

ON THE INTERPRETATIVE DIFFICULTIES OF TEXTS OF STANDARD PROBLEMS SOME ASPECTS OF A EXPERIMENTAL RESEARCH WITH CHILDREN 10 YEARS OLD

Giancarlo Navarra, GREM (Group of Research in Mathematical Education), University of Modena (Italy)

ABSTRACT

This paper presents some aspects of a research in progress, led with a group of teachers of different primary schools, with the aim of studying the interpretative difficulties of pupils in front of problems presented through written texts. In this case we shall work with texts of standard problems. After some general reflections on the connection between linguistic competence and interpretative difficulty and on the modalities of the research, we shall see, through an example, how a precise examination of the protocols of the pupils allows to ascertain positive attitudes and above all difficulties which remain normally hidden though hampering the solution of the problem.

1. Linguistic competence and interpretaton difficulties

One of the main obstacles which has to be faced daily by teachers is *the difficulty pupils find in spoken and written language*, and it is well known that *verbal linguistic competence* is an essential condition for learning quite apart from the disciplinary contexts. As regards mathematics, these difficulties may inhibit either the comprehension of the text of a problem or the following organization of the solution, specially when written communication of reasoning, hypothesis, choices is requested to pupils.

At this stage of our researches we are mainly concerned with the first aspect, and consequently with improving teachers' attention to the difficulties linked to the comprehension of texts of standard problems, which they often tend to understate, above all when they consider the problem to be "easy", or in any case compatible with the competence of the class.

Our work is organized according to this strand: a) preliminary analysis of many texts and identification of characters which may negatively influence the impact with the problem and its solution; b) organization of class activities suitable for making pupils' "hidden" difficulties come out when they face the text of a problem; c) precise examination of the protocols of the pupils in order to ascertain the causes of the difficulties or of the misconceptions (often, in routine tasks, there is a meeting between two stereotyped behaviours: on one hand pupils are not used to writing argumentations, on the other teachers are not used to requesting them and to interpreting them); d) class discussion for encreasing - pupils and teacher - metalinguistic an metacognitive abilities; e) organization of further activities, compensative of the difficulties noticed.

We shall now explain an instance relating to points a) and b).

2. The comprehension of a standard text: one problem and three paraphrases

The pupils (in this case 22, of two different schools) must compare a text (T) with three paraphrases of it, choose the wrong one and justify in writing the choice.

T: A grocer buys 35 l of oil. He keeps 17 l for himself and fills with the rest various one-liter bottles. He sells them and gains 86.000 L. How much did he sell every bottle?

Giuseppe: A grocer keeps for himself 17 l out of 35 l of oil he bought. He fills with the rest various one-liter bottles which he sells gaining 86.000 L. How much has he sold every bottle?

Bianca: A grocer buys 35 l of oil. He keeps for himself 17 l with which he fills various one-liter bottles which he sells with a revenue of 86.000 L. How much has he sold every bottle?

Anna: A grocer gains 86.000 L selling oil in a lot of one-liter bottles. Find how much he has sold every bottle. The sold oil is the rest between 35 l the grocer had bought and 17 l he kept for himself.

A third of the pupils identify correctly the mistake in the text by Bianca using a fair/good language and using the data. As an example:

Bianca is wrong because the grocer kept for himself 17 l and he didn't bottle them; he bottled the rest of 35 l, that is 35 l minus 17 l.

The remaining two thirds, who have not identified the incorrect paraphrasis use a very poor language and they choose (except one of them) the text by Anna. The analysis of protocols enables us to individuate the reasons of a so widespread choice:

- almost the 70% makes an “outside” choice. They are confused by the appearance of the text and they draw a conclusion typical of the bad detective: the suspected doesn't let himself be understood, therefore he is guilty. These pupils have a common characteristic: when writing the reasons of their choice they do not use any data; i.e. they do not refer to the mathematical part of the text but to a generic changement compared to T (organizing their argumentations around words like “order”, “confusion”, “to mix”) or to the low intelligibility (“the text is not well expressed”, “it is not clear”). We think that the difficulties derive from the mental representation of problematical situations. The events are described in T in a sequential way, in Anna on the contrary the sequentiality is reversed and broken: the text begins from the proceeds, is interrupted by the question and ends by explaining what has happened to the oil between the purchase and the sale.

