

PPELEM

Pupil Perceptions of Effective Learning Environments in Mathematics

*A simple way to learn about your children
and inform your teaching of mathematics*

In this article,

ANDREA McDONOUGH

**describes a teaching tool
that provides an opportunity
for learning about the
learners in a classroom.
Andrea's article illustrates
the vital links between
teaching, learning and
assessing that make up a
pedagogical relationship.**

How well do you know the individual children in your class? What do your children believe helps them to learn mathematics? How might their beliefs inform your teaching of mathematics?

As teachers strive to cater for all learners, strategies for gaining insights into the perspectives of individual students can be of value. One such strategy is a drawing and description procedure known as PPELEM (Pupil Perceptions of Effective Learning Environments in Mathematics) developed by the author to gain insights into children's beliefs about helping factors for learning mathematics.

Children are aware of their learning of mathematics and hold beliefs about helping and hindering factors (e.g. Franke & Carey, 1997; Herrington, 1990; McDonough, 1991, 2002; McDonough & Wallbridge, 1994). Although children's beliefs are a reality in the classroom and can impact upon participation and learning, they are not always apparent to teachers within day-to-day interactions. A focussed investigation of children's beliefs, such as through the use of PPELEM, can add to teacher knowledge of learner perspectives, can inform teaching, and can help children become more reflective about their learning.

PPELEM is a good starting point for exploring the beliefs of all or some individuals in a mathematics class, is non-threatening, and is generally simple for children to respond to. The procedure can be used on single or multiple occasions, such as at the beginning and end of the school year, and might be used in conjunction with other procedures (such as those developed by McDonough, 2002). PPELEM has been used successfully with children in Grades Prep to 8, can be used with the whole class, a focus group or an individual child, and is suitable for use by classroom teachers, trainee teachers and researchers.

How to use PPELEM

As stated above, PPELEM is a drawing and description procedure that gives children the opportunity to express beliefs about helping factors for learning mathematics and provides the teacher with insights that can inform teaching.

PPELEM involves individual reflection, the completion of a drawing, and then a written or oral description through questionnaire or interview.

The following procedure is recommended:

1. Ask the children to close their eyes and think of different times they have been learning maths, at school, at home or somewhere else.
2. Ask each child to choose one time when they felt they were learning maths well and to make a picture of it in their mind. Ask them to think about what they were doing, what they were learning, whether anyone else was present, and if so what they were doing, what they were using, if anything, and when this occurred.
3. Each child then completes a drawing (a quick sketch is adequate) of the chosen situation in which they were learning maths well, that they pictured in their mind.
4. To help the children focus on the task, you may have the following prompt written on the whiteboard or blackboard. For young children, the word 'situation' can be replaced with 'time and place'.

Think of a situation in which you are learning maths well. Draw it.

5. Once drawings are completed each child describes the situation (in writing such as when administered to a whole class, or orally when administered in an interview).
6. The drawing and description from each child are then considered as one expression of beliefs, or as one body of data.

In some Prep classes where children do not have a clear concept of 'maths', the activity starts with a discussion about when and how maths is used both in and out of the classroom, and therefore what maths might be. This discussion most meaningfully draws on the experiences of the children and their family members showing that people think mathematically and use and learn maths in the classroom and other situations.

To facilitate each child's description of the chosen situation, nine PPELEM questions are provided (see Figure 1). Some or all of these might be used. Written responses by younger children may need to be transcribed. The important point is that it is the children's perspectives that are recorded.

If choosing a limited number of questions, for either

written or oral response, the first and second questions are recommended. These are

1. In the situation you have chosen, what is most helping you to learn maths well and why?
2. What things could you not draw that are helping you to learn maths? How are they helping you?

The first question focuses on the key point of interest and the second gives the opportunity for children to identify helping factors they could not draw. It is recommended that the 'why' aspect of the first question is emphasised as it encourages the children to go beyond simple listing and reflect more on their learning. It also provides insights of greater depth. The full questionnaire (Figure 1) prompts further reflection and consequently has the potential to give additional insights. If desired, follow-up discussion with children in the whole class, small group or a one-to-one situation can occur.

The interview version of PPELEM is an alternative that is suitable for use with individual children. It might be conducted in either of two ways:

- i) have the child describe the drawing with the interviewer asking some or all questions from the questionnaire;
- ii) following completion of the drawing, ask the child to orally describe the situation he or she has chosen and, while listening to the child, the interviewer writes on cards the key words or phrases used.

Once the child's description is complete, check with the child that the cards do represent the situation, taking out words or phrases that do not, and adding words or phrases the child suggests. The child then identifies the most helpful factor, second most helpful and so on. As this ranking is done, probe further by asking questions such as why or how a factor is helpful for learning maths.

PPELEM: Pupil Perceptions of Effective Learning Environments in Mathematics

NameGrade
 DateMaleFemale

1. In the situation you have chosen, what is most helping you to learn maths well and why?
2. What things could you not draw which are helping you to learn maths? How are they helping you?
3. Where does the picture show you to be?
4. Who is in your picture?
5. What maths are you doing?
6. What maths are you learning?
7. What things are you using in your picture?
8. When have you experienced what you have drawn?
9. Add anything else you can to tell about the situation you have chosen.

