

Addressing the communication needs of deaf children in the mathematics classroom

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Support: The Nuffield Foundation

General instructions

Background

It has often been documented that deaf children are behind hearing children of the same age in mathematics. There is no evidence for a causal connection between the degree of hearing loss and mathematics achievement. Our previous work suggests that that hearing impairment places children *at risk* for underachievement in mathematics, rather than *causes* underachievement. This present booklet contains the activities that were found effective in supporting deaf children's communication in and helping them co-ordinate their informal knowledge with mathematical concepts taught in school. These activities were tried out by Teachers of the Deaf and their pupils in a project supported by The Nuffield Foundation. We are thankful to the school, the teachers and the children for their participation and The Nuffield Foundation for their support. The schools that took part were: Grove House School for deaf children, Heathlands School for deaf children. The Hearing Impaired Units that took part are based at the following schools: Culloden primary school, Darrick Wood Junior school, Kingsley Primary school, Knollmead primary school, Norwood Green primary school and Sellincourt primary school.

The booklet

The activities in the present booklet were designed with deaf children in mind. The purpose of the activities is to encourage the children to reason about mathematical situations, and to discuss and compare the solutions that they have arrived at with the teacher and with other children. For this reason, the materials are very visual and the children should be encouraged throughout the programme to draw their representations of the problem situations and solutions. After this they should be encouraged to compare their solutions with other children.

The sections printed on different colours have specific teaching objectives. We have ordered the items within each section by order of difficulty. An item at the end of the section may be more difficult than another at the beginning of the next one but we suggest that the items in each section should be kept together to keep the focus of the learning on the same objective.

To print the booklet for the teacher please select in printing options 'Notes pages'. To print the booklet for the children select in printing options 'Handouts' and then select 2 slides per page.

Section 1: Additive composition, number and measurement

The aims of this section of the programme were:

- to strengthen the pupils' understanding of additive composition;
- to strengthen their understanding of how numbers are used to measure, thereby expanding of the use of additive composition;
- to introduce the number line as a working tool for representing and solving problems.

The sections included were:

- items on counting money (including simple identification of coins)
- items on measurement (reading rulers and measuring with a broken ruler)
- items on representing values on the number line and using the number line when it does not start from 1

Section 2: Additive reasoning materials

Background

Basic addition and subtraction concepts start with the actions of putting things together and taking away. The classroom observations during the project showed that some teachers used concrete materials to help the younger children reason about problems that they found more difficult. Once they had solved some of these with objects, they were able to work with the booklet without difficulty. The connection between the way in which they had counted the objects and counting on the number line was easily made. You are also encouraged to introduce concepts by presenting them in more concrete situations first.

Actions take place over time: we need to use space to represent time for the children to work with place-holders in the sequences. Problems with start unknown (Mary had some sweets; her friend gave her 2; now she had 8; how many did her friend give her?) and with transformation unknown (A boy had 5 cakes; he ate some; now he has 3; how many did he eat?) are quite difficult for deaf pupils as they involve making time-related inferences.

Comparison problems are the most difficult of the additive problems with natural numbers for both hearing and hearing impaired children. Our programme introduced comparison problems by initially connecting the comparison to additive transformations. Our previous research (Nunes & Bryant, 1996) has shown that this is an effective way to make the solution of comparison problems accessible to 6-year-olds. Several of these items are included in the programme. Teachers reported that the number line was a particularly useful instrument when discussing the logic of comparisons.

Aims

- to represent time through space and introduce work with drawing and diagrams.
- to promote the co-ordination of addition and subtraction as inverse of each other
- to use the number line for calculation and demonstration for problems with different number meanings.

- to work with drawings and diagrams, representing time through spatial relations; and to use the number line for calculation and for the demonstration of different solutions to the same problems.

Problems involving addition and subtraction with different number meanings (measures, relations and transformations) and with different levels of complexity (invisible addends, start unknown, comparison) were included to provide the pupils with the opportunity to explore additive problems broadly. You are encouraged to use the pupils' records for the discussion of different ways of solving the same problems. Ask the children to represent the transformation, the result, or the operation needed to solve the problems on different occasions.

Section 3: Multiplicative reasoning materials

Background

The basis of multiplicative reasoning is the correspondence operation

The majority of 7 year olds can use correspondence to solve multiplicative problems

Division has two meanings that relate to different actions. The first action is *sharing* (or 'partitive') - for example: "There are 15 balloons and 3 boys. How many balloons for each boy?". Giving one balloon to each boy in turn, and repeating the action until the balloons have run out solves this problem. Then the number of balloons each boy has is counted for the answer; the second action requires the giving of measures (or 'quotitive') - for example: "There are 15 balloons, three in each bag. How many bags are there?". Here groups of three are organised until the balloons have run out. The number of groups is counted gives the answer to the problem. Both these actions must be co-ordinated with each other and with multiplication.

Aims

- to focus the children's attention on the correspondence between two variables
- to introduce a consistent representation through tables and graphs (two variables in correspondence)
- to focus the children's attention in the connections between the different multiplication and division ideas.

