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Gender differences in the acquisition of technical knowledge, skills and attitudes in Dutch primary education: the need for technology education

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1. Introduction

Technology remains a man's domain. The relationship between the number of men and women in technical functions is extremely unequal. Only a relatively small percentage of women are employed in the technical professions.

From a qualitative point of view two dimensions can be distinguished: the dimension 'non-technical vs. technical' and the dimension 'low status vs. high status'. The careers followed by women are largely found within the sector 'non-technical' and 'low status'. Conversely the jobs that are followed by men are found in all sectors. The inequality has grown historically and its social undesirability is widely recognised nowadays.

During secondary education girls tend to choose subjects that can be regarded as more or less non-technical and less scientific. This is true also when choices are made for vocational education. Vocational education of a technical nature is more frequently pursued by boys. This applies to both lower technical education and higher technical education. But it is severely frowned upon to suggest that girls might have less aptitude for technical professions, or that they have less capacities than boys.

A number of promotion campaigns were recently started by the Dutch government in an effort to try to influence the career selection behaviour of girls during secondary education in favour of technical education. Such campaigns are unlikely to have much effect. It is becoming more and more obvious that a long selection process precedes the actual career selection behaviour of girls and boys and it is assumed that the decision has already been formulated by the pupils during the primary school period. If this is the case it can be expected that the effects of the selection process arise in primary school, particularly in technology education.

2. Objectives

It is the aim of the study 'Technical knowledge, skills and attitudes' (TKSA-study), which started in August 1987, to gain more insight into the differences between groups

of primary school pupils with regard to their technical knowledge, skills and attitudes towards technology. This study is being carried out by the Centre for Applied Research in Education of the University of Twente (The Netherlands).

The main questions in this study are:

- Are there differences between girls and boys in group 1/2 and group 7 of Dutch primary education (*i.e.* kindergarten and grade 5) regarding their technical knowledge, skills and attitudes towards technology?
- Which factors — and particularly which school-specific factors (grade 5) — are responsible for these differences?

3. Theoretical framework

It is generally accepted that the selection process with regard to education and occupations in the field of technology and science is part of a larger sex role socialisation process. The sex role socialisation process starts at an early age and, in turn, is part of the socialisation process in the course of which a number of individual and group characteristics influence the development of a set of expectations with regard to their own individual functioning. During the socialisation process of young children biases arise naturally about their own career possibilities that also have an effect on their individual school — and vocational training choices. Within the socialisation process three actors are distinguished: the family, the school and the peer group (Dekkers and Smeets, 1982; Jungbluth, 1981; Linn and Peterson, 1985).

It is well-known that many things have a sex-specific character. The images of occupations in, for example, industry, the army or the construction business have a masculine character, but occupations in nursing or administration have more feminine character (Wijers, 1987). These images also apply to activities like small tasks carried out in the home, namely, car repairs (masculine), or housekeeping tasks and child care (feminine). Activities that have a strong relation to technology have a definite masculine character. From the point of the sex role

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Figure 1: The likely cause of the process of non-technical and technical training and occupation preferences

socialisation process theory the connection between technology and masculinity will lead to boys and girls having different expectations where technology is concerned. Differences can already be observed when the children are young (choice of toys, construction boxes, Technical LEGO) and these differences remain when they choose a training and an occupation. Thus, the orientation towards training and occupation relating to the dimension 'non-technical' does not start at the beginning of secondary education, but probably at an earlier stage (see Figure 1). It is therefore to be expected that boys will have more technical knowledge and skills than girls. And with respect to the development of different sets of expectations, as a result of sex role socialisation, boys will develop a more positive attitude towards technology than girls.

This study is linked to studies into the differences in achievement and attitudes in science, mathematics, information technology and technology education. Smail and Kelly (1984a; 1984b) found differences in attitude towards technology and science in the first stage of secondary education in England. However, no differences in knowledge were found in their study. The Technology Entering Behaviour Study by Streumer and

Doornekamp (1986) shows differences in technical knowledge between boys and girls of grade 6 (group 8 of Dutch primary education).

