

CHILDREN TALKING ABOUT CHILDREN'S MATHEMATICS

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When children report on other children's mathematics activities we can get insight into two things: the reporting children's thought processes and the activities of the children being reported on. In this article I discuss some of the benefits and technicalities of this procedure in the context of young children watching video tapes of other young children engaged in mathematics activities.

INTRODUCTION

This paper is about a particular methodology that I have found useful in probing children's mathematical procedures and understanding. It starts from the premise - essentially metacognitive in nature - that through the medium of video records of children involved in mathematical processes, these and other children can reflect on the nature of the children's mathematical thought processes.

I used this technique, with Anne Pitkethly, in a study of cognitive aspects of sharing, Davis and Pitkethly (in press), to probe children's awareness of logical aspects of sharing procedures. In that study we had edited video records of preschool children (4 to 5 years of age) engaged in various sharing activities, and we showed these edited segments to grade 2 children (8 years of age) in small groups in an interview situation.

In this article I discuss some of the advantages and limitations of this method for probing children's understanding and thought processes, and I consider its application not only as a research tool but as a probe for classroom teachers and as a pedagogical aid.

THE METHOD

The basis of this method is children watching and reporting on video records of children engaged in mathematical activities. The children in the video records may or may not be the same as those doing the reporting. For the purposes of research and analysis, and also to provide further video records of children's mathematical thought processes, the children involved in the reporting are themselves video taped.

I discuss below various steps and procedures that can facilitate or hinder the use of this method in practice.

(1) Scripting.

In the study, Davis and Pitkethly (in press), referred to above, both the original preschool interviews that provided the base video record, and the interviews with the children observing and reporting on these video records, were tightly scripted. The scripting was developed from an analysis of likely outcomes and was modified after an initial trial. In that particular study the script was very useful to the interviewer in that it kept the discussion close to the logical aspects of sharing, which was the original purpose of the study.

The development of a suitable script may take some time and may evolve in interactions with the children. This was the case for a script used with preschool children which evolved from previous studies of Hunting and Sharpley (1988) a), b). A script may or may not be adhered to strictly. An advantage of strict adherence to a script is that every child in each interview situation hears the same questions and so has the opportunity to respond in an environment that is nearly the same for every child.

A clear disadvantage of strict adherence to a script is precisely that different children do respond differently and often their responses open up possible new questions which an alert and sensitive interviewer can use to advantage. Sometimes, too, children need a starter question or series of such questions, and this cannot easily be scripted for since it depends heavily on the environment that is created by the interaction between the interviewer, the child or children being interviewed, and the novelty of the situation for the children.

In a more free flowing situation where departures from a script occur regularly the script acts as a focus for the purpose of the interviews and assists in keeping the discussion to the point.

It is my feeling, strengthened by experience and observations of others using this technique, that the absence of a planned script can easily lead to a disastrous interview in which the children essentially do not participate. It may not be essential to adhere to a script closely at all but it does appear to be necessary to have carefully planned, trialled, and written a script even if it is used only as a backup. The process of mental clarification for the researcher in writing a script and trialling it seems to be a necessary precondition to obtaining sensible and useful data.

(2) Engaging the children.

If the children in the interview situation - whether or not it is highly structured - do not engage with the interviewer and the questions put to them, then little can be expected as a result. An interview situation may be new to the children and the interviewer relatively or completely unknown to them. Coupled with this is the fact - all too obvious to the children - that they themselves are being video taped. This can and often does add up to a highly novel situation with many distracting and inhibiting features.

The remedies to potential non-engagement of the children are fairly straightforward but involve two features that the researcher needs to keep in mind.

The obvious remedies are to make the unfamiliar familiar - to spend time participating with the prospective interviewees in normal classroom activities prior to commencing the interviews, to get the children to assist in setting up video equipment, to spend time showing them their own images on the video monitor, and to spend time explaining the purpose of the video equipment and the interviews. All of this boils down to the children seeing the researcher and interviewer as human people with certain concerns in which the children will participate.

The first feature of the familiarisation process to bear in mind is that it takes time. If the principal researchers themselves are to be involved in the actual interviews, or even to be present when they are conducted, then they must participate in the familiarisation process and not simply leave it to a capable research assistant.

The second feature is of a more theoretical nature, but it is one the researcher should bear in mind when reporting on the results of a study conducted by this method. It is that by the very nature of the familiarisation process the researcher is not a distant observer, simply watching and recording natural phenomena, but is actually part of the very phenomena to be observed. The questions that this raise have been dealt with in a social constructivist setting by Gergen (1985) and I refer the reader to that paper, and also to Weinberg and Gavalek (1987), for a lucid discussion of the appropriate point of view for this type of research.

A final point to mention in connection with the children's engagement with the questions is that an interview can be tiring for very young children, and considerable attention needs to be paid to the time that will be required to complete any one interview. It seems that only a trial run can adequately determine this.

