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## **Assessment of practical skills in the Technology Curriculum in the Netherlands**

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# Assessment of practical skills in the Technology Curriculum 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*
- 2 *Technical products and systems*
- 3 *Designing and making products.*

*The National Institute for Educational Measurement was commissioned for the assessment of the national curriculum. The assessment of the technology curriculum is undertaken by tests that cover a combination of two domains.*

*Practical skills are very important in the curriculum. Tools for the assessment of these skills are developed by pilot surveys in the schools. Results of these surveys lead to adaptation and improvement of the contents and the features of the tests. The paper will illustrate this process of adaptation and improvement with an example of a design test.*

## 1 Introduction

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

- 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 school courses 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, called Basic Education. 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.

## 2 Core objectives

Technology as a part of the core curriculum is a new subject. The core objectives of this subject were recently revised<sup>1</sup>. There are 19 objectives divided into three domains:

Domain A. Technology and society

Technology in everyday life, industry (production plant), professions.  
Environmental aspects of technology.

Domain B. Technical products and systems

Materials: properties of materials in relation to functionality of products.

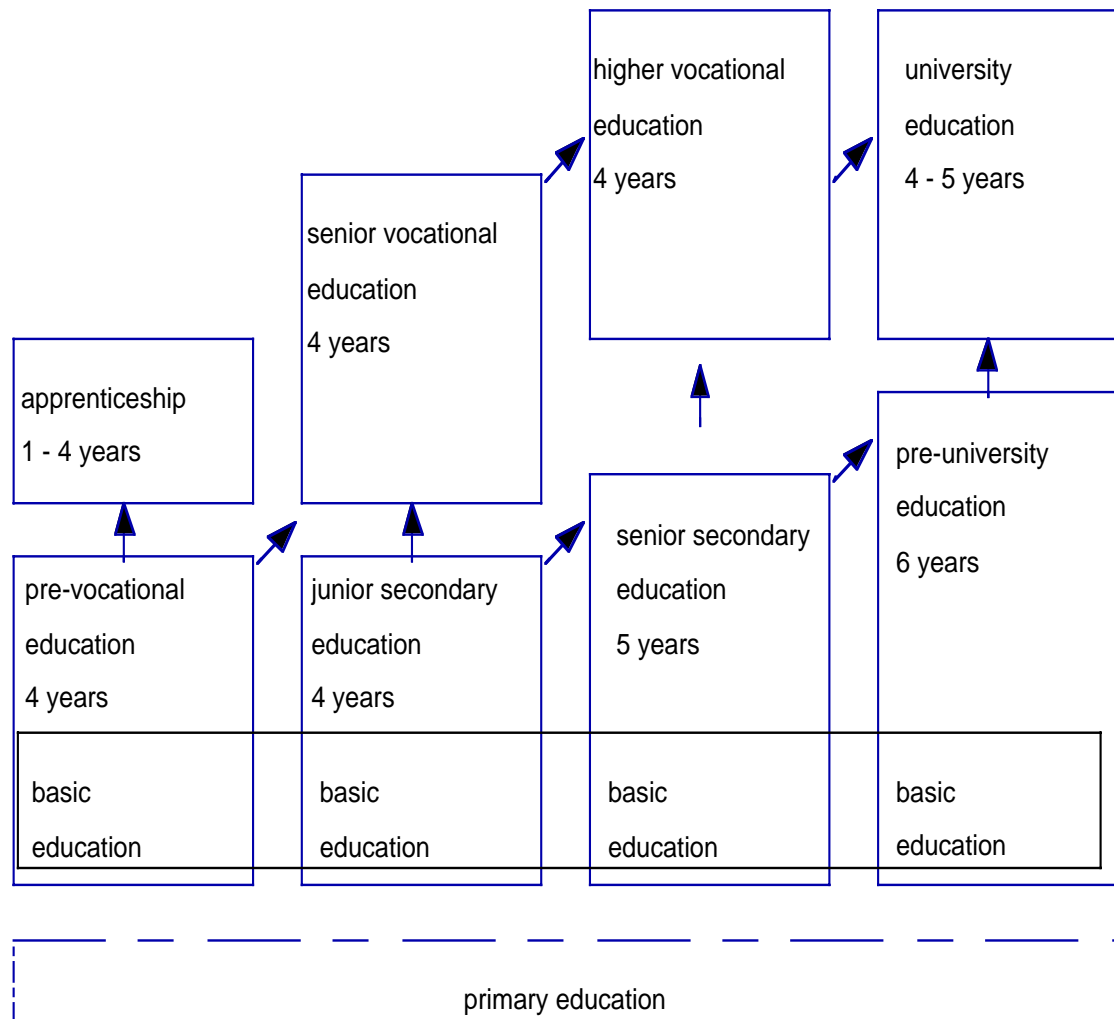


Figure 1 Secondary education in The Netherlands

Energy: transport and transformations of energy.