4. Design

The TKSA-study consists of two independent subdivisions: 526 pupils of 4/5 years old and 1097 pupils of 10/11 years old (group 1/2 and group 7, respectively, of the Dutch primary education level.) The concept of technology differs too much for these groups to allow us to be able to connect these subdivisions. Also a longitudinal design is not feasible because of the imposed conditions of this study. The data of both subdivisions are analysed separately.

The subdivision of pupils of 4/5 years old was chosen because these pupils may already have different attitudes to, knowledge and skills in technology before they begin primary school. Preschool experiences with technology are also examined. These data report the early technical knowledge, skills and attitudes of 5 year-old children towards technology. We also investigated the influence exerted by the parents. By the time pupils reach the age of 10 or 11, they have already undergone 6 to 7 years at the primary school. From the Technology Entering Be-

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haviour Study (Streumer and Doornekamp, 1986) it is known that differences occurred in technical knowledge and skills between boys and girls. The boys scored higher on most of the questions of the Entering Behaviour Test. The subjects used in that study were 12 year old boys and girls (from the last group of the primary school). It is expected that such differences will also occur in group 7 of the primary school.

Students of 20 Colleges of Education for primary school teachers appear, as part of their practical work, in both subdivisions as experimenters. These students were instructed and trained in advance to administer the tests. A nation-wide study was carried out at 90 primary schools. The sample of primary schools in this design was not randomised because researchers had to depend on the co-operation of Colleges of Education for primary school teachers. The representativeness of the schools is assessed retrospectively.

5. Instruments

Technology is not taught in Dutch primary schools. However, in many subjects (e.g., science, handicraft, needlework and world-orientation) technical topics do arise. These topics, together with the framework of technology education to be found in secondary education, form the basis for a test domain for each subdivision in this study. A group of experts has judged these test domains, and revised versions are used for the development of the tests for both subdivisions.

The tests for *group 1/2* of the primary school are administered individually by the experimenter. The following tests are used:

- Test of Technical Knowledge (TTK). This test consists of combination tasks, of verbalising technical activities, and of context tasks.
- Test of Technical Skills (TTS). This is a practical test. The pupil has to imitate two examples by using construction materials.
- Test of Technical Attitudes. The pupil has to make a choice between two kinds

of toys (TTA1) and a choice between 'feminine' toys and 'masculine' toys (TTA2).

General intelligence is measured by a part of a 'Scholastic Aptitude Test' (SAT).

A Pupil-Questionnaire and a Parent-Questionnaire are used for gathering additional information (e.g., the preference for technical or construction toys, the possibility having experience with technology at home, the parents' interest in technology, and the level of education and occupation of the parents).

The tests for *group 7* are completed by all pupils under the guidance of an experimenter. The following tests are used:

- Test of Technical Knowledge (TTK). This test consists of 38 multiple choice items. Three kinds of technical knowledge can be distinguished: knowledge of facts, insight knowledge and pragmatic knowledge.
- Test of Technical Skills. The practical part (TTSC) of this test is making a paper construction, the written part (TTSP) is solving five problems.
- Test of Technical Attitudes (TTA). This test consists of three subtests. The attitude is assessed by five scales: interest for technology (options), interest for technology (activities), image of technology, role model (general), and role model and work.

In a pilot study the Technical Tests were administered to 90 pupils in five primary schools. After analysing the data some items in the Test of Technical Knowledge have been adjusted.

General intelligence is measured by a part of the 'Standard Progressive Matrices' (SPM). The technical topics in primary education are also investigated. In different subjects (e.g., handicrafts, needlework, science and world-orientation) technical topics may arise. For this purpose a Curriculum Check-List is used to check those topics being taught in the primary schools that are involved in this study. Another important as-

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pect is the attitude of the teachers with regard to equality of the sexes in relation to technology. Information on this attitude and other information on the school is gathered by a School-Questionnaire.