(3) Group size and dynamics.

In an interview situation the size of the group to participate in any one interview can be critical. Often the interviews will be conducted in the classroom or in a small storage or work room of a school. My own experience is that the optimum size of the interview groups is one of the factors that can only be determined by a trial run.

Group dynamics play an important role in interviews. In small group interviews it is normally the classroom teacher who will choose the children to form any one group. However it is important to consider carefully the criteria for selection for the interviews and to explain these to the classroom teacher, and also to consider the possible advantages of preliminary interviews with the children to assist in selection for the interviews proper.

It is important, I believe, to report back to the teacher after each interview and give a short report on the adequacy of response or otherwise from the children in a particular group: if the classroom teacher knows what the researcher is looking for they can usually be of considerable help. This is not to say that the research results are defined from the beginning: only that some parameters need to be set, and without this tuning the result will be no more than a naturalistic observation.

(4) Classroom training.

It is a fact of life that each teacher encourages their own protocol and code of behaviour in a classroom. This is a factor that can have a determining effect on the interviews.

The most obvious procedural matter to attend to before the interviews is to determine whether the children are normally free to speak spontaneously or whether they are usually allowed to speak only if they raise their hand. If it is the latter and the researcher hopes for a fairly free flowing interview with spontaneous comment from the children then disappointment is likely to ensue.

There are other aspects of normal classroom procedure that appear to be difficult to foresee but which can have a devastating effect on the study in question. An example is the interviews (Hunting and Davis, 1988) that provided the base video record for Davis and Pitkethly (in press). In these interviews there was a component of spontaneous sharing, and it puzzled us that several preschool children grabbed handfuls of jelly babies and said to the other children in their group: "What you get is what you get!" In later discussion with the preschool director we discovered that she regularly played a game of throwing jelly babies at random and encouraged children to help themselves while she said "What you get is what you get". In the interviews reported in Davis and Pitkethly (in press) it was asked at one point if the children thought it was a good idea to look at what other children did. Their unanimous negative answers prompted us to discuss this matter with the classroom teacher who told us that she regularly instructed the children to work things out for themselves and then ask the teacher for help if they were stuck, but not to take notice of what other children did or said.

These unforeseen classroom practices can be confounding variables, and at first sight there seems to be little one can do to eliminate them. In the cases mentioned above the matter could possibly have been resolved beforehand by going through the script carefully with the preschool director or teacher and asking for any regular practices that might provide clear biases to the children's responses.

(5) Video technicalities.

There are various procedural matters that make for good practice in the use of video and naturally these need to be attended to. What is peculiar to the school or classroom however are the needs for as little intrusion as possible, for as good a sound quality as is possible in the likely context of considerable background noise, and for adequate lighting in a room that normally will be poorly lit for video purposes. This really adds up to very portable equipment such as an all in one video recorder and playback machine, adequate sound facilities such as a plate microphone, and experience in different light settings.

For the purposes of later analysing and editing the video record, and for its use in pedagogy and teacher development, it is very useful to use the best quality video tape. Each edit and copy from lower quality tape will provide an inferior image and sound reproduction, to the point where the copies become rapidly unuseable.

These are all points that any competent media unit would normally attend to: the researcher needs to be aware however that valuable field time can easily be wasted by not attending to them.

RATIONALE

There are two basic reasons for using this method of children watching and reporting on children. The first of these is that it can provide us with insights into a given child's thinking by presenting that child with a video record of their own actions. This is a so-called stimulated recall technique, and my experience inclines me to believe that it needs to be handled with considerable care. One major problem is that some children can be overwhelmed by their own image on the monitor and have difficulty in reflecting upon their own thoughts and actions in such a situation.

The second basic reason for using this technique is to allow children to give us their insights into the thought processes and observed behaviour of other children, and so provide us with a point of view to which we apparently have lost direct access. In so doing the children whom we interview not only give us insight into other children's thoughts and actions but also into their own.

This is essentially the rationale for the technique as a research tool. There is however a pedagogical rationale which comes about because as children look at and reflect on other children involved in mathematical tasks they themselves are actually learning something from what they see on the monitor, from how they interact with each other, and via the interviewer's questions. To the best of my knowledge this technique is not widely used as a pedagogical tool, and I discuss the issues it raises for mathematics teaching and learning below.

WHY MATHEMATICS?

The methodological issues I have discussed so far arose from a technique used in research in mathematics education, but inherently there is no reason why children watching and reporting on children could not be used in any area of educational research. The question I consider here is whether there is anything that makes this technique particularly useful for research in mathematics education.

The idea to use this technique in research in mathematics education came out of a general constructivist framework. This is not to say that the methodology that I advocate has to be based on a constructivist philosophy: Only that the general constructivist movement as it applies to mathematics education strongly emphasises the direct observation of children engaged in mathematics activities.

