

## Summary

### *Problems and methods*

The project has been carried out at the Institute of Educational Research, Teachers College, University of Stockholm (director: Professor Torsten Husén) by order of the Industrial Council for Social and Economic Studies (SNS) and the Government Committee of 1957 on the final organization of the comprehensive school. The results are intended to be used as a basis for the committee when working out curricula for the comprehensive school.

#### **Problems**

The main problems of the research work are to investigate the following aspects in the curriculum contents of mathematics and Swedish language in the basic school. Furthermore the results of different partial investigations are to be compared.

1. The need of knowledge in different elements of each subject, partly for further studies and vocational activities, partly for leisure time.
2. The results of teaching in the basic school in relation to the requirements.
3. The teaching of the basic school in different elements of the subjects.

#### **Methods**

Regarding *problem 1*, questionnaires were distributed to:

- a. Teachers of vocational schools concerning the needs of previous knowledge and the requirements of the vocation in itself
- b. Teachers of gymnasia (high-school) concerning the needs of previous knowledge
- c. Supervisors of certain categories within trade and industry
- d. Employees aged 18—30 within certain occupations.

Regarding *problem 2*, questionnaires were distributed to:

- a—b. Teachers of vocational schools and gymnasia (high-school) concerning the standard of the pupils' previous knowledge, when beginning their further training
- c. Supervisors concerning the standard of the employees' knowledge
- d. Employees concerning their own lack of knowledge.

Besides, filled investigations with objective achievement tests have been carried out among employees. The results of these tests have been related to the pupils' results in the last form of the basic school ("folkskolan klass 7") with respect to the same mean of the marks in the subject. This investigations intend to enlighten, more systematically, the problem of retaining knowledge after school, according to the same principles as those of Norris (1940).

Regarding *problem 3*, questionnaires were distributed to teachers of the upper section of the secondary school and corresponding forms in the basic school. The teachers were asked how they spent the time available on different sub-elements of their subjects.

The following *response frequencies* were obtained for the questionnaires sent by post:

Questionnaires to	Mathematics		Swedish language	
	Responses		Responses	
	n	%	n	%
Vocational schools	444	86	449	84
Gymnasia	331	88	412	86
Teachers of the upper section of the secondary school and corresponding forms of the basic school	1,597	80	1,192	66

The differences between various sub-groups are not significant. The figures for vocational schools indicate the number of schools answering the questionnaires. For each course separate answers were obtained. Thus the number of questionnaires is larger, (in mathematics 931, in Swedish language 812).

The *field study* of employees took place at 51 enterprises, representing the following branches: Mining and metal works, wood and pulp works, food production industries, offices, banks, and insurance companies. There were 12 categories of employees and the total number of persons tested was 1,586, i.e. 91 % participants. This percentage does not include individuals, who were ill at the period of testing. Including these persons the percentage will be 85 %. The testings took 4½ hours. The supervisors had only to fill in the questionnaires (N=219).

The investigations of the last form of the basic school were carried out in the 7th form of the basic school "folkskolan" (N=980), and in the secondary school "realskolan" (N=618).

### *Results: Mathematics*

**The need for mathematical knowledge for further training in vocational training schools and in gymnasia.**

The results of the vocational training schools have been analysed for the following ten groups of vocations:

<i>For industrial employees</i>	<i>Other employees</i>
Metal workers (M)	Agricultural workers (J)
Motor mechanics and electricians (ME)	Transport workers, military and civil guards (TMC)
Wood and pulp workers, builders (TB)	Clerks (K)
Other workers (ÖI)	Domestic workers (Hu)
	Nurses (V)
	Teachers (P) (mainly preschool)

Pupils to the above mentioned industrial vocations have merely passed the primary school "folkskolan". Persons who intend to become nurses and teachers have mostly passed the secondary school "realexamen". Pupils to other vocations come from both of these types of schools.