A Pupil-Questionnaire and a Parent-Questionnaire are used to gather additional information. The above mentioned school-specific factors, pupil-specific factors (intelligence and age) and several family-specific factors will be looked at by analysis of variance for their influence on the technical knowledge, the technical skills and the attitudes towards technology of pupils of 10/11 years old.

6. Results

The data of each subdivision are analysed separately. The statistical data analysis consists of frequency distributions, correlations, t-test and analyses of variance. The results of the analyses will also be given separately. The well-known SPSS package was used for this purpose.

For this paper only the data of pupils of Dutch origin are analysed. In the sample of *group 1/2* 89.5% of the pupils ($n=471$) is Dutch, in the sample of *group 7* this is 85.1% of the pupils ($n=933$).

6.1 Subdivision group 1/2

The sample of this subdivision consists of 471 pupils of Dutch origin: 231 girls and 234 boys (the gender is not known for 6 pupils). The average age is 5 years and 3 months. 58 Primary schools are involved in the subdivision.

At first the observed differences are discussed, next we go further into the possible explanatory factors. The differences that are relevant for this study are summed up in Table 1.

The girls have a mean score on the Scholastic Aptitude Test that is significantly higher than the mean score of the boys. This is a normal phenomena because girls generally do better on these kinds of tests than boys.

The boys have higher mean scores in all the Technical Tests. The differences between girls and boys are considerable when we

look at the mean scores of both Tests for Technical Attitude. Boys have a greater preference for masculine toys than girls. The maximum score is 5.00 the mean score for boys is 4.04).

The girls do have a preference for feminine toys but to a lesser degree. Additionally, the boys have a stronger preference for playing with construction toys than the girls (the maximum score is 12.00 when construction toys are preferred to non-construction toys, and more complicated construction toys are preferred to less complicated construction toys).

These differences agree with the opinion of the teachers and the parents (see Table 1). Not only do boys have a stronger preference for construction toys, but they also play more intensively with these toys than girls.

In Table 2 the correlations between the technical variables and the general intelligence is given for girls and boys. Table 2 shows no correlation between technical attitude (TTA1 and TTA2) on the one hand and technical knowledge (TTK) and (TTS) on the other. There are correlations between general intelligence on the one hand and technical knowledge and skills on the other for girls and boys. And there is also a correlation between technical attitude 'preference for construction toys' (TTA1) and technical attitude 'feminine-masculine toys' (TTA2) and between technical knowledge and technical skills.

By means of several factor analyses of variance the influence of various pupil-specific, family-specific and school-specific factors (in total 18 factors) on the four Technical Test scores is investigated. These factors are generated by converting variables at interval-level into (among others) dichotomous variables. One dependent variable (test score) and two independent variables (factor 'gender' and one of the 18 factors) (two-way analysis) were placed in each analysis of variance.

Pupil-specific factors

Intelligence and age influence the score of the Test Technical Knowledge (TTK) and Skills (TTS). The scores increase when the

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Test results	Girls		Boys		T-value	Prob.
	mean	n	mean	n		
TTKnowledge	23.71	231	24.61	234	-2.33	0.020
TTSkills	9.13	216	12.07	220	-3.15	0.002
TTAttitude1: constr. - toys	5.26	229	8.12	234	-14.33	0.000
TTAttitude2: fem.-masc. toy	1.56	229	4.04	234	-22.26	0.000
Schol. Aptitude Test	15.92	229	14.80	231	2.63	0.009
Some results of the Pupil-Questionnaire						
Painting and drawing	0.37	231	0.13	234	6.22	0.000
Construction	0.12	231	0.79	234	-19.51	0.000
Dolls	0.73	231	0.31	234	9.96	0.000
Fine motor skills	4.28	231	3.53	234	4.96	0.000
Handicraft	3.65	231	3.31	234	3.60	0.000
Some results of the Parent-Questionnaire						
Builder	1.74	205	2.44	202	-10.14	0.000
Fantasy games	2.51	202	2.50	204	0.14	0.000
Play with construction toys	1.36	205	2.22	203	-11.83	0.000

Table 1: Differences between girls and boys group 1/2

intelligence of the age is greater. In Table 2 the correlation between general intelligence and technical knowledge and between general intelligence and technical skills is, compared with other correlations in Table 2, relatively high (technical knowledge: girls 0.39 and boys 0.46; technical skills: girls 0.26 and boys 0.29).

