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The assessment of the technology curriculum in the first stage of secondary education in the Netherlands

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Abstract

In 1993 the first stage of secondary education in The Netherlands was restructured. All pupils of the age of 12 - 15 years old follow a national core curriculum, called Basic Education. Technology is a new subject in this curriculum. The objectives of Technology are divided into three domains:

- 1 Technology and Society, including technology in daily life, technology manufacturing, vocations in technology and environmental aspects of technology.*
- 2 Handling technology: working principles, systems, control and using technology.*
- 3 Designing and making functional products.*

The National Institute for Educational Measurement is commissioned for the assessment of the National Curriculum. The assessment of the Technology Curriculum is realized by three different tests:

- 1 A written test.*
- 2 A practical skill test.*
- 3 Designing and making a functional product.*

Although the curriculum is taught at one level, there is a need for tests that take into account the differences between pupils. The paper will give a short overview of secondary education in The Netherlands, the implementation of the National Curriculum and the assessment of the Technology Curriculum and the practical choices that were made in the construction of test items.

1 Secondary education in the Netherlands

Secondary education in the Netherlands is a categorical system. It consists of separate types of schools. The system is selective: after primary education children are assigned to separate types of schools. There are four different school types:

- pre-vocational education
- junior secondary education
- senior secondary education
- pre-university education

The first two types of schools take four years, the third takes five years and the last six. All types of schools are completed by an examination. The examination consists of a compulsory and nation-wide component and a school-based component. Both contribute equally to the final mark for each subject.

Since August 1993 all Dutch schools for secondary education have embarked on a new course. It is the greatest reform since the start of the present system in 1968. The most important changes have to do with the

contents of the curriculum. A new core curriculum has become compulsory for all pupils between the ages of 12 and 15 years. Although these content-related changes have far-reaching consequences, the external structure of the educational system remains essentially unchanged. Figure 1 illustrates the new situation.

The new core curriculum consists of 15 compulsory subjects with some free choices: there is an option between French or German and two out of six art-related subjects. The timetable has become a recommended table. Table 1 gives an outline of the new situation.

New subjects in this core curriculum are: technology education, information science and home economics/personal care. Schools are free to combine subjects within certain boundaries.

A new element of the reform consists of the core objectives or attainment targets for each subject. These objectives are formulated

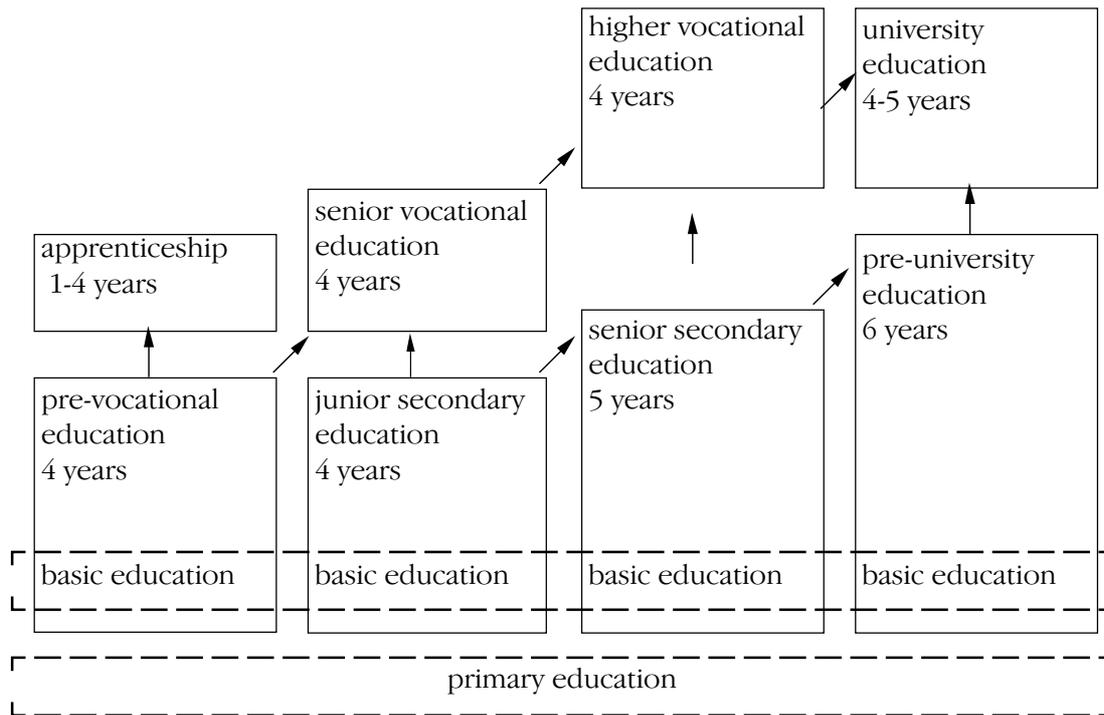


Figure 1: Secondary education in the Netherlands

SUBJECTS AND TIMETABLE OF THE CORE CURRICULUM		
	Subject	Timetable (total hours)
1.	Dutch language	400
2.	English	280
3.	French or German	240
4.	Mathematics	400
5.	Physics and Chemistry	200
6.	Biology	120
7.	Home economics and Health education	100
8.	History and Civics	200
9.	Geography	140
10.	Economics	80
11.	Technology education	180
12.	Information science	20
13/14.	Two subjects to be chosen from:	280
*	Visual arts: drawing, crafts and textile arts	
*	Music	
*	Dance	
*	Drama	
15.	Physical Education	360