The material from the *gymnasia* has been divided into the following sub-groups:

AI <sup>3</sup> , AI <sup>4</sup>	=Allmän linje (general subjects)
RI <sup>3</sup> , RI <sup>4</sup>	=Reallinje (mainly science)
Hg	=Handelsgymnasium (Trade gymnasium)
HTL	=Högre tekniskt läroverk (Technical gymnasium)
Ss	=Småskollärlärlinje (Teachers college for teachers in the primary school, form 1—3)
Fs	=Folkskollärlärlinje (Teachers college for teachers in higher forms of the primary school)

In order to make the judgements more modulated, to give the raters a common frame of reference and to avoid the systematic rating tendencies, the subjects of mathematics and Swedish language have been analysed in various elements and sub-elements. The course contents of mathematics comprises of 48 sub-elements, distributed in the following elements:

Arithmetic, with and without *fractions* (decimal, common etc.)

Measurements

Equations, (also algebra and square roots)

Applied mathematics (percentage, interest, cash account etc.)

Geometry, theorems and constructions

Geometry, applied: planimetry, stereometry

Mental arithmetic and estimations

The *ratings* were made in an ordinal scale, graded from 0—5, where:

0=no needs of previous knowledge

3=needs of a certain amount of knowledge

5=needs of qualified knowledge

The *working-out* aims at obtaining the interior resemblance between various courses with regard to the importance of different elements. In this case rank correlations have been used, and—in certain cases—Kendall's

coefficient of concordance (Siegel 1956). This type of analysis is called *analysis of structural resemblance*.

Moreover, the working-out aims at obtaining comparisons between the absolute figures of the ratings, *analysis of level*, for various courses—as well as for the entire material. Differences between various courses—with regard to each element—were tested by the extended median test (Siegel 1956), between separate courses by the median test.

The differences between the rank orders of the elements within the entire material are tested by Friedman's two-way analysis of variance by ranks (tab. 21, 23). The differences between single elements within the various courses are tested by Wilcoxon's matched-pairs signed-ranks test (Siegel 1956, tab. 22, 24).

*Results:* The resemblance of *structure* between the entire material for vocational training schools and the entire material for gymnasia is comparatively strong,  $\rho = .71$ . Between the groups of courses within each of these two materials it is also strong [vocational schools (YMa)  $\rho_{av} = .85$ , gymnasia (GyMa)  $\rho_{av} = .76$ . Tab. 29 p. 116].

Within the industrial groups of courses the resemblance of structure is very significant ( $\rho > .90$ ), as well as between the courses named Hu, V and P (tab. 30, p. 117). Within the material of the gymnasia (tab. 34, p. 120), there is above all one group, the trade gymnasium (Hg), that deviates from the other courses.

In most cases, the *analysis of level* shows strong needs for the courses of the gymnasia (tab. 26 p. 112). The differences between the groups of courses are shown in tab. 37 (vocational schools), and in tab. 38 (gymnasia).

The results are compiled in fig. 4 (p. 135). Dark colours imply stronger needs.

Four categories of elements can be distinguished:

I. Elements wanted in all types of courses, and all types of schools. These elements can be labelled as "minimum essentials" of mathematics. To these elements belong: Arithmetic, even common fractions, measurements, mental arithmetic and estimations. Applied mathematics: percentage, interest, cash account and means.

II. Elements wanted merely from specific courses. To these elements belong: Applied geometry (esp. planimetry), simple commercial mathematics and simple equations.

III. Elements needed in certain groups only in the gymnasia: Geometry (theorems and constructions) difficult equations, algebra, square roots, the maining part of applied geometry and commercial mathematics of a more specific type.

IV. Elements not needed: E.g. slide-rules, calculating machines.

**Other investigations**

*The need for mathematical skills according to supervisors and employees* has been designed as frequency ratings for most of the employees.

In most occupations the frequencies are low, even if the structure of the frequency ratings is quite similar to the structure of the needs of previous knowledge. Higher frequencies are merely reported for simple mathematical functions i.e. arithmetic with decimal fractions, percentage and estimations.

*The need for mathematics in leisure time* is, according to the employees' own ratings, not very frequent for most of them.

In general the need for mathematics in leisure time is lower than at work.