I feel that by arguing for engaging with children in their observations of and inferences about other children we are going one step further in the decentralisation of the researcher, and moving a step closer to placing children, their actions, thoughts, and constructions closer to centre stage. This is entirely consistent with my earlier statement that in such interviews one should use a script as a basis and aim to stick to what the interviewer sees as the point of the interview. At the same time the interviewer ought to allow for the possibility of the exploration of different avenues that arise from the children's responses. The question is one of balance and communication: the absence of a script or planning can, and in my experience does, lead to a mess. Too tight a script, and too strong an adherence to it, leaves the interviewer hearing only what they wanted to hear.

Mathematics has procedures, structure, logic, and applications, and these features are woven tightly together - all of them contributing to the overall meaning of any given mathematical concept for a specific individual. This means that when even a very young child engages in mathematical activity there is a rich intellectual and social background to that activity, more or less of which is seen according to the experience of the observer.

We could, for instance, video tape young children involved in sharing and halving activities and ask slightly older children to comment on why, for example, one child on the video tape finds half of a licorice stick by making multiple cuts. This type of activity involves the reporting child as a sort of junior researcher whose views on the phenomena at hand we seek: at the same time we seek to understand the reporting child's cognitive processes. In this halving example that I have given the reporting child might, for instance, assert that the younger child didn't know the meaning of one-half. This tells us, I believe, that the reporting child sees the video taped child at an earlier stage in their conception of one-half; it then prompts us to ask the reporting child what they themselves would have done to find one-half of the licorice stick.

The points about mathematical activities that makes this technique so useful are manifold.

Firstly the wider adult community has a generally accepted notion of what certain mathematical terms mean and by getting children to reflect on other children's engagements with these terms we can see the development of understanding at two levels: that of the reporting child and that of the video taped child.

Secondly, there are usually more precise meanings of mathematical terms adopted by professional users of mathematics, and in the same way we can see the children's approach to understanding these terms from a more precise and logical point of view.

Thirdly, as well as concepts, logic, and facts, mathematics also has procedures, and the point about procedures - for example methods for adding two or more decimal numbers - is not that they are right or wrong in any absolute sense, but rather that they work. There are many ways for example to add or subtract two decimal numbers and often young children will invent their own procedures.

When therefore we ask children to report on video records of other children using procedures different from their own we can hope to probe the reporting child's sense that procedures can be individual, their acceptance or otherwise that a different procedure is valid, and their ability to reason about the validity of different procedures.

Fourthly, a social constructivist point of view leads us to expect that a reporting child will, if prompted, express the social interactions or lack of them that brought a child whom they are viewing to the state that they observe. In the halving example above, a child might say that the video taped child does not make just one cut because they never had to share a doughnut with a brother or sister. In this way the reporting child is telling about the real or imagined social interactions that allowed them to gain a deeper conception of one-half and is inferring that this could be the reason for the video taped child's relative ineptitude. Commentary like this can be of considerable help to a researcher in deciphering the complex web of social interactions that produce children's conceptions at any given time.

PEDAGOGY

I have already mentioned that there is a pedagogical rationale for getting children to reflect and report on other children involved in mathematical tasks, and it is that the children are actually thinking and learning as they observe and report.

Here is a possibility for classroom use in mathematics teaching. A teacher has discussed subtraction of two and three digit numbers and notices that several children in the room have difficulties with borrowing from the tens or hundreds column, and that some children seem to prefer to subtract by counting on, but seem perturbed that they aren't doing it "right". The teacher plays a video segment that shows children of the same age doing subtraction by various methods and that includes some obvious errors in borrowing. A script comes with the video, and the teacher initiates a classroom discussion based on what the children report they have seen on the video and how they respond to each other's observations.

A discussion session like this, based on other children's actual performance in mathematical tasks aims to point out several things to the children: that there are a number of ways to a desired end, that children other than themselves have difficulties, that they are not alone in preferring different methods, and that directed discussion can be of great benefit in clarifying issues.

CONCLUSION

My experience with children reporting on children's mathematical behaviour leads me to believe that this is a technique that offers considerable potential to a research worker interested in cognitive, affective, and social aspects of children's mathematical learning.

One exciting aspect of this technique is that the reporting children often make unexpected and insightful statements: far more I believe than if we were to simply observe these children involved in mathematical tasks, whether of a routine or problem solving nature. By asking children to observe and report in this way we seek to access their cognitive architectures and the complex web of social interactions that produced them. Happily, children seem to be willing and able to report on other children's actions, moods, and possible thought processes and so offer us windows into their own thinking. In order to get this technique to produce sensible results however considerable thought and planning needs to go into the design of the tasks for the base video record and into the structure of the interview questions.

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