Dialogue in mathematics
– is it important?

by Pamela Marino

Dialogue is a two-way process involving speaking and listening, a conversation between two or more persons (pupil/pupil or pupil/teacher). It can develop into discussion, the critical examination and exchange of ideas. The teacher can instigate dialogue by, for example, posing a question, outlining a task, setting a problem or introducing a new idea. Pupils can also instigate dialogue – from an observation, activity, problem, question or finding. Before pupils can undertake dialogue, however, they need a certain level of language, the means through which mathematics is communicated (Wilder, 1965; Skemp, 1971).

Mathematical Language and Vocabulary

Mathematical language is neither easy nor straightforward (Cockcroft, 1982; Gibbs and Orton in Orton and Wain, 1994). It contains words that can have more than one meaning depending on the context – such as ‘difference’, ‘more’ or ‘less’. It also contains words with a different meaning outside of mathematics – such as ‘billion’, ‘table’, ‘product’ or ‘scale’. Yet mathematical language remains fundamental to learning (Schools Council Curriculum Bulletin, 1972), central to the development of thinking (Cockcroft, 1982), an essential part in the formulation of concepts (Skemp, 1971). It is necessary for the expression of ideas (Child, 1973), developing through use and practice, which is why “from their earliest days at school children should be encouraged to discuss and explain the mathematics they are doing” (Cockcroft, 1982, p.90).

Preston (1978) suggests that some pupils’ fear of mathematics could be rooted in language. He points to the care and time given to teaching pupils to read in English, where a child is unlikely to be presented with books of a far greater reading age and expected to read, understand and incorporate that language into immediate use. In mathematics Preston argues, such attention is not necessarily given. For example, in examining eight mathematics textbooks, Preston found that addition was necessarily given. For example, in examining eight mathematics textbooks, Preston found that addition was presented in eighteen different ways throughout the eight. One textbook alone used fourteen of the eighteen ways.

Pupils require a range of vocabulary so as to talk about the mathematics they are doing and progress in mathematical understanding (Skemp, 1971; Schools Curriculum Council, 1972; Cockcroft, 1982; DES, 1989). The National Numeracy Strategy addresses this in its publication ‘Mathematical Vocabulary’ (DfEE, 1999), where it outlines a list of necessary words and phrases for each year group. The skill of understanding (Skemp, 1971; Schools Curriculum Council, 1994). The Hay McBer Report (2000) defines effective teachers as those who “ask a lot of questions and involve pupils in classroom discussion” (p.11). They use “a variety of questioning techniques to probe pupils’ knowledge and understanding” (p.7), monitoring and challenging thinking with pupils actively involved.

Cobb et al. (1993) observed increased learning and greater achievement where pupils were stimulated and motivated by a mathematical ethos stemming from pupil/pupil and pupil/teacher interaction and discussion. The pupil's own conceptualization of a problem can extend by having to explain to a partner why his/her answer is wrong (Yackel et al., 1991). It is also possible that connections could be made during the discussion between different aspects of mathematics, thereby increasing understanding (Askew et al., 1997). Discussion can also help develop logical reasoning (Gibbs and Orton in Orton and Wain, 1994). Gibbs and Orton cite evidence from Paley (in Cadzen, 1988) in support. Paley observed two pupils in discussion spark ideas off each other, resulting in greater clarification and consolidation of ideas.

Paley also noted the positive effect of praise and encouragement between the two. Research has shown that a positive attitude is important – it can help develop greater confidence, which is self-perpetuating and can lead to increased effort and achievement (Bell et al., 1983; Buxton, 1981; Marino, 1998). This in turn can result in greater perseverance in the face of difficulty (Askew and Wiliam, 1995).
The Benefits of Dialogue

Dialogue allows the teacher:

- To guide pupils along particular routes, drawing attention to certain points, links, problems or errors.
- To match the level of difficulty to individual pupils.
- To assess the understanding of each pupil, highlighting gaps or problem areas.
- To assess the use and development of each pupil’s vocabulary – the range, accuracy, consistency and confidence with which it is used.
- To create opportunities to use new language.

With regard to the pupil, dialogue helps formulate thought, enabling pupils to think out the ideas contained in the activities they undertake, where “different points of view offer considerable opportunities for exploring and increasing the depth of understanding of all members of the class” (Cockcroft, 1982, p.84). Dialogue can help:

- Consolidate and clarify ideas.
- Put an activity into context – reporting on what they did, how they did it, what they predicted might happen and what actually did happen.
- Develop new knowledge by explaining to each other and sharing ideas.
- Expose different strategies and approaches, identifying the most efficient method or unusual patterns, and in so doing possibly make links between different aspects.

