ARGUMENTATION CREATED BY 4-6 YEARS OLD CHILDREN IN PATTERNS ENVIRONMENT

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RATIONALE

In Polish kindergartens and at primary educational level, the traditional model of teaching mathematics is still very strong. Teachers, very courageous and innovative in many educational domains, often feel lost while leading mathematical activities.

In our opinion the problem is rooted in the following:

1. Strong tradition of Jean Piaget’s model of children’ intellectual development, stages of intelligence and general periods of development. Children between two and seven years old are characterized by pre-conceptual thinking at the pre-operational level. Abstract and logical thinking, complex verbal and problem-solving abilities, symbolic thinking as well as hypothesis formation are attributed to formal operations, started by 11 years old. These frameworks were a base for belief, that young children are not able to perceive general rules and relations, and – as a consequence - are not able to build their own mathematics. This is why teachers considered their role as a mediator between “mathematics” and “child” who have to show and to explain all important facts and relations.

2. Lack of research in domain “mathematics education”, lead by native researchers and taking into consideration tradition and achievement of local didactics and pedagogy.

3. Isolation, lack of penetrates (contacts with) the word results in the Polish practice in a very weak cooperation between academic centre, schools and teachers at this educational level.

4. Too little mathematical background in the group of primary educational teachers. This is a main reason, that they are afraid of non-conventional way of talking. Teachers expect the „right” answers, not controversial ones.

Those opinions are supported by the results of opinion poll. One of the authors has been examining the attitude of teachers and students towards school mathematics during 2003 and 2004, mainly among part-time students. The core of the group consisted of 118 part-time students of Pedagogical Faculty Rzeszów University. Those were the future teachers of early mathematics (children aged 6-9) whose occupational preparation consisted of: language, mathematical, biological and artistic, technical and physical education. The second group (34 people) consisted of active teachers, mainly with long-term job seniority, working in kindergartens or primary schools of podkarpackie province.

For the statement: teacher of mathematics should always explain and show everything clearly, ex. how to add while crossing decimal threshold positive answer were given by almost 100% of respondents.

Because of such teaching style, pupils are restricted in their own ingenuity. Among others – they have very limited space for individual talk and utterance, often - they cannot express their own
opinion. Children do not talk too much during math. lessons. Usually, they only answer to teacher’s questions.

THEORETICAL BACKGROUND

Such situation is in a great contradiction with the world opinion about children’s way of learning mathematics, as well at the first educational level. For example, in MATHE 2000 Manifesto we can find the opinion, that such teaching aims like mathematisation, communication, discovering, reasoning have to be present at the every educational level.


Theoretical base for our research is Vygotskian’s approach, elaborated mainly in the book “Thinking and Speaking”, (1989). His hypothesis is that verbal language plays not only an important role in transforming information to the others (communication role), but is also very important for the thinking process. Language is important on all levels of thinking, but in the childhood it has a special meaning: Following quotation from the Vygotskian’s book summarizing one of important aspects of his theory about relation between thoughts and words: The child’s thought, precisely because it is born as a dim, amorphous whole, must find expression in a single word. The child chooses a word as an eligible dress for his thought. As his thought becomes more differentiated, the child is less apt to express it in single words but constructs a composite whole. Conversely, progress in speech to the differentiated whole of a sentence helps the child’s thoughts to progress from a homogeneous whole to well-defined parts (Vygotski, Thinking and Speaking, p.333)

Since 2003, during conference CERME, one working group has been devoted to the problem “Mathematics and Language”. In 2007, group of researchers working in this WG have formulated two large research streams:

- The nature of language and its use in doing mathematics as the main focus – at different levels of granularity,
- Study of language as a vehicle to address other issues of primary interest.

Some discussed questions were as follows:

- how does linguistic activity contribute to the construction of mathematical meaning? (in debate, through writing, individually through “inner speech”);
- when we consider students’ mathematical competence, to what extend is their linguistic competence a part of this? (Morgan C, non-published report of WG8 group, Cyprus, 2007)

Those questions were for us as the direct motivation for research.

One of the most important issues of teaching mathematics among little children is to introduce them into a specific mathematical way of thinking. Patterns are a friendly environment for children, are close to their natural, spontaneous activity. But the most important reason why patterns are important in children work is, that during the work with patterns elements of mathematical thinking occur: discovering the regularity, rhythm, distractions, discoveries of the general structure (not only concentrating at specific features, particular ones). The pattern is a form, template, model (or, more abstractly, a set of rules). Patterns are common in many areas of
mathematics. Very often we can meet the opinion, that mathematics is described as the Science of Pattern.

In our research we tried to observe how patterns environment can stimulate children to talk.