The interaction effect of intelligence and gender on technical attitude 'feminine-masculine toys' (TTA2) is confusing: boys with intelligence test scores of between 12 and 15 have mean test scores above the mean score of the other boys, while the girls with the

same intelligence test scores have a mean test score below the mean score of other girls.

Family-specific factors

About 90% of the parents of the pupils involved in this sample completed the Parent-Questionnaire. Table 3 shows some results.

In this study the family-specific factors are the level of training and/or occupation of the parents, whether the training and/or occupation is technical or not, doing repairs and/or small jobs at home, handy with tools and generally interested in technology.

Table 2: Correlations between technical variables and general intelligence

	Girls				Boys			
	TTS	TTA1	TTA2	SAT	TTS	TTA1	TTA2	SAT
TTK	0.22**	-0.06	-0.09	0.39**	0.39**	0.16	0.10	0.46**
TTS		0.01	-0.02	0.26**		0.08	-0.01	0.29**
TTA1			0.30**	-0.02			0.30**	0.08
TTA2				-0.09				0.04
** = <.001 * = <.01								

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	Mothers		Fathers	
	mean	n	mean	n
Level of training and/or occupation	1.45	397	1.71	404
Technical training and/or occupation	0.01	397	0.59	397
Handy with tools (own judgement)	2.24	410	3.20	402
Repairs at home, car, bicycle, electrical	3.51	411	13.92	411
Mending clothes, dressmaking	1.67	411	0.07	411
Interested in technology	4.90	387	6.21	393
Importance of emancipation	7.45	376	6.80	371

There are three main effects on the dependent variable technical knowledge (TTK). Boys and girls of fathers with a high level of training and/or occupation have higher mean scores. This also applies where mothers with a high level of training and/or occupation are concerned. Mothers who show more interest in technology influence the scores of their sons and daughters.

There are no significant effects of the family-specific factors on the technical skills scores. Two factors give interaction effects on these scores. When the mother increases her interest in technology then the mean scores of the daughters decrease, while the mean scores of the sons increase. This is also the case when the mother is increasingly more handy with tools.

Fathers with a technical training and/or occupation influence the scores on both Test Technical Attitude for girls as well as for boys. The level of training and/or occupation of the mother has a negative effect on the mean scores of boys and girls: when the level rises, the mean scores drop. When the mother is very handy with tools their daughters and sons have lower mean scores than when the mother is not very handy. With nearly all family-specific factors there is a main effect of the independent factors 'gender'. This means that boys have higher mean scores than the girls on the four Technical Tests.

School-specific factors

In this subdivision there are only some general school-specific factors, which are

not related to technology. There are no main effects on the Four Technical Test scores.

6.2 Subdivision group 7

The sample of this subdivision consists of 933 pupils of Dutch origin: 464 girls and 466 boys (the gender is not known for 3 pupils). The average age is 10 years and 11 months. 57 Primary schools are involved in this subdivision.

At first the observed differences are discussed, next we consider possible explanations. The differences that are relevant for this study are summed up in Table 4.

There is no significant difference in intelligence between girls and boys. Notably, boys score significantly higher than the girls in technology. An exception to this is the Test Technical Skills 'Construction' (TTSC). The girls scores are about the same as the boys scores. The results presented above are obtained by means of separate t-tests. As we will see later, the analyses of variance will give the same significant differences.

The results of the Pupil-Questionnaire and the Parent- Questionnaire show significantly higher mean scores for the boys. The boys read more books on technical subjects, play longer with technical toys and are more stimulated to carry out technical activities than the girls.

