rocket report

Pathway of emergent numeracy development for students with additional needs 8. Learning to apply mathematical operations for precise manipulation of numbers

The student is starting to apply mathematical operations such as division, and to describe the outcomes using mathematical language such as 'half the group' or 'a quarter of a cup'. She may use skip counting in everyday activities and can explain its purpose. The student is beginning to create and/or explain patterns comprising different objects and may predict the probability of an outcome in a familiar situation. She is learning to work with large numbers, and may demonstrate understanding of place value by explaining the value of each numeral in four digit numbers. The student is starting to apply mathematical strategies, such as addition and subtraction to solve and explain number patterns, and use measuring tapes or rulers to accurately measure length and explain his or her findings.

7. Learning to extend and apply number concepts to order, compare, and measure events and objects

The student is beginning to demonstrate an understanding of how numbers can be applied to abstract concepts such as ordering and comparing events and objects. An understanding of order may be demonstrated by placing Australian money in relative order or by explaining a sequence of events using ordinal number. The student is learning the language of time and may refer to the duration of activities using units such as minutes, hours and days. S/he is developing the language to describe comparisons between various sized objects and make meaning from unfamiliar representations of multiple pieces of information, such as a timetable. In working with number, the student is beginning to demonstrate strategies (other than recount) to find the total when working with changes of quantity and is developing the skills to accurately record three digit numbers that are read or signed to him or her.

6. Learning to classify shapes and objects into groups and work with numbers up to 100

The student is learning to represent numbers to 100, which may be demonstrated by placing written or printed two-digit numbers in ascending order. S/he may skip count objects in twos, fives and tens. S/he may demonstrate an understanding of number conservation by explaining that the total number of objects does not change when their position is rearranged. The student is developing the language to communicate the placement of an object using terms such as left, right, top and bottom and can identify and describe familiar 2D shapes they see in their environment. S/he is beginning to think about groupings and may demonstrate this by applying rules (e.g., same shape or colour) to organise objects into various categories and explain their classifications. Students at this level are developing an understanding of measurement and this may by demonstrated by the use of informal measures to compare length. S/he is beginning to identify Australian notes and coins by their value name.

5. Learning to count up to 20 and back and building a vocabulary to describe simple numerical concepts

The student is learning to count forwards and backwards from 0 to 20. S/he is beginning to recognise patterns, developing an ability to extend an alternating pattern and identify the missing element in a simple number sequence. In working with quantity, the student is learning to split a collection of objects into subgroups when asked or following a demonstration and may use simple words to describe a change in quantity (e.g., smaller or bigger). The student is starting to use language to describe concepts such as chance and order. For example, the student may comment that an event might or might not occur or that events were ordered first, second and third. S/he is developing an understanding of the relative duration of events and may demonstrate this by communicating that one event took longer than another.

4. Learning to use number words to count and to identify differing magnitudes

The student is learning to consistently attach number words to objects to find the total of a group. She is developing the skills to order numerals from 0 to 10 and to indicate the total of a collection of 1 to 3 objects without counting (subitising). In working with quantity, the student is beginning to count in order to check the quantity of a group of concrete materials if objects have been added or subtracted. The student is starting to communicate his or her understanding of size or magnitude by comparing and indicating the larger of two objects and may demonstrate early concepts of division by splitting an object into parts when asked or following a demonstration. She is developing an understanding of directional terms, displayed by following instructions given by another to locate an object.

3. Learning the language of number, shape and relationships

The student is becoming aware of the language of numeracy, and beginning to respond to instructions such as being asked to take away or add an item to a group, to respond to the use of ordinal numbers, and to name familiar 2D shapes. She is working with manipulatives and may sort tokens, coins or counters into like groups as well as indicate the longer of two objects when asked. In working with number, the student is beginning to connect number words with up to three objects and to check the quantity of objects in a group if they are rearranged.

2. Responding to numeracy based activities

The student is learning to respond to numeracy-based activities, such as objects being added or taken away from a group. In working with quantity, the student may attend to an object or group of objects being divided into portions or groups and may react to the representation of up to three objects. The student is beginning to explore different sized objects with support and accept guidance to place numerals 1 to 5 in order. In working with manipulatives, the student is starting to match two like objects from a group of three and sort objects into groups based on an attribute such as acolour or size.

1. Reacting to the environment

The student is beginning to react to changes within the familiar environment, and events such as other people counting or the movement of an object. S/he may react to representations of familiar activities or objects or shapes presented by another person.





Example case study

Joshua

Joshua, who is 12 years old, attends a school for students who are deaf or hard of hearing. He has an intellectual disability, which has made it difficult for him to establish the foundations of literacy and numeracy skills. His teacher has assessed him as working at Level 2 on the Mathematics progression. His records show that Joshua recognises a representation of up to three objects and can place the numerals 1 to 5 in order with support and prompting. He watches, and sometimes comments, when an object or collection of objects is divided into parts, and adds an extra item to a collection when asked. He can point to different shapes (e.g., a circle or square) when they are shown to him in a classroom activity, and he enjoys exploring objects of different size and shape. He notices when objects have been moved, although he does not yet have the words to describe their position in relation to each other, and he responds to changes in the classroom such as a new person entering the room or a new activity being placed before him.

Participants are given one case study

It described the skills achieved by a student on the numeracy items, and their level, and disability

The student age was altered, and a name invented



ILP template to complete

Work in pairs to write an ILP



Reflecting on using the materials to plan for student learning

About you:

What is your current role (e.g., teacher, leadership, student etc.)

Have you used ABLES in a school before?

Have you used SWANs in a school before? _____

Drawing on your activities today:

Could you place the case study student into a level on the progression (the blue sheet)?

Why/why not?

How easy/difficult was it to complete the section on:

Long term goal: _____

Entry skills: _____

Outcome targets/short term goals: _____

How easy/difficult was it to write teaching strategies matched to this student and their needs?

Suggesting improvements:

What changes would you suggest to make this progression more useful? (e.g., presented differently, separated into strands, interactive report, linked to reports from multiple assessments etc.?

What additional materials would support you to target your teaching of the skills described in the progression?

Reflecting on using the materials for planning

Thank you! jane.strickland@unimelb.edu.au