Table 1: Subjects and timetable of the core curriculum

without an indication of the level that pupils should achieve.

2 Teaching Technology

Technology as a part of the core curriculum is a new subject. The core objectives are divided into three domains:

A *Technology and society*

- 1 Technology in everyday life. Consequences of post-war technological developments with regard to materials, energy and information for everyday life.
- 2 Industry. Features of a production plant, phases in an production line, working

conditions and the differences of work for men and women.

- 3 Professions. The use of technical equipment in various professions and changes in professions as a result of technological developments.
 - 4 Environment. Effects of technical developments and production processes on the environment and prevention of pollution and exhaustion of natural sources as a result of the use of technical applications.
- B *Using products of technology***
- 5 Mechanical principles. Principles of mechanical operation, transmission problems and constructing models with specific parts.
 - 6 Technical systems. Energy transformation in (fuel) engines, a dynamo, etc. Shaped materials, static construction principles and connection systems.
 - 7 Control systems. Elements of a control system: sensor, processor, actuator. Manipulating (computer controlled) models of control systems.
 - 8 Use of technical products. Designations and expressions. Tools, devices and aids for carrying out simple technical operations. Assessment of functionality and safety of technical products.

C *Producing functional products*

- 9 Preparatory activities. Technical documentation and instructions. Making a work plan. Interpreting regulations for safety
- 10 Design, drawing and reading technical drawings. Making and reading technical drawing, simple sketch or report of a workpiece. Measuring
- 11 Processing materials operations using wood, metals, plastics and textile
- 12 Evaluation of products. Application of predefined criteria related to useability. Choice of materials and environmental aspects of hand-made objects.

The government has provided special classroom equipment for teaching technology. The core objectives for Technology are formulated without an indication of the level of achievement. The problem of teaching at

one level is solved by the possibility of choosing text books or other sources specially written for one or a combination of two school types. Differences between text books and sources do not affect the contents of the core objectives but affect teaching methodology only.

3 The assessment of the National Curriculum

In the Netherlands the National Institute for Educational Measurement (Cito) was commissioned for the assessment of the core curriculum.

CITO has developed national tests for the curriculum according to the core objectives. Tests are approved by the Minister of Education and Science and are compulsory for all schools with one exception: schools of certain denominations that have strong objections to using these tests are allowed to use their own tests.

Each subject has a set of tests depending on the variety of objectives to be tested. Tests are made at one level for the whole range of pupils.

The functions of the national tests for the core curriculum are:

- determining the level of achievement of individual pupils, classes and schools.
- nation-wide evaluation and control of the quality of education in the first stage of secondary education.

In the year 1994 - 1995 the first national tests for the core curriculum were administered. The first results show two problems. First there is the problem of the school organisation: schools are not equipped for these operations. The second problem is the level of difficulty of the tests. For pupils in pre-vocational and junior secondary education the tests appeared to be rather difficult and for most pupils in pre-university education the tests were quite simple.

4 The assessment of the Technology Curriculum

For the subject Technology Cito has developed three tests.

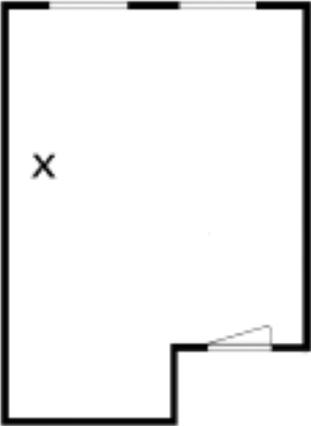
- 1 A written test, consisting of short-answer items or multiple choice items. (One lesson)
- 2 A practical skill test, for example building a construction with a construction model set, investigation into the working principles of an apparatus or programming a computer controlled model of a control system. (Two lessons)
- 3 Designing and producing a functional product. (Six lessons)

Tests are developed in a first lay-out version and are tried out in a random selection of schools. The written test is tried out with a large amount of pupils (each item is pre-tested with about 200 pupils), the other two tests are pre-tested on a smaller scale (each test is pre-tested in two or three forms). The data of these pre-tests are the base for the construction of the definite version of the tests.

A governmental Examination Board gives a final approval of the tests. Three examples of the first tests are given below.

