

**THE PUPPETS PROJECT:
USING PUPPETS TO PROMOTE ENGAGEMENT AND TALK IN SCIENCE**

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Keywords

Puppets, engagement, talk, motivation, questioning

Abstract

The PUPPETS Project uses puppets as a stimulus for children to engage in conversations involving reasoning in primary science lessons. Data were gathered using a variety of methods, including audio and video recording, and analysed using an open coding approach based on grounded theory. The data indicate that puppets are engaging and motivating for children; that they promote talk involving reasoning; that they can be particularly effective with reluctant speakers; that they appear to be effective across the whole primary age range; and that they promote significant changes in teachers' professional practice.

Introduction

The PUPPETS Project is a research and development initiative funded by the Nuffield Foundation which aims to help teachers provide more opportunities for productive talk in science lessons, using puppets as a stimulus. The research focuses on the effectiveness of hand-held puppets to engage primary school children's attention, challenge their ideas and promote conversations involving reasoning in science.

The value of talk in children's learning is well-documented; talking about their ideas helps children to clarify their thinking and develops their capacity to reason (Kuhn et al, 1997; Mercer et al, 2004). This is particularly important in science, as the development of conceptual understanding and the ability to use reasoning are central goals of science education. Unfortunately the type of talk that promotes reasoning and thinking is frequently absent in science lessons (Newton et al, 1999). Reasons for this may include the uncertainty teachers have about the value of children's conversations, limited knowledge of appropriate teaching strategies, and insecure subject knowledge (Osborne and Simon, 1996; Solomon, 1998).

Focused and productive talk normally requires a suitable stimulus that engages children, enabling them to feel personally involved and committed to the conversation. The use of puppets is well-established in primary schools in subjects such as language and social education (Thorp, 2005). There is some evidence that puppets can have a valuable impact in motivating children and promoting language development (Low & Matthew, 2000). Puppets can engage the children's attention, provide a context for conversation and promote purposeful activity. We believe that puppets could also act as an effective stimulus for generating talk involving reasoning in science lessons. This would build on previous work on group interactions (Maloney, 2002) and on using concept cartoons (Keogh and Naylor, 1999), which have proved to be a powerful means of generating discussion and argument (Downing, 2005). Puppets seem to provide a mechanism for 'bringing the concept cartoons alive', with dialogue between the puppets or between the teacher and the puppets acting as a stimulus for children to engage with that dialogue.

The main research questions to be investigated were:

1. In what ways can puppets be used in primary science lessons to enhance children's engagement and promote talk involving reasoning in science?
2. Is it possible to initiate changes in teachers' beliefs about the value of children's talk and in their management of talk in science lessons?

Mode of inquiry

The project began with a pilot phase, involving eight teachers, to develop materials and guidance for teachers to use with puppets in their science lessons. These teachers attended a workshop to become familiar with the use of puppets, after which each teacher was audio and video-recorded during a science lesson where puppets were used. In each of these lessons sample groups of children were audio-recorded during small group conversations.

Preliminary analysis of the data from these puppets lessons led to the development of an analytical framework for classroom discourse using grounded theory (Glaser and Strauss, 1967). The focus for the analytical framework was on the nature of talk, including the use of reasoning and argument by the teacher, the puppets and the children. The pilot study also provided valuable feedback on the guidance provided for the teachers and on whether any classroom management issues were significant. The research team's preliminary judgments were tested out with the teachers at a follow up meeting, as a result of which the analytical framework and guidance were refined for the main study.

A further 16 teachers were involved in the main study, drawn from primary schools in the London and Manchester areas and covering a range of social, cultural and ethnic backgrounds. These teachers were observed and video-recorded teaching a typical science lesson. Two groups of children in each class were also audio and/or video-recorded during periods of pupil activity. Teachers were interviewed to obtain their views on the nature and value of children's talk and details about how they taught science. These initial observations and interviews provided a baseline against which future lessons could be compared. Transcripts of the teachers' and children's talk were scrutinised and the provisional analytical framework was further developed. This analytical framework was then available to apply to the data from lessons where puppets were used in science teaching.

These 16 teachers then attended a preparation meeting to provide guidance on how puppets might be used effectively, including issues such as role and characterisation of the puppets. Video clips and transcripts from the pilot phase were used to illustrate aspects of the teacher's role and how puppets might interact with the children.

After a period of several weeks, during which the teachers could get used to using puppets, a second science lesson was observed and recorded with the teacher using one or more puppets as part of their teaching. Teachers were asked to continue to teach lessons from their usual scheme of work, so that lessons without puppets and with puppets would be broadly comparable. Between them teachers were teaching a wide range of topics, both with and without puppets.

As before the teachers were observed and video-recorded, with two groups of children in each class also audio and/or video-recorded during periods of pupil activity. Teachers were interviewed to ascertain their views on the impact of the puppets; they also kept reflective diaries to enable them to capture their feelings about the use of puppets and record any significant classroom incidents at the time. Interviews with groups of children were video-recorded to provide data from the children's perspective. The range of data sources and collection methods allowed extensive triangulation and cross-referencing of the data. A follow-up meeting with the teachers provided feedback on the longer-term impact of using puppets and their response to issues emerging about the use of puppets in science lessons.

