Researching numeracy teaching approaches in primary schools

The RESEARCHING NUMERACY PROJECT TEAM reports on the Victorian project aimed at the identification of effective teaching approaches in numeracy. The project was conceptualised by the Victorian Department of Education and Training, the Catholic Education Commission and the Association of Independent Schools and was conducted in partnership with a research team from RMIT University.

The *Researching numeracy* project aimed to identify effective classroom teaching approaches in mathematics for students in the early years (Prep – Year 4) and the middle years (Years 5 and 6) in a range of Victorian schools. It also sought to determine the potential of these approaches for improving student outcomes.

The action research component of the project involved the research team working with teachers from sixteen research schools as they enacted their action plans and helped identify and describe a range of numeracy teaching approaches. A range of measures were used to explore the research questions, including a behind-the-screen process[1], which involved the structured observation of a group of teachers by their peers facilitated by members of the research team. To evaluate the effectiveness of the proposed numeracy teaching approaches, sample based, student interview data were collected at the beginning and end of the project from both the research schools and a matched set of reference schools.

1. An important and innovative component of the data collection was an adaptation of the one-way screen technique used in reading recovery training. This adaptation became known as the behind-the-screen process throughout the project.

Potential influence of the findings on classroom practice and students' numeracy outcomes

The research findings are likely to influence classroom practice and impact on students' numeracy outcomes in several ways.

- The identification and elaboration of a range of interaction patterns or scaffolding practices (described below) will help teachers make more informed decisions about how to address specific learning needs and promote and sustain mathematical thinking.
- Access to an emergent professional language will encourage and facilitate increased professional discussion, reflection and critical review of 'taken-for-granted'

teaching practices in mathematics — a first step in improving practice.

- Participation in a behind-the-screen process or similar opportunities for peer observation and review will develop and deepen teachers' understanding of their practice, and contribute to the ongoing development of a professional language.
- Recognition of the critical importance of teachers' pedagogical content knowledge will encourage professional learning teams to identify their learning needs and initiate action as appropriate (e.g., mentoring, team-teaching and/or targeted professional development).
- Recognition of the dynamic relationship between classroom cultures and scaffolding practices will encourage teachers and professional learning teams to examine the type of classroom cultures they establish and the nature and role of interaction in the construction of mathematical meaning.
- Recognition of the complexity of classroom organisation and structure will encourage teachers to select lesson structures and groups specific to purpose. That is, according to the nature of the task(s) and scaffolding practices chosen to meet specific learning needs.
- The demonstrated value of a whole school approach, supported by effective leadership and shared expectations will inform the work of professional learning teams and encourage then to engage with practice in a more open and critical way.

Scaffolding practices

A major outcome of this research is the identification, description and elaboration of twelve scaffolding practices that contribute to improved student learning outcomes in a range of Victorian primary school settings, including a special school. As a consequence of this work, the notion of numeracy teaching approaches was broadened to encompass the communicative acts teachers engage in as they support students in their mathematical learning.

The scaffolding practices can be selected and used appropriate to purpose, for example, to explore/make explicit what is known, challenge/extend students' mathematical thinking, demonstrate the use of a mathematical instrument, or to assist students to arrive at a key generalisation. In particular, they support teachers to make more informed decisions about how they will meet the learning needs of all students in the most appropriate way possible. The identification of these scaffolding practices provided teachers in the research project with a professional language to discuss teaching practices.

Excavating

drawing out, digging, uncovering what is known, making it transparent

Teacher systematically questions to find out what students know or to make the known explicit. Teacher explores children's understanding in a systematic way.

Modelling

demonstrating, directing, instructing, showing, telling, funnelling, naming, labelling, explaining

Teacher shows students what to do and/or how to do it. Teacher instructs, explains, demonstrates, tells, offers behaviour for imitation.

Collaborating

acting as an accomplice, co-learner/problem-solver, co-conspirator, negotiating

Teacher works interactively with students in-the-moment on a task to jointly achieve a solution. Teacher contributes ideas, tries things out, responds to suggestions of others, invites comments/opinions in what she/he is doing, accepts critique.

Guiding

cuing, prompting, hinting, navigating, shepherding, encouraging, nudging

Teacher observes, listens, monitors students as they work, asks questions designed to help them see connections, and/or articulate generalisations.

Convince me

seeking explanation, justification, evidence; proving

Teacher actively seeks evidence, encourages students to be more specific. Teacher may act as if he/she doesn't understand what students are saying, encourages students to explain, to provide/obtain data.

Noticing

highlighting, drawing attention to, valuing, pointing to

Teacher draws students attention to particular feature without telling students what to see/notice (i.e., by careful questioning, rephrasing or gestures), encourages students to question their sensory experience.

Focussing

coaching, tutoring, mentoring, flagging, redirecting, revoicing, filtering

Teacher focusses on a specific gap (i.e., a concept, skill or strategy) that students need to progress. Teacher maintains a joint collective focus and provides an opportunity for students to bridge the gap themselves.

Probing

clarifying, monitoring, checking

Teacher evaluates students understanding using a specific question/task designed to elicit a range of strategies, presses for clarification, identifies possible areas of need.

Orienting

setting the scene, contextualising, reminding, alerting, recalling
Teacher sets the scene, poses a problem, establishes a context, invokes relevant prior knowledge and experience, provides a rationale (not necessarily at the beginning of the lesson, but at the beginning of a new task/idea).

Reflecting/reviewing

sharing, reflecting, recounting, summarising, capturing, reinforcing, reflecting, rehearsing
Teacher orchestrates a recount of what was learnt, a sharing of ideas and strategies. This typically occurs during whole class share time at the end of a lesson where learning is made explicit, key strategies are articulated, valued and recorded.

Extending

challenging, spring boarding, linking, connecting
Teacher sets significant challenge, uses open-ended questions to explore extent of children's understanding, facilitate generalisations, provide a context for further learning.

Apprenticing

Inviting peer assistance, peer teaching, peer mentoring
Teacher provides opportunities for more learned peers to operate in a student-as-teacher capacity, endorses student/student interaction.

Further findings

Additional data from the action research component of the project indicate that deep pedagogical content knowledge and appropriate classroom cultures are needed to support effective scaffolding practices. In the context of this research, pedagogical content knowledge refers to knowing how to represent and formulate the subject so that it is comprehensible to others. In particular, it was evident that where teachers were aware of students' prior knowledge and experience and had a well developed understanding of relevant learning trajectories, they were more likely to choose and use appropriate mathematical learning activities. Where there was evidence of a mutually respectful learning environment in which the teacher and students were expected to formulate, share and justify their thinking, it was more likely that the mathematical potential of the activities would be realised and interactions would be more deeply focussed on the mathematics. Where these were in place, it was clear that scaffolding practices were likely to be used to greater effect and teachers were more likely to remain focussed and press for understanding.

Conclusion

Considered overall, the outcomes and findings of this project clearly suggest that access to a professional language in conjunction with opportunities for sustained, collective reflection on practice powerfully impact on teachers' knowledge base for teaching mathematics. While an important prompt for this was the requirement to plan for, implement and reflect on one's communicative practices, it was not until such reflections were shared, and scaffolding practices became the object of inquiry that teachers' knowledge was substantially shifted. While targeted professional development in key areas identified by the project can and will make a difference, ultimately, a change in how teachers see themselves and the nature of their work is required. It is suggested that teaching needs to be seen as a social, not individual practice, that shapes and is shaped by the culture in which it is embedded. As a consequence, attempts to improve teachers' knowledge will need to be multi-faceted, focussing as much on the knowledge and skills of individuals, as the culture of the community in which those knowledge and skills are exercised.

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