- The 30% strives to interpret the data but is entrapped by errors deriving from a careless reading. Federica, for example, indicating as mistaken the paraphrasis by Anna, writes

Anna, because the grocer had not bought 17 l and he had not kept them for himself, but he had bought 35 l of oil.

She fails because, reading the last sentence of Anna's text, she overlooks the main clause and, skipping the conjunction, obtains: “the grocer bought 17 l“. Whereas Alessandro indicates

Anna because the grocer does not gain 68.000 L from selling the oil in one-litre bottles, but with the residual.

He is wrong because he concentrates on the first sentence of Anna's text and does not consider the following information, included that contained in the third sentence one which affirms exactly that “the sold oil is the residual between... “. Alberto chooses:

Anna, because she says that the residual is the result between 35 and 17.

Evidently he does not understand to what refers that “rest” in T, presumably because he was confused by the fact that the terms “35”, “17”, “the rest” are in three different sentences - and thence the connection between them should be conceptually rebuilt - while in Anna, on the contrary, they are written in the same sentence. Like other pupils, Alberto too is confused by this change and does not recognize the semantic equivalence of the sentences.

In short, the stumbling-blocks are: a) the presence of two subjects in the text by Anna and of only one in the others; b) the use of the term “rest”, which expresses the abstraction of a *connection* between data, and represents a logical jump compared to the “concreteness” of sentences which mention “to buy” or “to sell”; c) the order in which the data are written (the same in T and in Bianca, partially changed in Giuseppe, completely reversed in Anna); d) the consequent structure of T and of three paraphrases (the text of Anna is the most complicated because it begins “from the tail end”; e) some key words in the text of Bianca (“with which”) which overturn the structure of the problem.

The characteristics d) and e) are illustrated in the following graphs (similar to those which have been used in the class-discussions by means of the overhead projector, precious instrument during comparison, explanation, comment activities.

<i>Structure of the texts T, Giuseppe, Anna</i>		<i>Structure of the text Bianca</i>	
35		35	
17	35-17 one-litre bottles 68.000	17	
		one-litre bottles 68.000	

3. Conclusive remarks

We have tried to show how the most clever reasoners tend to integrate the linguistic and mathematical aspects. On the contrary the weak ones, in evident trouble in controlling both aspects, and thence their links, are inclined to operate unconsciously some meaning conversions from one side, “obscuring” the mathematical meaning of the problem and, from the other, weeding out the text, adapting it to their abilities. The final result is in most cases a surface argumentation which expresses therefore “outside” choices without referring to data. Rather than a careless reading we may call it an unconsciously “partisan” reading, which selects “friendly parts” of the text and neglects the others.

References

- Boero P., 1987, Sul problema dei problemi aritmetici nella scuola elementare, *L'insegnamento della Matematica e delle Scienze integrate*, vol.9, n.9, 48-93.
- D'Amore B. et al., 1995, La ri-formulazione dei testi dei problemi scolastici standard, *L'insegnamento della Matematica e delle Scienze integrate*, vol.18A, n.2, 131-146.
- Malara N.A., 1994, The problem as a tool for the promotion of hypothetical reasoning and metaknowledge, in Bazzini L., Steiner H. (eds.), *Proc. of the Second Italian German Bilateral Symposium on Didactics of Mathematics*, Osnabrück, Germany, 303-324.
- Laborde C., 1990, Language and Mathematics, in Howson A.G., Kahane J.P. (eds.), *Mathematics and Cognition*, Cambridge University Press, 53-69.