General intelligence (SPM) correlates significantly with technical knowledge (TTK), technical skills 'construction' (TTSC), technical skills 'problem solving' (TTSP) and technical attitude 'activities' (TTA1) for girls as well as for boys (see

Table 3: Differences between mothers and fathers of pupils from group 1/2

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Table 5). There is no correlation with technical attitude 'interests' (TTA2). The other correlations are regularly higher for the boys than for the girls. With regard to technology the boys seem in some degree to be more consistent.

About 85% of the parents of pupils involved in this sample have completed the Parent-Questionnaire. Table 6 shows some results.

The parents of the pupils of group 1/2 as well as the parents of the pupils of group 7 are almost identical in so far as the under-mentioned characteristics are concerned (see Table 3 and Table 6).

By means of a number of two-way analyses of variances we have investigated whether the observed differences between girls and boys in technical knowledge, skills and attitude towards technology can be carried back to the pupil-specific, family-specific or school-specific factors.

We have to be careful when we draw conclusions. The factors have been analysed independently of other factors (only in com-

bination with the variable 'gender'). Later, a combined model will be tested. In none of the analyses with the test scores of the Test Technical Skills 'Construction' as the dependent variable have main effects been observed for the factor 'gender' (see also Table 4).

Pupil-specific factors

In this analysis intelligence and age are regarded as pupil-specific factors, beside the factor 'gender'. Intelligence has influence on technical knowledge, skills 'construction', skills 'problem solving' and attitude 'activities'. When the intelligence is higher, the mean scores on these tests are also higher. The two-way interaction of intelligence and gender on technical skills 'problem solving' is weak. The age of the pupils has no influence on the various Technical Test Scores.

Family-specific factors

The level of training and/or occupation of the father as well as the mother influences

Table 4: Differences between girls and boys from group 7

Test results	Girls		Boys		T-value	Prob.
	mean	n	mean	n		
TTKnowledge	16.09	455	20.19	464	-12.93	0.000
TTSkills: Problem solving	9.08	452	10.74	460	-5.87	0.000
TTSkills: Construction	10.73	403	11.22	404	-.81	0.000
TTAttitude1: activities	16.65	453	23.68	460	-16.90	0.000
TTAttitude2: interests	17.12	452	22.16	463	-13.06	0.000
Stand. Progr. Matrices	15.34	455	14.96	452	1.58	0.000
Some results from the Pupil-Questionnaire						
Books on technical subjects	0.05	392	0.26	389	-8.42	0.000
Time spent playing with technical toys	0.94	378	1.82	366	-14.77	0.000
Availability of technical toys	2.34	406	3.85	404	-11.99	0.000
Some results of the Parent-Questionnaire						
Judgem. play w. techn. toys	2.09	402	3.85	403	-17.67	0.000
Judgem. child is technical	5.88	390	6.82	398	-8.31	0.000
Stimulates children to be interested in technology	6.20	393	6.80	395	-5.80	0.000

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the scores on the Test Technical Knowledge (TTK) and the Test Technical Skills 'Construction' (TTSC). With the last mentioned dependent variable there is one interaction effect. When the mother is keenly interested in technology the mean scores of their daughters drop, while the mean scores of their sons continue to rise.

The scores on the Test Technical Skills 'Problem Solving' (TTSP) is also influenced by the level of training and/or occupation of the parents. The influence is in the same direction. The interaction effect (level of training and/or occupation of the mother) causes a slight drop in the mean score of the boys. There are opposite main effects of the 'technical training and/or occupation' factor of the father and the mother. When the training and/or occupation of the father is more technical, the mean scores of the boys as well as the girls drop.

The family-specific factors 'repairs at home' influences the mean scores on the Test Technical Attitude 'Activities' (TTA1). When the parents do more repairs at home (e.g., painting and decorating, electrical work, car repairs and plumbing) their children have a more positive attitude towards activities done by men or women. This also applies when the mother is more interested in technology.