Example 1 (Written test)

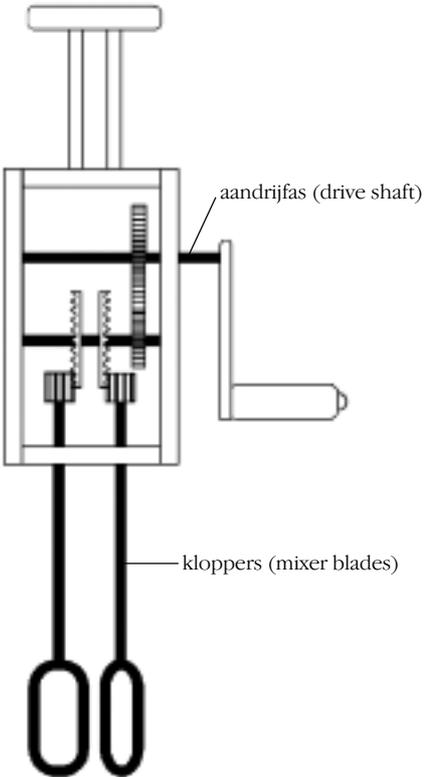
Below you see the floor plan of Marlon's new bedroom, scale 1 : 50. The character 'X' indicates the position of her bed. The bed is 200 x 90 cm.



Draw the bed to the right scale in the floor plan

Example 3 (Practical skill test)

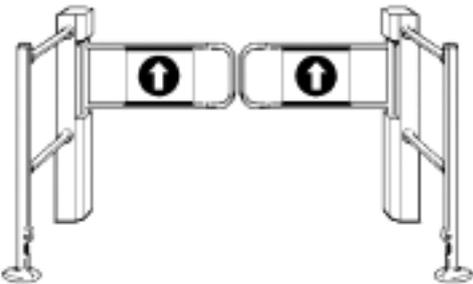
Transmissions are not only present in big engines. Small apparatuses too have many transmissions, for example a mixer. There are mixers for operation by hand. In the drawing below you see such a transmission.



Build a model of this transmission. When the handle is turned around once, the mixer blades should turn around six times

Example 2 (Written test)

At the entrance of a super market there is a gate. When you pass the gate, it opens automatically



Explain the working principle of the gate

5 Research activities

In 1995 Cito collected two types of data: data concerning the administration of the first generation of tests for the core curriculum and data concerning the pre-test of the second generation of tests.

In 1994 - 1995 only the written test was compulsory for schools. Every school had to send the scores of the seventh pupil of each group to Cito. The scores of the technology test are given in table 2.

Level	pre-vocational (level 1)	junior secondary (level 2)	senior secondary (level 3)	pre-university (level 4)
Score	56 %	67 %	71 %	77 %

Table 2: Scores of the first generation written technology test

The table shows that the technology test is made well by the whole population of pupils. Nevertheless schools and teachers are not satisfied with one single test for all pupils. For that reason the Department of Education has decided to release the tests of the second generation in two versions: an 'easy' version and one 'more difficult' version. Schools are free to give the easy or the more difficult version of the test to their pupils.

Before constructing two definite versions of a technology test much research had to be done.

For the second generation of the *written test* 53 items were pre-tested in two types of schools: pre-vocational schools (level 1) and pre-university schools (level 4). The overall scores of these items are summarised in table 3.

	level 1	level 4
p-value	46.2 %	54.2 %

Table 3: Overall scores of 53 pretested items

Removing 14 items with low p-values and dividing the other 39 items into two sets with an overlap of 7 items gives the following result (table 4).

	'easy' version		'difficult' version	
Level	level 1	level 4	level 1	level 4
p-value	60.2 %	67.0 %	49.7 %	60.6 %

Table 4: P-values of the both version of the second technology test.

According to a ruling of the Examination Board that a test should have a score of at least 50 %, the easy version of the test is suitable for level 1 and the difficult version is suitable for level 4.

The *practical skill test* and the *functional product test* are pre-tested in two or three groups of different types of schools, attended by a staff member of Cito. After pre-testing, a definite version of these tests is constructed. Differences between pupils concerning practical skills and problem solving behaviour are less evident than differences concerning cognitive skills.

For this reason the last two tests are made in one version with supplementary indications in a teacher's guide for the use in different types of schools.

6 Differences between pupils and practical choices

Pupils in the different school types of the Dutch educational system have different abilities. The statement of the government is that all pupils should achieve the same core objectives of the core curriculum. Differences between pupils are differences in learning styles, linguistic skills, practical skills, problem solving behaviour and the level of achievement.

For the subject of technology some of these differences can be translated into a test in one or two versions, suitable for pupils in the first stage of secondary education in The Netherlands.

Based on data of pre-tests in schools we can state that by using two different test versions the whole population of pupils will be able to show whether and in what way they have achieved the core objectives of the core curriculum.