For various reasons not all the teachers were able to continue in the project. By the end of the main research phase, data were available for 13 of the original 16 teachers.

Data analysis and results

Using an open-coding approach (Strauss and Corbin, 1998), transcripts of all the conversations between teachers, puppets and children were coded and the coding framework discussed between researchers. An extensive range of codes was developed to identify episodes of discourse during the lesson which seemed significant in the development of children's engagement and thinking. Approximately 30 codes were generated in the initial data analysis, representing all the types of discourse which had occurred. These were reduced to a more manageable number (10) by

conflating codes where possible. These 10 codes were related to either the teacher, the child or the puppet, giving us a total of 30 types of utterances.

The data were then scrutinised to identify where significant changes had occurred. Only some of the codes, where significant changes were evident, are reported on here.

Examples of the codes used included:

Q: question that requires reasoning

N: question that does not require a reasoned answer

A: use of argument to challenge or justify a point of view

R: recall of information from memory

P: gives information or asks question relating to the procedure to be followed

The analytical framework has enabled us to make comparisons between the time spent in various types of talk, to determine the nature of the discourse of the children, teachers and puppets, and to identify critical episodes of problem-solving and argumentation. The key themes emerging from this analysis include:

- puppets enhance engagement and motivation
- puppets provide a stimulus for talk involving reasoning
- puppets engage reluctant speakers
- the use of puppets is appropriate across the age range from 4 to 11 years
- puppets facilitate changes in the teachers' practice

Enhancing engagement and motivation

In each class nearly all the children showed high levels of engagement and motivation in response to the puppets. Evidence of engagement included children asking when puppets are to be used; physical interaction with the puppets (for example, holding their hands); following the puppet around the room; talking to the puppets. All of the teachers noted that puppets enhanced pupil engagement pupils in their diaries and/or in their interviews; pupils in each group interviewed stated that they preferred lessons with puppets and that the puppets helped them to learn. Video evidence from lessons using puppets showed that pupils were focused on the puppets, that they had high levels of concentration, that they stayed on task and that they were eager to contribute to discussion.

Typical comments from teachers included:

"Children were keen to tell the puppet what they knew but also listened more attentively"
(Teacher I)

"The children responded brilliantly. Thought they may be cynical, esp. Y5 boys, but they were especially motivated". (Teacher C)

"All children were keen to ask or answer a question and join in discussion" (Teacher C)

Analysis of interview transcripts with the children confirmed this high level of interest and engagement. Comments about the use of puppets included:

"Lessons are more fun"

"I understand better with the puppets"

"It inspired my imagination"

"You want to answer questions more"

"I am much more enthusiastic about learning now we have the puppets"

Providing a stimulus for talk involving reasoning

Analysis of interview transcripts showed that each of the teachers claimed that puppets are an effective stimulus for talk involving reasoning. They described how more children talk in science lessons with the puppets, how children give fuller explanations and listen more closely. They noted that children explained and justified their ideas more, and that this continued even when the puppet was not being used.

Video recording of children engaged in small group conversations allowed comparisons to be made of the nature of their conversations without (Lesson 1) and with (Lesson 2) the use of puppets. Table 1 shows comparisons of the amount of talk involving reasoning compared to talk about procedural matters. The table shows the cumulative time spent in each type of talk across all the classes for which data was available.

Conversations were coded as talk involving reasoning when children appeared to use evidence, reasoning or justification in a concept-based conversation about a scientific question. For example, a child talking about what type of rock might be used for a rock climbing area replies:

“Waterproof, because if you go on them when they are not waterproof, like limestone, it could go, if they are still water in them you could slip, or because there is holes in it, it could just break away.”

Conversations were coded as procedural talk when children focused on practical aspects of a lesson with no reasoning involved. For example:

“Use, oh, oh, (taps pencil on table, looks for an eraser and then carries on writing over the top of what she’s done. Looks at another Child’s work). Oh I’ve got it wrong! I need an eraser. (rubs out work and starts writing again). By using a measuring tape. How do you spell measure?”

TABLE 1

There was a marked increase in the time that children were engaged in talk involving reasoning and a decrease in the time that they were talking about practical and procedural matters. A chi-squared test shows these changes to be statistically significant ($p < 0.001$). The teachers’ use of puppets appears to have had a significant impact on the amount of small group talk involving reasoning taking place in the majority of the classes. Other aspects of the data show that the total amount of time spent in small group conversations was broadly similar in lessons without and with puppets. In other words, the increase in the amount of small group talk involving reasoning represents a change in the **nature** of children’s talk, not just an increase in the total amount of time made available by the teacher for talking. Children generally were highly focused and engaged in the whole class introduction to the lessons using puppets and this appeared to carry over into small group work.

