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CREATIVE THINKING IN MATHEMATICS

Book Review. In: Thinking. The Journal of Philosophy for Children XIV (1998): 2, 48-49

Review of:

Christoph SELTER & Hartmut SPIEGEL. *Wie Kinder rechnen*. [How children calculate.] Leipzig etc.: Ernst Klett Grundschulverlag, 1997. 160 p. Paperback qto. ISBN 3 12 199098 5.

Twenty five years of experience by a big number of people, partly documented in a number of books and in a great many articles, have shown that children are capable of philosophical thinking. Children often choose original entrances to complex questions and come up with creative solutions which grown-ups would not easily expect.

Creative thinking in philosophy is possible, because philosophical questions are open questions: an investigation into the nature of the problem is the start of the enterprise and the way followed is often much more interesting than the final results. This enables children to be equal partners of grown-ups: their lack of knowledge is compensated by their openness.

Quite different - most people would tend to think - is the situation in mathematics. Mathematical problems are well-defined, they have strict solutions, and - at least for school mathematics - the way to success is clear and unilinear for the initiated. And because the standard solutions to problems of mathematics and calculation on paper look identical for sets of problems, it is easily assumed that what goes on or has to go on in the head of the learner, the child, is uniform too.

Whoever thinks that for the child there is only one way to solve a mathematical problem and that creative originality has no place in elementary mathematics should

read Selter's and Spiegel's book, which well merits an English translation.[1] Let me begin with an example. A seven year old boy - Sven - has to add the following numbers:

9 12 10 11 8 10 9 8 12 11 10 12

He comes up with this answer:

119 121 121 122 120 120 119 117 119 120 120 122

and asks the teacher if it is right. It is! However, it will take the reader some time to find out what Sven exactly did. Try for yourself before reading the answer![2]

The authors of this delightful book intend to show that children calculate differently: 1) than we do; 2) than we assume; 3) than other children do; 4) than they did before. In the second chapter they give examples to illustrate these four points of view. In the next chapter they describe children's methods to handle several specific problems. Chapter four consists of extensive transcripts of interviews with children, which are subsequently partly analysed - some analysing being left to the reader. The authors end with a chapter devoted to methodological questions concerning interviews with children. I will not go into every detail of the book, but concentrate on several points which seem to me particularly interesting or instructive for those engaged in doing philosophy for children.

The authors start from the assumption that - even if the thinking steps of children are sometimes difficult to understand or reconstruct - a rational thinking process underlies even their errors. "Errors should not be considered as flaws which should be eradicated as soon as possible or - even better - nipped in the bud. Instead, we should understand them as integrating part of a constructive learning process." (p. 13) "We are of the opinion that one can considerably disrupt children's thought if one immediately tries to correct them." (ibid.)

This is particularly clear in one of the experimental sequences, where children are asked to solve 'impossible' word problems - 'impossible', because there is no solution.

Word problems are problems of the type: “At the start of a sea voyage the captain has one and a half times the combined age of his two members of crew. After a voyage of five years they return and on return the age of the captain is exactly the combined age of his members of crew. How old is the captain on return?” Instead, the children have to solve problems like: “A shepherd has 19 sheep and 13 goats. How old is the shepherd?” In the fourth class 60% of the children ‘solve’ this kind of problem, whereas in the first class only 10% do so. Obviously - the authors conclude - the attitude of the children towards the problems was shaped by school instruction and, moreover, they had learned that mathematical problems have very little to do with reality and have to be solved, no matter how.

The authors and their student collaborators make use of the so-called ‘clinical’ method coined by Piaget, of which the aim is to reconstruct the thinking process of the children interviewed - which is not to say the authors underline Piaget conclusions. Even a transcript of the most sensitive interview requires, however, an interpretation and the authors explicitly warn for the many mistakes the investigator can make here. Their purpose, of course, is research into thinking processes by means of interviews - a situation very different from classroom discussions in a community of inquiry -, but the amount of detailed observations and reconstructions makes the commentary on the interviews nevertheless highly instructive for philosophers.

Particularly treacherous is the fact that children not only think differently, but create their own terminology - and in mathematics even their own notation - to express their thought. The details of their analyses here are very instructive for those engaged in philosophy for children too.

Not only instructive, but also amusing in this respect is a part of the book which would not be easy to translate into English. In German (and also in Dutch) for numbers between 20 and 100 the units are expressed before the tens; so 21 is pronounced as one-and-twenty, where the ‘and’ is reduced to a barely perceptible ‘n’. The hundreds, however, come first. So 102 is pronounced as ‘hundred two’, but 121 as ‘hundred

one-and-twenty'. One can imagine what children do to this system of nomenclature, which - by the way - is an obstacle for foreigners learning the language too. A child saying 'two hundred' may mean 102, never having noticed the 'n' in between. So what seems to be a curious mistaken could be well understood. On the other hand, the quaint system of nomenclature can and does seduce children to acquire curious representations of the number system. There may well be interesting parallels in philosophy.

Noteworthy is the fact, that trains of thought with which the interviewer has difficulties are easily understood by other children. In combination with the fact that the regular procedures of school instruction in some cases more block than stimulate children's thought, this means that children should - as the authors conclude - be given the opportunity to use their own procedures and terminology as long as possible, instead of insisting on orderly procedures and a uniform terminology from the start.

Many of the transcripts in the book are elucidated by diagrams or even drawings. Apart from that, the book is interspersed with often philosophical observations of children to numbers and mathematical problems as page fillers without connection to the text, and this collection of anecdotes is a little book in itself. May someone who masters the German language feel stimulated by this review to translate this book!

NOTES

[1] The authors work as trainers of mathematics teachers in the University of Paderborn.

[2] Sven noticed, that all 12 numbers were near to 10. So he started with 12 times 10 = 120. For each number he added or subtracted the deviation: so the first correction was 119, because 9 is 1 less than 10. And so on.