The interest of the parents in technology (reading books or magazines and/or watch-

ing television programmes about technology) encourages an interest in technology in their children. When the fathers are more handy with tools than other fathers, the children of the handy fathers have higher mean scores. The influence of the mean scores of the daughters is greater than on the mean scores of the sons. The portion of 'technology' in the training and/or occupation of the father influences also the interest of the children in technology.

Some of the interaction effects caused by some family-specific factors give few possibilities for interpretation.

School-specific factor

The Netherlands has been divided into four regions for an analysis variance with region as the independent variable. On four out of five Technical Tests this factor has a main effect. The mean scores per region show that in several tests the children in the north and the west of The Netherlands have the lowest mean scores, while children from the east and the south have the highest mean scores. These differences agree with the differences in the results from the annual Primary School Achievement Test. The factor 'urbanisation' (number of inhabitants) only influences the scores on the Test Technical Skills 'Construction' (TTSC).

The first real school-specific factor is 'number of pupils'. In order to investigate

Table 5: Correlations between technical variables and general intelligence

	Girls					Boys				
	TTSP	TTSC	TTA1	TTA2	SPM	TTSP	TTSC	TTA1	TTA2	SAT
TTK	0.23**	0.32**	0.20**	0.11	0.41**	0.45**	0.25**	0.33**	0.18**	0.40**
TTSP		0.16**	0.05	-0.01	0.20**		0.22**	0.17**	0.09	0.36**
TTSC			0.07	0.07	0.34**			0.11	0.09	0.29**
TTA1				0.36*	0.12*				0.37**	0.14*
TTA2					0.01					0.05
** = < 0.001 * = < 0.01										

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	Mothers		Fathers	
	mean	n	mean	n
Level of training and/or occupation	1.40	741	1.73	764
Technical training and/or occupation	0.01	741	0.48	764
Handy with tools (own judgement)	2.34	785	3.19	755
Repairs at home, car, bicycle, electrical	3.51	804	13.53	771
Mending clothes, dressmaking	1.68	805	0.06	770
Interested in technology	5.06	751	5.40	733
Importance of emancipation	7.59	751	6.92	704

Table 6: Differences between mothers and fathers of pupils from group 7

the influence of this variable the pupils are divided into six groups according to the number of pupils in their school. This factor causes only a main effect on both Tests Technical Skills (TTSC and TTSP). However, no relation between the mean scores per group and the number of pupils per group can be observed. The school-specific variable 'denomination' caused main effects on the five Technical Test scores. Though the influence on these scores is not always the same, one can state that the children at state schools have lower mean scores than other children. In four tests children from Roman Catholic schools have the highest mean scores, boys as well as girls.

Many primary schools in The Netherlands have integrated the subjects handicraft and needlework. The children from those schools have a more positive attitude towards technology than children from schools that have not integrated these subjects. This positive attitude is also obtained when girls and boys follow both these lessons, and not handicraft for only the boys and needlework for girls.

Children from schools that pay attention to technology as a subject or integrate it with other subjects do not have higher mean scores on the Test Technical Attitude 'Interests' (TTA2) than children from schools that pay attention to technology only by chance.

The technical topics in the curriculum are divided into knowledge and skills. An analysis of variance is carried out on these factors (separate) with the factor 'gender'. The result shows main effects of the factor

'knowledge' on the five Technical Tests. More technical 'knowledge' topics in the curriculum go with higher mean scores on the tests. The influence of technical 'skills' topics is only observed in the mean scores of two tests.

The school-specific factor 'emancipation in the curriculum' has a positive influence on the scores of the Test Technical Skills 'Problem Solving' (TTSP) and a negative influence on the scores of the Test Technical Attitude 'Interests' (TTA2).