Engaging reluctant speakers

The majority of the teachers noted in their interviews that the children were extremely keen to talk with the puppets. Several teachers noted that they were particularly effective with shy children who are normally reluctant to speak. This was confirmed by the children themselves in interview transcripts, where several children claimed that puppets help shy children to talk in class. Their comments included:

“I’m not nervous talking in front of the class (with the puppet) so it’s helped me – because they all look at the puppet not me.” (Child A, age 11)

“The puppet explains things using less scientific words – which is more understanding.” (Child B, age 10)

"It's more comfortable talking to the puppet. If you get it wrong with the teacher she says 'No'. The puppet says 'not really correct'." (Child C, age 10)

"The teacher already knows the answer anyway. So she's really just testing you. The puppet doesn't know the answer so we have to explain it in a way he will understand." (Child D, age 11)

"I put up my hand more with the puppet because I understand it more." (Child E, age 11)

The puppets appeared to create cognitive conflict for the children in a non-threatening manner, operating as peers with the children without the complications of the status attached to the teacher. By removing the status factor they enabled the children to speak more freely without fearing that judgments would be made about their conversations.

Puppets being used with a wide age range of pupils

The main research study was carried out with pupils in English schools in Years 3-6, with an age range from 7-11 years. No evidence was found of any significant differences in the children's responses across this age range. The age range was wider in the pilot study, with children from Years 1-6 (ages 5-11) being involved. Again no evidence was found of any differences in the children's responses according to their age.

In addition to this research study two additional small-scale research studies have been carried out with pre-service teachers. Both of these involved pre-service teachers working with all the classes across a whole school, from Reception to Year 6 (ages 4-11). Results in these two studies were more variable, with the student teacher's ability to manage the class successfully and the teacher's level of commitment to supporting the student teacher being significant factors in these studies. However in both cases the age of the children involved had no apparent bearing on the nature of their response.

The data are consistent in indicating that the use of puppets in science lessons is appropriate across the age range from 4 to 11 years.

Facilitating changes in the teacher's practice

The teacher's use of questions which require thinking and reasoning rather than recall of information is a critical factor in promoting talk involving reasoning. Thinking and reasoning questions explicitly value justification and inference, act as a prompt to critical reasoning and begin to model the process of argumentation. Table 2 shows a comparison between the questions asked by teachers in typical science lessons (Lesson 1) and science lessons where puppets were used (Lesson 2). In Lesson 2 questions may be asked by the teacher or by the puppet. The numbers shown in the table are the cumulative total of all the questions asked by the teachers or puppets in the lessons.

Questions were coded as reasoning questions if they required thinking, reasoning or justification from children. For example:

"Well what do you think a nice rock climbing area should have, and what should it look like. What do you think?"

Questions were coded as non-reasoning questions when they did not require thinking, reasoning or justification (such as recall questions). For example:

"Think back to yesterday and why we eat, well what did we say? What were the two reasons why we eat food, William?"

TABLE 2

In lessons where puppets were used there was a marked increase in the use of reasoning questions and a decrease in recall questions. A chi-squared test shows these changes to be statistically significant ($p < 0.001$).

This increase in the use of reasoning questions is consistent with the way that puppets present problems to the class. Because the puppets present problems rather than instructions, whole class discussion with pupils is more likely to involve exploratory conversations about how the problem might be solved.

Conclusions and implications

The research indicates that puppets can provide a useful mechanism to enhance children's engagement and to promote talk involving reasoning in primary science lessons. There is evidence that when teachers use the puppets children talk more readily about scientific problems and higher-order thinking (such as explanation and justification) is promoted. They can be particularly significant in engaging reluctant speakers, such as shy children, and promoting greater involvement in scientific discussion with these children. The puppets appear to be effective in providing an interactive narrative which sets a context for learning and provides a purpose for children's talk and follow-up activity. It is notable that the increase in argument and talk involving reasoning is in relation to explicitly scientific problems, rather than in relation to the socio-scientific issues which are frequently used by researchers to promote argument in science lessons.

The research also indicates that teachers using puppets are likely to ask more questions involving reasoning and to ask fewer questions which only require recall. This fairly fundamental change in professional practice was achieved with only a short (2 hour) preparation session and the provision of relatively inexpensive resources. The puppets were used within the teachers' existing schemes of work with no disruption to the usual curriculum. Little additional preparation was required for lessons involving puppets. They therefore appear to offer a valuable extension to the teaching/learning strategies typically used by primary school teachers in science and a potentially valuable mechanism for facilitating change in professional practice.

Further issues to be explored in the research will include analysis of the puppets' role at different parts of the lesson, how teachers create characters for their puppets and how teachers avoid stereotyping their roles.

Figure legends

Table 1: comparison of small group conversations without and with puppets

	Talk involving reasoning	Procedural talk
Lesson 1 (without puppets)	48.5 mins	72.5 mins
Lesson 2 (with puppets)	128.5 mins	30 mins

Table 2: comparison of teacher questions without and with puppets

	Reasoning questions	Non-reasoning questions
Lesson 1 (without puppets)	73	388
Lesson 2 (with puppets)	263	291

Acknowledgement

We are grateful to the Nuffield Foundation for funding the research.

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