TESTING THE MATURITY FOR LEARNING THE ALGORITHM OF MULTIPLICATION

1. THE DESIGN OF AN ALGORITHM PROGRAM

Wiskobas, the primary school mathematics project of IOWO*, has been developed in the Dr. W. Drees school in Arnhem in the course of the years 1971–76. In their algorithm program the stress is on Grades 2–4 (ages 7–10). A large number of observations in the progress of the development have been published in Dutch in Wiskobas Bulletin [1], supplemented by a contribution to psychology of learning [2].

Three phases are to be distinguished in the algorithm program:

(a) Learning addition and subtraction. An important aid in the initial phase is the abacus. For this reason this part is also called the abacus program (see Section 2).

(b) Learning multiplication. The characteristic aid is the crosspoints model [3]. This initially concrete model develops gradually into a thinking model.

(c) Learning long division. The procedure of repeated subtraction is gradually shortened [4].

The algorithm program as developed in the Drees school is a process of increasing schematization, leading the pupils to the usual algorithms.

2. LEVELS IN THE ABACUS PROGRAM [5]

This part starts in the second grade with the abacus as a counting device. In the first weeks of grade 3 working with the abacus is directed towards the usual algorithm. The children pass certain levels of schematizing. We show these levels globally with the addition problem $35 + 46 = 81$.

* Instituut Ontwikkeling Wiskunde Onderwijs = Institute for the Development of Mathematical Education.
Level 1: Adding with the aid of the abacus

1. setting up separately,
2. taking together,
3. exchanging.

Level 2: Adding with position lines

\[
\begin{array}{c|c}
3 & 5 \\
4 & 6 \\
7 & 11 \\
8 & 1 \\
\end{array}
\]

Taking together and exchanging are still separated.

Level 3: Adding according to the usual pattern

\[
\begin{align*}
3 & 5 \\
4 & 6 + \\
8 & 1 \\
\end{align*}
\]

Taking together and exchanging combined by transfer.

A large number of intermediate levels among pupils can be observed in the practice of teaching. The pupils of the Drees school worked at the same time on different levels. Even every single pupil could work on various levels of schematizing at the same time. The term ‘increasing schematization’ does not only mean the process of mathematisation but also the learning processes of the pupils.