Figure 1



Figure 2. Michael's PPELEM drawing.

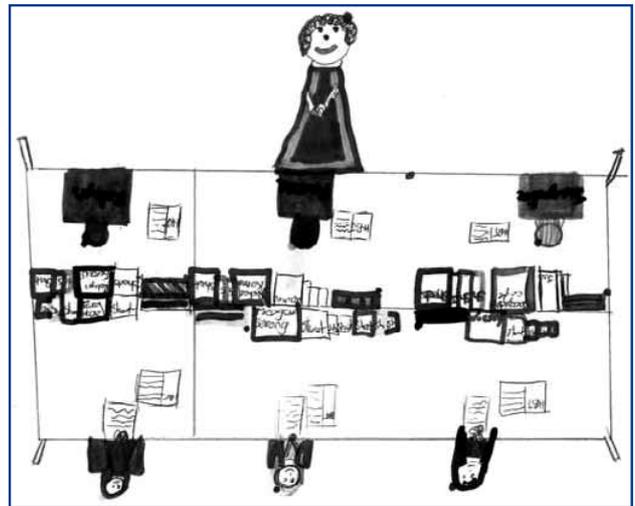


Figure 3. 'A situation in which I was learning maths well' — Samantha's drawing.

Following the collection of PPELEM responses, whether by interview or questionnaire, the teacher analyses the responses and reflects on how these might inform his or her mathematics teaching.

Analysis of PPELEM responses

In examining responses from individuals within a class, a teacher might take one or more foci such as

- children of special interest (such as students whose needs are not met well with the present approach);
- all students, for an overall perspective; or
- responses regarding a particular element of mathematics teaching — such as teacher help or the use of games (note that the 'teacher' might be a class teacher, parent, sibling or other).

As stated above, both a child's drawing and description are considered as one body of data. The importance of this is illustrated in Michael's response to PPELEM.

Michael's drawing (Figure 2) might be interpreted as suggesting that another child helped him in his learning of maths. However, in his oral description of the situation, Michael revealed that he drew John 'just because he sits next to me'. John was not perceived as helping Michael to learn maths well. If the drawing only had been considered, a different and inaccurate interpretation may have been made.

To illustrate the process of collecting and responding to PPELEM data, one child's response to PPELEM is provided and discussed below.

Illustrating PPELEM and its role in informing teaching

When asked to draw a picture of a situation in which she was learning maths well, Samantha, a Grade 5 child, drew a classroom situation showing children working individually from a commercially produced text book (Figure 3). She wrote that what most helped her to learn maths well was 'the book

because if I don't understand something it will sometimes give a demonstration [sic] and then I will understand'.

The teacher was surprised by Samantha's response: she stated that the text was 'hardly ever' used in her mathematics classes. The teacher felt that she could not totally change her teaching approach; that is, she would not necessarily make more use of textbooks. However, she appreciated coming to know Samantha's perception of what helped her to learn maths and thus reflected on the child's response and identified changes that could be trialled in the classroom. She experimented with strategies to meet Samantha's need for clear demonstrations and structure. For example, she thought about how she could provide more structure in her discussions with the children, and how she might be more explicit with the key mathematical ideas while still retaining openness in the tasks. She considered how she could involve and challenge the children, for example, by having them work with others to identify key ideas and strategies. She thought also about using the lesson reflection and lesson summary statement for identification of key ideas and strategies. The teacher wanted to retain some openness in the mathematics and have the children take responsibility for their learning but also recognised the need to provide some structure. In this way Samantha's response motivated the teacher to think about the balance in her teaching.

In summary, by using the PPELEM procedure the teacher explored Samantha's perspectives on her learning of maths, reflected upon the response by drawing on her experience as a teacher and her knowledge of children's learning and effective teaching, and took action as a result. Following the changes, this sequence of events could occur again resulting in an ongoing cycle of exploration, reflection, response, exploration, reflection, response, and so on.

Benefits of using PPELEM

PPELEM can inform teachers in regard to a range of aspects of mathematics teaching. The discussion considers benefits of using PPELEM, focusing mainly on the type and value of insights gained, and is structured according to themes that are illustrated with comments. These themes come from reflections by trainee teachers, but are reflected also in other uses of PPELEM such as in research studies (e.g. McDonough & Wallbridge, 1994).

In the second half of 2001, trainee teachers at Australian Catholic University, in their final year of primary teacher training, each used PPELEM with a class of students. The grade levels ranged from Prep to Year 8. In most cases the ACU trainee teachers were, a few weeks later, to teach math-

ematics to that class of students during a six-week practicum. The PPELEM task was used to help the trainee teachers learn about the individuals in the class, and plan for teaching mathematics to those children. Following the teaching experience, 170 of the ACU trainee teachers completed a questionnaire commenting on the value of the PPELEM procedure.

PPELEM provides insights into children as individuals

One feature of PPELEM that became apparent to the trainee teachers was its potential for gaining insights into children as individuals who bring their own perspectives to mathematics learning.

Each child had something different to say. I was able to ascertain each child's thoughts and could see where they were coming from.