**DESCRIPTION OF THE RESEARCH**

The research was conducted during year 2006-2007 among children 4 - 6 years old, in kindergarten groups. Observations were leading in Public Kindergarten no 17 in Rzeszów (Poland). Drawing and discussing were the basic research method. Children’ work was videotaped, and analyzed. The main aim of research was to examine how children make argumentation in special geometrical environment.

One of the tasks used as the research tools was as follows:

**Task 1. (Work in a small group)**

Children make a paper „path”, draw „stones”, and paint them into three different colors, making patterns. Next day groups exchanges „paths”. Teacher covers one stone with a sheet of paper. Chosen child has to say what a color of this stone is and to give the reason, that his opinion is correct.

**EXAMPLES OF CHILDREN’S ARGUMENTATIONS**

Gathered material shows, that children’s argumentation goes beyond the narrow frames. Children can use the general, abstract argumentation; they see “a general in particular”.

**Example**

Ola (5l), Wiktoria (5l), Kuba (4l), Michał (4l)

N: Who knows, which colour has a covered stone?
M: White
N: And why you, Michał, think that it is white?
M: Because it is.
N: And Ola, what do you think?
Ola: Green.
N: Why do you think, that it is green?
O: Because here is red (she shows a stone lying before the covered one), and here, after a red stone there is a green one (she shows a group of stones lying earlier, but not directly before the group with the covered stone)
N: And what Wiktoria can say?
Wiktoria: the same
N: Why do you think, that it is green?
W: Because it is here and there (points at stones lying on the both sides of the covered stone), and here in the middle, there is the green one.
N: And what Kubuś will say on this matter?
K: It is red.

Two 5 year old girls have noticed a rule, but their argumentations are various. The sense of Ola’s comments is as follows: „If before the covered stone is the red stone, than the covered stone has to be green, because after the red one there is always the green one”. In Wiktoria statement we can find: in whole patterns there is a basic motif: red- green- blue, so, if the covered stone on the left side has a red stone, and on the right – a blue one, I can be sure, that in the middle is a green one.

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1 The Italia didactian, B. d’Amore is the author of this task.
Argumentations given by Ola and Wiktoria we will use as examples of two different approaches to the problem given to the children. In spite of the fact that both statements are general, there is a fundamental difference between them. The first argumentation (given by Ola) we can call the procedural (dynamic), the second one (given by Wiktoria) – conceptual (static).

- **Dynamic** – children refer their own opinions on the basis of directly (empirically) perceived relations between the other group of stones, and one particular group with the covered element. Perceived group exist physically, children show them, very often saying: „look, those stones are colored in this way”. Valid principle is like this: arrangement in a group of stones I see => arrangement in a group of stones I see only in a part.

- **Static** – children refer their opinions to abstract isolated basic motif. They understand the general rule in the pattern, they can say, what is the order in colors, the outcome in each place of the “path”. Valid principle is like this:

  arrangement in the basic motif $\Leftrightarrow$ arrangement in the each other concrete motif.

Similarly to Ola, other children make an argumentation: „Because it was. Because I look on those colors”, “Because I was looking on those previous stones”, “because earlier are also blue-red-green”, “Because I see,…Because here are those (showing on the other, not covered stones)”, “Because I checked it here (in other place): green, yellow, and this is why,”

Argumentations go together with Wiktoria’s statement: “Simply, I know. Because it is at place where there has to be red”, “Because, …because,,,, is it always green, red and yellow”, “because is like in traffic lights: red-green, yellow”, “Because it is pattern”.

It is very difficult to say, which type of argumentation is on the most advanced level. We have observed that the same child uses one argumentation in one situation, and the other one with the reference to the other situation. But in general, the concept of pattern and its motif is closer to the argumentation of the older (6 years old) children.

**SUMMARY**

In the last few years, it became popular to consider drawings in terms of signs, communication processes. Drawing is regarded as a form of “dialogue between gestures and mind”. The child is entirely involved in the act of drawing; his body and mind are expressing some idea. The drawing is a graphic language, by which the child expresses his thoughts, before he can do it with words. The drawing one will always relate to the acquired knowledge, as well as to his own, individual information. The research question is how this natural, spontaneous “drawing language” connects with the speaking language.

Solving the task we presented, children first painted the stones, and after that – they had an opportunity to talk. In our research we put stress not on the act of drawing, but - on the talk. Questions put by the teacher allowed child to look for the regularities, to find arguments. Examples we show convince us, that children are able to find general, but individual arguments. The talk takes place in a group, the teacher puts the same question to particular children. They often answered: I think the same as (for example – Marcin), but when asked to give their own reasons, they formulate it in their own words. They don’t copy statements of other children and on this base we are in opinion, that children understand the general rule and they are able to express it in their own words.
REFERENCES


