

(NEW VOICES)

Planning, teaching and assessing mathematics learning for real!



LEONIE YOUNDALE

describes her experiences with teaching a small group of children the number sequence 11–20.

As a final year Bachelor of Education student at the University of Tasmania, I recently participated in an innovative program for improving mathematics learning outcomes for primary school students and the mathematics teaching development of pre-service teachers. As a participant in the program, I was required to plan, teach and assess a sequence of six mathematics lessons for a group of seven students at a local primary school. The planning was undertaken in collaboration with a fellow student and was approved by both the classroom teacher and university staff prior to the commencement of the lessons. We were allocated a group of Prep and Grade 1 students who required a focus on the number sequence 11–20.

This article describes the processes we undertook, observations made, and lessons learned as a result of this experience.

Beginning the program

Early in the semester, pre-service teachers were allocated to teams of approximately three people and each team was assigned a colleague teacher with whom to collaborate. The first meeting with the colleague teachers was held at the university and discussion occurred around the classroom context, the focus group of students, relevant behavioural and health

issues, students' family dynamics, and their learning needs. This meeting was followed by another at the school, where we met senior school staff and teachers. They shared their whole school goals and philosophy regarding mathematics teaching and learning, including their school mathematics curriculum. Of particular interest was their commitment to use standardised vocabulary for mathematics across the school. This strategy was aimed at reducing confusion and easing transitions from one grade to the next. During this meeting we arranged a time to meet the focus students in their classroom.

To begin the sequence we were required to plan and implement an assessment of the students' current understandings of the numbers 11–20. Collaborative planning led to the identification of the following learning outcomes:

1. Students will match the numbers 10–20 to a collection of the same number of objects.
2. Students will correctly represent the numbers 10–20 through written oral and visual forms.
3. Students will match the numbers 10–20 with appropriate dot arrays/numbers of objects.
4. Students will correctly count and order the numbers 10–20 both forward and backwards.
5. Students will recognise the relationship between 10 and the numbers 11–20.

The assessment of current knowledge was based on these learning outcomes and conducted with students individually. Observations were recorded on a checklist, along with anecdotal notes. Although time consuming, this approach resulted in rich data on which to base future planning and provided an opportunity for detailed observation.

The pre-teaching assessment revealed common difficulties with the following:

- representing the numbers (11–20) in text;
- making collections to represent a given number (11–20);
- drawing arrays (11–20).

Other observations included:

- some students exhibited competence in one-one correspondence;
- others forgot the size of the required collection and continued counting;
- when asked to count individually, many students skipped some numbers or said them out of sequence;
- all students could pronounce the numbers correctly;
- all but two students exhibited significant difficulty with recognising the words for the numbers 11–20.

After a review of the pre-teaching assessment data, it was determined that the planned learning outcomes remained appropriate for the target learners.

Developing the learning sequence

From these data, the learning sequence was developed. Constructivist theories informed our planning and this teaching experience provided a rich opportunity to observe the effectiveness of using such theories to inform planning and practice (Krause, Bochner & Duchesne, 2006). Lessons would typically involve significant focus on the use of concrete materials. They were also based around short sharp activities which suited the attention spans of our young learners and provided connections between the identified learning outcomes.

For example, Lesson 3 in the sequence saw students undertaking the following activities:

- counting set collections of counters out of containers and identifying the size of the collections;
- matching the cardinality of their collections with cards displaying the matching numeral;
- whole group and individual counting forward from identified numbers to twenty and backward to ten;
- positioning numeral cards matching the cardinality of their collections on a number line;
- representing the numerals matching the size of their collections in text first by

tracing dotted representations, and then by writing the number freehand.

At the end of the sequence, we re-administered the assessment conducted at the beginning (see Figures 1 and 2). The following observations are indicative of the types of observations made in relation to individual students (pseudonyms are used):

- Tom: Did not attempt the numeral recognition tasks on the pre-assessment task but was able to respond to all tasks during summative assessment; reversed 14, 18 and 13.
- John: Was not present for some of the lessons; summative assessment incomplete; randomly assigned numerals to dot arrays.
- Susan: showed vast improvement in summative testing; accurate 1–1 correspondence; all numerals were represented correctly except the 6 in 16 which was written backwards; self correction evident.
- Lucy: A lack of accuracy with 1–1 correspondence due to rushing the count and not using a systematic approach; reversals of 5 and 7; a good understanding of ordering forward and backward.
- Charlie: Reversing the numbers 6 and 2 and reversing the order of the digits in 19; marked improvement in ordering forward and backwards with all tasks completed successfully in the summative assessment.