It increased my awareness of individual needs and learning styles.

I found some children had more abstract ideas than I first thought.

Experienced teachers know that children are individuals who bring their own perspectives to the learning situation, but, without the use of a procedure such as PPELEM, may not have insights into the actual perspectives of the individuals in their class. Just as PPELEM gave the trainee teachers insights into individual children's thoughts and needs, it can also do this for experienced teachers who wish to know and cater better for all learners.

PPELEM informs planning and teaching

The majority of trainee teachers believed also that the PPELEM responses informed their planning. References were made to both general and specific ways in which this occurred:

It helped me realise that children need PRACTICAL maths that relates to their lives.

Games and discussion was the way I taught [during the six-week practicum] as that was how the majority learned and liked to learn.

Most students indicated that they learnt best with computers, so we did a measurement unit on Melbourne water using www.melbournewater.com.au.

The use of PPELEM encouraged the trainee teachers to reflect upon appropriate strategies and resources to use in teaching mathematics to the class for which they were responsible. PPELEM can do the same for experienced teachers.

There was a sense also that PPELEM could help in preparation for teaching a class with which one is not familiar, as expressed in the following comment:

It gave me a sense of direction on what and how to teach maths in the class — and what worked well and what did not.

In this way PPELEM can be useful also for experienced teachers when administered at the beginning of the school year.

There were also trainee teachers who realised, perceptively, that what was missing in children's responses to PPELEM also could inform their planning. For example,

The task showed me that the students had only a limited experience of what they see as learning maths. By talking to the students they told me that playing games is not maths — so consequently I introduced maths games with discussions.

The responses of students were basically the same, a teacher at the front of the class and students working individually at tables working with their maths book. This showed me that there was not much variation between maths lessons, and I needed to explore other teaching strategies.

As illustrated also in the teacher's reflection and action following Samantha's PPELEM drawing and description, as discussed above, teachers do not always implement the exact strategies children believe help them to learn mathematics well, but can take the children's needs into account in making plans for their teaching. PPELEM responses are considered in light of professional knowledge of effective teaching and learning of mathematics and thus inform teaching in the cycle of exploration, reflection and response as described above.

PPELEM provides insights into children's perceptions of where maths learning occurs

One aspect that was mentioned by a number of trainee teachers related to mathematical activity outside of school. For example, the following statements were made:

[PPELEM] showed the level of work done at home.

I found it particularly useful as a means of determining how well the children understand the use of mathematics as a real life skill, not just a subject.

These reflections touch on two different aspects related to mathematics occurring outside of school. The first suggests mathematics occurring in the home for a school related purpose and the second suggests mathematics for an everyday purpose. When examining PPELEM responses, classroom teachers might also note the presence of such.

Although PPELEM gives the opportunity for children to portray only one learning situation, it gives some insights into where children believe mathematics learning occurs, as well as who and what is perceived as helpful for their learning.

PPELEM provides feedback on teaching

PPELEM can provide feedback on teaching strategies and in this way is an assessment tool for teachers.

One trainee teacher commented that a teacher can gain 'self-satisfaction [when] students enjoy lessons and respond well'. The procedure might result also in teachers questioning their teaching. For example, in one Grade 5/6 class that participated in an earlier study (McDonough & Wallbridge, 1994), more than half the children chose a home situation as that in which they were learning maths well. These responses caused the teacher to reflect upon her mathematics teaching. A teacher in this situation might also take further steps to investigate in what way the teaching is and is not meeting the children's needs for learning mathematics.

Conclusion

This article has identified many benefits in using the PPELEM procedure. Within the discussion it is suggested that PPELEM:

- encourages children to reflect upon and become more aware of their learning of maths;
- provides an opportunity for children to express their beliefs in a non-threatening way;
- communicates to children that their teacher values their personal perspectives on learning maths and takes action as a result;
- is a useful tool for gaining insights into some affective aspects of learning mathematics; and
- provides teachers with a means to build up awareness of individual perspectives, to reflect upon insights gained, and to be better informed for catering for individual children in mathematics learning situations.

As described earlier, PPELEM can be administered through questionnaire or interview, is suitable for a range of grade levels and for individuals, groups, or whole class administration. It has been used successfully by teachers, trainee teachers and researchers. In some cases children have been asked also to complete the PPELEM procedure for a situation in which something is stopping them or making it hard for them to learn maths, giving further insights into children's perspectives on learning maths. It is possible also to adapt PPELEM for use in other curriculum areas.

Readers of this article are encouraged to try PPELEM for themselves! This might be with a small number of children or a whole class. PPELEM provides a wonderful opportunity for teachers to gain insights into beliefs about mathematics learning held by individual children. The author would love to receive feedback such as teacher comments, children's

responses and insights gained. Contact can be made with Andrea McDonough by email at

a.mcdonough@patrick.acu.edu.au

or by post at Australian Catholic University, 115 Victoria Parade, Fitzroy, Victoria, 3065.

Editors' note

In Victoria, 'Prep' refers to the first year of school.

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Andrea McDonough is a Senior Lecturer in Mathematics Education at the Australian Catholic University (St Patrick's Campus).

ADMC