Generating Dialogue

The National Curriculum (DES, 1989) stressed the need for activities that balance the different modes of learning – observing, talking, listening and discussing, as well as doing. The strategy offers opportunities for such discussion to take place, such as within the plenary part of the daily mathematics lesson. Interestingly, whilst the oral and mental starter was quickly established as the most effective part of the daily mathematics lesson the plenary remains the weakest (OFSTED, 2000, 2000a, 2002). According to HMI this stems from “a lack of questioning to reinforce the main teaching points or assess pupils’ understanding” (OFSTED, 2002, p.10), where too many teachers “rarely go beyond just asking pupils what they have learned” (OFSTED, 2000a, p.10). Weaknesses can be found early on at the planning stage, “particularly where teachers do not identify clearly the enough the questions they intend to ask to assess pupils’ understanding” (OFSTED, 2002, p.10).

The best plenary sessions were characterized by teaching that “engaged the pupils in discussion, identifying and rectifying any misunderstanding and errors noted during earlier parts of the lesson; reinforced what had been learned, providing additional examples, consolidating the vocabulary and notation pupils had met, setting short tasks that drew on the pupils’ knowledge, and encouraging pupils to describe and explain how they had tackled a particular case” (OFSTED, 2000a, p.15). Certain elements can help develop more effective discussion. For example:

- **Pre-planning:** Although dialogue can occur spontaneously, OFSTED (2000a) noted that the better plenary sessions were clearly and carefully pre-planned. The teacher was clear about what exactly was to be achieved and what questions needed to be asked in order to assess pupil understanding.

  **Timing:** OFSTED (2000a) observed some difficulty in judging the appropriate amount of time given to discussion in the plenary – too short and the discussion remains superficial, with insufficient time to develop; too long and time is wasted, discussion meanders, pupils can lose interest and become bored.

- **Stimuli:** The most successful discussion in the plenary was initiated through a stimulus. Possible stimuli might include:
  - Posing a question from a prepared list of questions – OFSTED (2000a) found general questions such as “what have we learned today” to be less effective in generating discussion than specific questions.
  - Undertaking a short activity linked to the main teaching activity – forcing pupils to draw upon and use the knowledge they have just learned, a reinforcement, which allows the teacher to assess learning and identify problems or misunderstandings.
  - Reporting on an observation or finding – clarifying the process through verbalization, using in context the vocabulary learned, allowing pupils to describe, compare and contrast their methods and routes to identify the most effective.
  - Raising a problem identified earlier in the lesson.

Preparing a stimulus, such as offering a list of questions or identifying a particularly interesting point, can help where pupils have difficulty getting started quickly. It can also help keep the discussion alive and on target.

**A variety of questioning techniques:** Research has shown that effective teachers adopt “a sophisticated questioning approach – ranging from asking many brief questions on main and supplementary points to multiple questioning of individuals to provide greater understanding and challenge” (Hay McBer, 2000, p.11). The NNS publication ‘Mathematical Vocabulary’ (DfEE, 1999) contains a useful section on questioning, different types of questions and examples of good dialogue.

**Grouping for discussion:** Gibbs and Orton (in Orton and Wain, 1994) emphasize the importance of good social interaction between members, a point supported by Webb (1991) who notes that certain pupil combinations work better than others. Webb (quoted in Orton and Wain, 1994) further suggests that ability can impact on the success of the dialogue and recommends grouping pupils of close ability levels (medium and low, or medium and high abilities) but avoiding a wide spread (high and low).

**Possible problem areas:** Yackel et al. (1991) propose setting up class rules before starting as a way of eliminating possible problems. For example, establishing that discussion is a two-way process involving listening as well as speaking could avoid the situation where some dominate the discussion to the exclusion of others. Where one member is not participating, Webb (1991) suggests giving a particular role – such as scribe, question poser or reporter – to encourage greater participation.
In Conclusion

Dialogue is an essential element in the effective teaching and learning of mathematics. It helps formulate thought, consolidating and clarifying ideas. It enables pupils to think out the ideas contained in the activities they undertake, placing those activities in context. It also exposes pupils to a variety of strategies and approaches. “different points of view offer considerable opportunities for exploring and increasing the depth of understanding of all members of the class” (Cockcroft, 1982, p.84). Effective teachers adopt a variety of questioning techniques, addressing particular questions to reinforce and consolidate what has been learnt, challenging the more able and encouraging the less able. Dialogue also allows the teacher to assess understanding, highlighting any misunderstandings or errors. As such, dialogue plays an important part in both the teaching and learning of mathematics.

References


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