Generally the summative assessment revealed that many of the participants were still exhibiting poor number recognition skills but had made progress in relation to some learning outcomes.

What we learned

Throughout the process we were required to journal about our learning journey and to use the thoughts expressed in this journal to make a claim about mathematics teaching and learning, based on our observations and experiences throughout the sequence. What stood out for me was the difficulty students

experienced with recognising numerals. The recognition of numerals 11, 12, 13, 15, and 20 proved to be a particularly complex obstacle. Perhaps this is not surprising, given that with these numerals it is difficult to distinguish which digit is in the unit position from listening to the number being said (you cannot hear the two in 12 or the three in 13, etc.). This in turn makes it difficult for students to make a connection between the final count of a collection of 11, 12, 13, 15 or 20 items and the numeral representing the size of the collection. Consequently, the numerals between 20 and 30 often pose less of a problem as you can *hear* the “-one” in 21, the “-two” in 22, and so on, all the way to 30. If students have learned the numbers 11–20 before learning 20–30, as is usually the case, they will be familiar with the “thir-” sound in 30 because they have heard it in “thirteen” and connect its oral and written forms (McIntosh, 2002). The Department of Education Tasmania (1992, p. 6) acknowledges the importance of these connections, stating that mathematical knowledge includes “developing a specific vocabulary so that mathematics can be communicated precisely and shared meanings can be developed”.

We also observed that students had difficulty using a pencil to create dot arrays to match numerals. They demonstrated difficulty using 1–1 correspondence to check their progress if the dot array was too small. This led to inaccuracies in their responses and therefore this strategy proved an invalid form of assessment.

Implications for teaching

There are a number of strategies that can be implemented in the classroom to assist students with number recognition. Haylock and Cockburn (2008), for example, recommend an activity whereby children count numbers attached to a number line by pointing to the numeral and saying its name

out loud. Helping students to develop this connection involves much repetition of the connection between the visual representation of the numeral and saying the number (Haylock & Cockburn, 2008). Van de Walle (2007) recommends the use of calculators to develop number recognition, where teachers identify a number, model entering that number into the calculator, and then show the students the display. Students can then be instructed to enter different numbers; first with instruction on which digit to enter first, and later, as competence develops, entering whole numbers as requested. Facilitating these repetitive activities in guided groups means that students can participate in them whilst being supported by a more capable other.

Initial familiarity with the basic vocabulary and sequencing of counting must be learned by rote. However, it is when identifying the cardinality of collections and matching this to numeral representations that richer meanings are constructed and flexibility in working with numbers begins to develop (Van de Walle, 2007).

Conclusions

Participating in this unit provided me with invaluable experience in a real classroom context: planning teaching and assessing targeted skills to meet the needs of specific learners. It has facilitated development of my teaching philosophy and as a result has led me to make several resolutions. Considering the apparent difficulty students demonstrate with recognising the numerals 11–20, in my future teaching practice I will use a variety of approaches to developing this understanding: my students will use concrete materials; I will employ matching strategies and use number lines and calculators as counting aids; these activities will be part of a regular routine to develop and consolidate learning and will not be done in isolation; I will focus my teaching on providing students with opportunities to make connections, and to communicate

their understandings and learning in social contexts. Finally, I am now acutely aware of the need to identify students' difficulties through valid assessment procedures. I hope that this article will enable other teachers to see the importance of insights that can be gained through working closely with a small group of students and carefully observing their progress.

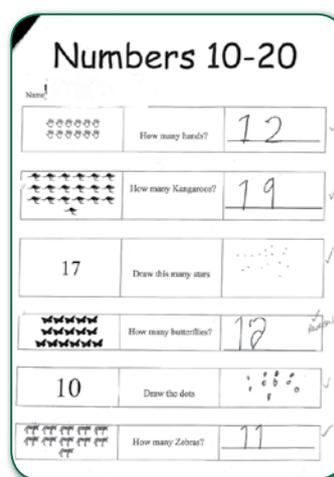


Figure 1. Sample assessment task.

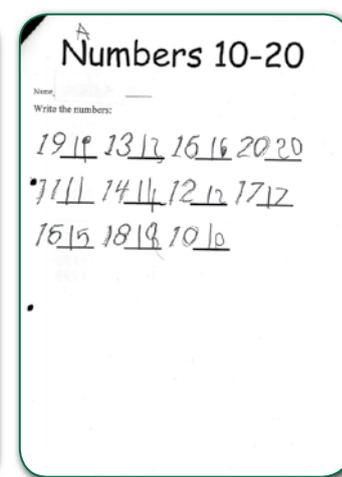


Figure 2. Sample assessment task.

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