*The ratings of the standard of the pupils' previous knowledge* have been done by the teachers (fig. 26 p. 276). Dark colours imply lack of knowledge. In general all teachers emphasize the lack of knowledge in mental arithmetic, estimations and arithmetic with common fractions. The vocational teachers, especially those of industrial schools, also emphasize the lack of many other elements, applied geometry, among others. The teachers of the gymnasia are not satisfied with theoretical geometry (theorems) difficult equations, and algebra.

*The ratings of the employees' knowledge done by the supervisors* are not negative. However, these ratings must be compared with the small needs of mathematics.

The employees themselves are of the opinion that their knowledge of mathematics is too small in most occupations.

*The retention of knowledge after school* has been tested, according to the same principles as Norris (1940). However we have endeavoured to keep constant:

- a. the length of the basic school.
- b. the level of knowledge of the persons tested estimated by the marks in each subject
- c. the range of further education in vocational training schools.

This has been done by applying the principles of analysis of covariance.

The results are given for six sub-tests:

1. Decimals (R I) 2. Common fractions (R II) 3. Equations (R III) 4. Percentage (R IV) 5. Geometry (triangle) (R V) 6. Estimations (Öb). See tab. 156—161, fig. 39—40, 42—45 chapter 17.

Positive differences between equivalent groups of employees and pupils are marked by vertical lines, and negative differences are marked by horizontal lines. Dark colours imply significance in the separate groups ( $p < .05$ ).

Positive differences mean increased knowledge, and negative differences mean loss of knowledge.

A general loss of knowledge is shown in arithmetic, decimal fractions, common fractions, equations, and geometry (triangle).

The employees, who have passed a vocational training school after the basic school (folkskola), show however, another tendency. Among them the level of achievement is largely unchanged in decimal and common fractions and positive in equations and triangle.

Positive differences are shown for pupils with only basic schooling "folkskola" in applied mathematics: percentage.

On the test of estimations there are also positive differences for all groups.

The *questionnaires to the teachers* of the upper section of the school have merely been evaluated for the basic school "folkskolan", and the secondary school "allmänna realskolan". In "folkskolan" we have results from the 7th form, and in "realskolan" from the three highest forms  $3^5 + 2^4$ ,  $4^5 + 3^4$  and  $5^5 + 4^4$ .

In tab. 173 (p. 438 f.) you can find the results of the number of lessons for various elements ( $\Sigma$  LE). You can also find the share of the courses in per cent of the total lesson hours in mathematic.

The fundamental elements (decimals etc.) are systematically treated in the lower courses. The proportional share of these subjects in the upper courses is fairly small, in the 7th form, folkskolan, about 17 %, compared with forms  $3^5 + 2^4$  "realskolan" about 2 %.

It is quite obvious that there is less time needed, for repetitions of these elements, in the secondary school "realskolan".

Regarding the basic school "folkskolan" the lessons are evenly distributed on the various elements. When comparing the secondary school "realskolan" and the basic school "folkskolan", it can be noted that the 7th form of the basic school "folkskolan" does not spend much time on theoretical geometry, but instead on applied geometry.

For all four groups little time is devoted to mental arithmetic and to estimations (2—6 %).

In the secondary school (realskolan) the following elements are dominating:

- a. equations (forms  $3^5 + 2^4$ ) about 40 %
- b. geometry (forms  $5^5 + 4^4$ ) about 45—50 %
- c. Theoretical geometry is important, about 20 %.

### *Results: Swedish language*

**Need of previous knowledge from vocational training schools and gymnasia**

The material has been analysed after the same principles and with the same groups as in mathematics.

In the group of gymnasia, however, the latin course "latinlinjen" has been included (LI<sup>3</sup>, LI<sup>4</sup>).

In this questionnaire the number of sub-elements was 47, distributed on the following elements:

Reading, vocabulary, abilities of using books, oral communication, composition, grammar, spelling, punctuation, Danish and Norwegian.

A five graded rating scale was used:

0 = no previous knowledge

2 = a certain amount of knowledge

4 = qualified knowledge.

The resemblance of structure between the total materials of vocational training schools and gymnasia is considerable ( $\rho = .84$ ).