Information: communication systems, control systems. analogue and digital. Manipulating (computer controlled) models.

Domain C. Designing and making products

Strategies in problem solving. Design techniques (sketching, drawing). Processing materials and evaluating products.

The core objectives for Technology are formulated without any indication of the level of achievement. The problem of teaching to a mixture of pupils of varying level of competency is solved by the possibility of choosing text books or other resources

specially written for one or a combination of two school types. Differences between text books and resources 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 of each subject in the curriculum. Tests are approved by the Ministry of Education, Culture and Science and are compulsory for all schools with one exception: schools of certain religious 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.

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 years '94 - '95 and '95 - '96 the first generation of the tests for the core curriculum was administered<sup>2</sup>. The results show two problems. First there was the problem of the school organisation: schools were not equipped for these operations because of the large number of tests that had to be administered in a short period. The second problem was 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. The Department of Education decided to release the tests of the second generation ('96 - '97) in two versions: an 'easy' version and one 'more difficult' version. Schools were free to give the easy or the more difficult version of the test to their pupils. In order to reduce the number of tests every year from 1997 onwards a selection of the core objectives will be tested.

#### 4 The assessment of the Technology Curriculum

For the subject Technology initially three tests have been developed.

- 1 A written test, consisting of short-answer items or multiple choice items.  
(Testing time: 50 minutes or one period)
- 2 A practical skills test (Two periods)
- 3 A functional product test. Designing and making a functional product. (Six periods)

This first generation of tests were constructed at one level for the whole range of pupils. The second generation of the written test was released in two versions: an 'easy' version and one 'more difficult' version, both consisting of 23 items with an overlap of 7 items. The last two tests were made in one version with supplementary indications in a teacher's guide for the use in different types of schools. A problem was that only one of the three types

of tests was compulsory and most schools chose the written test, so the practice of curriculum testing did not agree with the objectives of technology teaching in the classroom: at least 75 % of the time should be spent on practical skills. For this reason the assessment model for technology has been changed recently. Starting with the third generation of tests, every year one of the following alternatives will be released:

- 1 A combination of a written test and a practical skills test  
(two periods).
- 2 A combination of a written test and a functional product test  
(six periods).

In this model the importance of practical skills is more underlined.

Tests are developed in a first version and are tried out in a random selection of schools. The items of the written test are tried out with a large number of pupils (each item is pre-tested with about 200 pupils), the practical parts of the 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 final versions of the tests. A governmental Test Board gives the final approval for the tests.

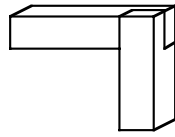
#### 5 Practical skills

In the practical skills test and the functional product test, practical skills play an important role<sup>3</sup>. Traditionally practical skills are related to concrete operations: making a workpiece, operating apparatuses, singing in a choir and playing football. Every operation of this type can directly be observed, contrary to mental operations, such as analysing, judging, etc. In this definition practical skills in the technology curriculum are merely manipulative skills. Another way of defining practical skills is looking at them as a combination of cognitive skills and manipulative skills.

The following example, which does not pretend to be a perfect case, will illustrate this way of looking at practical skills.

Exercise: Make a rectangular attachment of two pieces of wood.  
See figure 2.

Figure 2 Attachment of wooden pieces



Pupils have to consider and make a number of choices in order to accomplish this task:

- think about the strength of the attachment
- think about the visibility of the attachment
- think about the different types of attachment

Suppose a pupil chooses an attachment with nails. Before starting he/she has to choose:

- the type and number of nails
- the right hammer

Being at work he/she has to:

- control the rectangular position of both parts of the workpiece
- see that the wooden pieces are not split by the nails
- use the hammer in the right way.

In this example a simple task is divided into more sub-tasks. Each sub-task requires practical skills in the second sense: practical skills as a combination of thinking and doing.

## 6 Assessment of practical skills

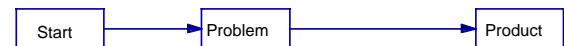
One of the continuous threads through the technology curriculum is the aspect of problem solving. There are different approaches or strategies in problem solving<sup>4</sup>. One of them is the so-called DEC-approach for designing and making functional products. DEC stands for Design - Execute - Control.

- Design:
- define criteria for the product
  - generate ideas and make sketches
  - think about the solution of technical problems
  - make a choice of materials, techniques and working principles
- Execute:
- make a technical drawing
  - make a workplan
  - make the product according to the workplan
- Control:
- evaluate the product

This DEC-approach is generally applied in text books and seems also an appropriate approach for the development of assessment tools.

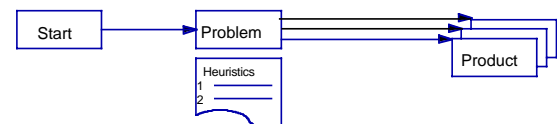
It is possible to realise this approach in 4 different models. Models are different in the way pupils are instructed to accomplish their tasks.