7. Conclusions

7.1. Subdivision group 1/2

In this study significant differences between boys and girls from group 1/2 with regard to technical knowledge, skills and attitude towards technology have been observed. The boys have higher mean scores in the five tests. The girls do better in the Scholastic Aptitude Test. The boys prefer to play with masculine toys and construction toys. Nearly the same differences are found with the Pupil-Questionnaire and the Parent-Questionnaire. The influence of intelligence and age (pupil-specific factors) on the test-scores is not surprising. The family-specific factors investigated in this study have little influence on the various test-results. The level of training and/or occupation of both parents influences the scores on the Test Technical Knowledge. Children of fathers with a more technical training and/or occupation have a more positive attitude towards technology.

With nearly all family-specific factors there is a main effect of the independent

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'gender' factor. When the father does repairs or small jobs at home, there is no significant difference between boys and girls on the Test Technical Knowledge.

The school has, as expected, no effect on the test scores.

7.2 Subdivision group 7

We have been able to determine that there is no significant difference in general intelligence between the sexes. The boys score significantly higher on the Technical Tests, with the exception of the Test Technical Skills 'Construction'.

The boys read more books about technology and have more technical toys to play with than the girls. The parents judge their sons to be more technical than their daughters. The scores on the Test of Technical Attitude 'Interests' do not correlate with general intelligence. General intelligence influences the other test scores positively, while the age of the children does not play a role. Sex differences with regard to technology are also present with the parents of the pupils of group 7. Various family-specific factors influence certain test scores. In seven cases they apply to the father as well as the mother (e.g., the level of training and/or occupation). A technical training and/or occupation has an effect only on the scores of the Test Technical Skills 'Problem Solving'. When the parents show an interest in technology, it has a positive effect on the attitude of their children towards technology. Regional differences have been found between the participating schools. These differences agree with results of the Primary School Achievement Test. Children at a state school score significantly lower than children who attend protestant or Roman Catholic schools. The way schools have organised the subjects of handicrafts and needlework (subjects integrated, and taught to boys and girls), has a positive effect on the attitude of the children.

The children of those schools paying more attention to technology in their curriculum gain higher scores in the tests than children from other schools. The girls benefit from these circumstances, but the boys

benefit also. The gap between the boys and the girls is not closed yet by the extra attention given to technology at school.

8. Discussion

The operationalisation of the variables technical knowledge, skills and attitudes was easier to perform for subdivision group 7 than for subdivision group 1/2. The contents of technology for group 7 agrees more with what is generally understood by technology.

The presence of sex differences with regard to technical knowledge, technical skills 'problem solving' and both technical attitudes at the age of 10/11 years according to the theoretical framework shows clearly that the sex role socialisation process is already active during primary education. The Test of Technical Skills 'Construction' appears not to be a valid operationalisation of technical skills. Probably this test assesses manual dexterity rather than technical skills (working with materials and tools). The sex differences with regard to technical knowledge, technical skills and attitude towards technology are already present in 5-year old children. We may conclude that the socialisation process mentioned earlier starts before the children enter the primary school.

By studying the explaining factors in subdivision group 7 for the differences that have been found in technology, it is possible to determine how the sex role socialisation process can be influenced. The analyses of variance have yielded a varied picture as was presented in the preceding paragraph. Factors such as the level of training and/or occupation of the parents' interest in technology and technology education at the primary school have a positive effect on the technical knowledge, skills and attitudes towards technology of girls and boys. By familiarising the children with technology one has the possibility to influence the selection process in favour of technology.

In a number of towns in The Netherlands projects have been set up where girls from about 10 years can become acquainted with technology after school hours. These projects are called 'Technika 10'. Women instruct girls in all kinds of technology. Only a

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Small groups of sixth formers
permitted by PRIOR ARRANGEMENT
ONLY.

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The need for technology education

limited number of girls have the possibility to go to 'Technika 10'. The results of these projects show great promise.

This study emphasises the need of a more structural approach for all children by means of introducing technology as a subject in their primary schooling. Existing subjects of the primary school curriculum already comprise several technology topics. These have to be worked up into a clearly described subject. In other (European) countries there are good examples of technology starting in *kindergarten*. Only, when primary education pays more attention to technology education, will promotion campaigns no longer be necessary.

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