Still more pronounced is the resemblance of structure between different courses within each of these materials. The average rank correlation has been computed by Kendall's coefficient of concordance. (.87 for vocational training schools and .90 for gymnasia). The separate inter-correlations between the medians for the different courses are to be found in tab. 48—49 (p. 150 and p. 151) for vocational training schools, and tab. 51—52 (p. 154) for gymnasia.

The total material of the gymnasia is on the whole, on a higher level than that of the vocational training schools (tab. 45 p. 148).

Pronounced differences between various courses are to be found both in the material of the vocational training schools (tab. 56 p. 160—161), and the material of the gymnasia (tab. 57 p. 162).

The latter shows a more strongly marked homogeneity.

On the whole, the basis for all courses of all schools is considerably wider than in mathematics (fig. 8 p. 168).

No important differences can be traced between various elements. On the other hand in many cases, it is possible to distinguish within each element a significant rank order between the separate sub-elements.

This tendency is shown for instance in tab. 41 p. 140 (vocational training schools) and in tab. 43 p. 144 (gymnasia).

The horizontal lines signify levels of significance, according to Wilcoxon's matched-pairs signed-rank test (Siegel 1956).

#### Other investigations

*The need of Swedish language in the different occupations* (frequency ratings) has been analysed in a limited number of elements by supervisors as well as by employees. Frequencies of "at least once a week", are only reached (structions), oral communication (short reports, opinions on questions etc.), by most of the groups in less complicated functions of reading (reading in-

structions), oral communication (short reports, opinions on questions etc.), vocabulary, and to a small extent, filling in forms. For office groups other elements of writing are included.

*The need of knowledge in Swedish language in leisure time*

Frequency ratings for the reading and writing of various texts have been used. Frequencies for reading newspapers every day are for instance:

- a. male industrial workers 90 %
- b. male clerks 94 %
- c. female clerks 76 %.

Other differences between male and female employees within the same groups have also been noticed.

Thus female employees read more magazines and weekly papers than male employees. Male employees, on the other hand, read more hobby magazines and professional journals.

Female employees write letters more frequently than their male colleagues. (Tab. 101—104 p. 247—249.)

All of these tendencies are similar to those found in earlier investigations.

*The ratings of the pupils' previous knowledge show lack of knowledge:*

- a. In vocational training schools, industrial groups:  
Basic elements, esp. grammar, composition, spelling, punctuation, spoken language and good pronunciation.
- b. In gymnasia:  
Only one element viz. using commas!

*The ratings of the employees' knowledge by the supervisors* show, on the whole, no complaints. However, one exception may be pointed out viz. the element of oral communication. This is also the case concerning the employees' own ratings, above all among female employees.

Composition is the element that is most negatively rated by the *employees* themselves.

*The results of retention of knowledge after school* is more uniform than in mathematics. Most tests (vocabulary, abilities of using books, spelling, punctuation), show increased abilities after school. This applies to pupils in "folkskolan" as well as to pupils in "realskolan" disregarding their vocational training.

A slight tendency of an increase in capacity can be traced among the employees. Two tests, however, have other tendencies. In reading comprehension, for the group aged 18—30, the results are mainly unchanged. In grammatical correctness there is a positive tendency, which is limited to basic school pupils, who are vocationally trained.



The teaching at school consists mainly of reading and writing (25—35 % and 20—40 %). On the other hand, the elements of abilities in using books, oral communication, and vocabulary have a much lower percentage (0—2 %, 6—12 %, 1—5 %). Spelling, punctuation, and grammar take a relatively large proportion of the lessons. In the basic school: 15 % for each element, in 3<sup>5</sup> + 2<sup>4</sup> "realskolan": 6 resp. 20 %. In the upper forms of "realskolan" these elements rapidly lose their shares of the lessons (under 5 %).

### Discussion

These results must be seen in relation to each other to become a basis for practical conclusions. Furthermore they must be completed with other aspects regarding the general goal, and the importance of various aspects e.g. the needs of a good all-round education. When studying the results, we must also consider the special circumstances within Swedish schools of to-day. Therefore no practical conclusions are included in this report.

However, we hope to be able to facilitate the planning of future curricula.