### 1 The closed model



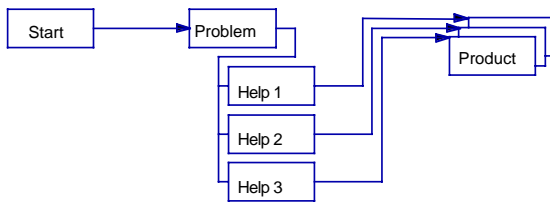
This model gives instructions for the task like a cook-book. Problems are formulated as instructions. Every sub-task is well-defined and a correct execution of the instructions gives a standard outcome. Evaluating the process can be done by looking at the product. Questions like: does it agree with defined criteria, has it correct measures, does it work?, etc.. This model is appropriate for product evaluation but seems not to be appropriate as a tool for the assessment of the whole technology curriculum. It will rather be a method of teaching technology in the normal classroom situation.

### 2 The heuristic model



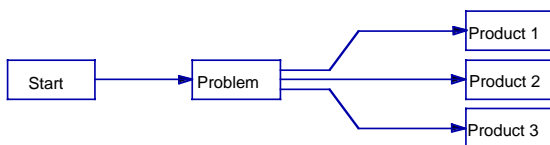
When pupils meet one or more problems during execution of the task they will be supported with heuristics. Heuristics are questions or instructions that do not give complete solutions but give direction to the process of problem solving. The outcomes can be slightly different. In order to construct a more or less difficult assessment tool it is possible to solve one or more sub-problems in advance and to leave the other problems for the pupils. Besides the evaluation of the product one has to take into account the choices pupils have made during the process. This is possible by asking pupils to make a report of their activities.

### 3 The feed-back model



When a pupil meets a problem feed-back can be given by means of a help-chart. A help-chart functions like a safety-net. There are several levels of help-charts. Subsequent levels give more detailed instruction to the pupil. Outcomes will be different. This model is appropriate as an assessment model for the technology curriculum. When the use of help-charts is administered the teacher has a measure for independent working of the pupil.

### 4 The open model



The open model gives no insight in the process, unless pupils are asked to make a detailed report of their work. Assessment of the task can be done on the base of the report and the product.

### 7 The development of a functional product test

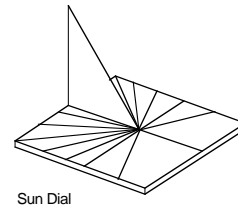
At this moment Cito is developing a functional product test which is shown here. See notes at end.

#### a Situation

Pupils are asked to design and make a sun dial as shown in the figure.

The design and dimensions of the dial are given.

The problem to be solved is to design and make a construction for the dial so that it can be folded into a flat package of a specified size.



#### b Instructions to the pupils

##### Design

- 1 Introduction with some questions.
- 2 Problem: generate 3 solutions of the problem.
- 3 Make 3 sketches.

##### Draw

- 4 Choose the best solution and write down the arguments for your choice.
- 5 Make a drawing of this solution with measurements, etc.

##### Construct

- 6 Make a workplan.
- 7 Construct the dial.

##### Evaluate

- 8 Does it work?
- 9 Evaluate the product.

#### c Assessment

The outcomes of each of the instructions were observed and scored on assessment scales.

### 8 Results

Pupils of a pre-vocational and a senior secondary form in the first stage of secondary education (KS-3) made the a-variant of this test in a pilot situation. The amount of time of this test was 6 hours. The results have shown differences between pupils.

Pupils of pre-vocational level proved to be good sketchers and drawers. They spent 3 hours on the first two stages (design and draw) and came to a great variety of alternatives for the solution of the problem. After this stage they had time enough to make the dial according to their design and workplan. Pupils of the senior secondary level needed less time to accomplish the task, because they generated only one idea and built it. Pupils of this level were not motivated to make more sketches and wanted to start directly with

constructing the dial. Pupils proved to have different motivation, skills and learning styles. Suitable tests for different pupils will not only accommodate to the varying levels of competency of pupils but will also take account into different skills and learning styles. At the presentation of the paper on the conference the initial text and the revised version of the test will be shown and discussed.

## 9 Conclusion

In the Netherlands, teachers, schools and government are discussing questions of levels and learning styles in the first stage of secondary education. The political goal of the government is that all pupils should achieve the same core objectives of the core curriculum.

Pupils in different types of schools have different abilities. Also pupils in the same type of school will be different. The observation of learning styles, linguistic skills, practical skills, problem solving behaviour and the level of achievement of pupils is the base for the development of tests for different pupils.

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 it can be stated that by using two versions of a written test 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. Tests for the assessment of practical skills are constructed as variants of the same test, according to the variety in abilities and learning styles of pupils.

## Notes

- Hand-outs of the full text of the test will be provided at the conference

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