Proceedings of Q2006
European Conference on Quality in Survey Statistics

How to Measure Education in Cross-National Comparison: A Matrix of Education as a New Instrument

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1. Introduction

The comparative measurement of education is a complex task. The national systems of education and schooling are differently organized across national states and nations. In this paper we will sort the certificates from general and professional schools into one matrix that allows us to compare the "highest level of education obtained" across countries.

2. The problems

By historical development and political tradition, national educational systems are particular for each nation. In general, each school system incorporates in general education the preschool and the basic school education with a various number of degrees to obtain; in the professional education with the whole range between school based and vocational, enterprise based training and all the possible mixtures; and finally in high school education with its entire spectrum of diplomas. Common to all are four sections:

- The primary section, including the preschool and basic education for 4 or 6 years of schooling;
- the lower secondary programs cover in most European countries the general education until the end of basic education with a first school certificate after 8 to 11 years of schooling;
- the upper secondary segment includes the school institutions until the entry to high school, and the professional training until the first vocational certificate that allows to execute the learned profession, but lower then high school degrees;
- the tertiary section contains all the different types of high schools, the applied universities and the universities with the academic education until research qualifications are obtained.

So far, three common anchor points can be identified: the basic certificate, the highest possible degree of general education as the entry point to university, and finally the end of university education with the PhD thesis.

An important factor is the degree of side by side existence of private and public schooling in the general and professional training sectors. Of course, the transition from general to vocational sectors is characterizing the national school system. The differentiation of professional education certificates and their following up rules are of

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importance. An important question concerns the political and social acceptance of schools and their diploma as well as the legal and political control of the state.

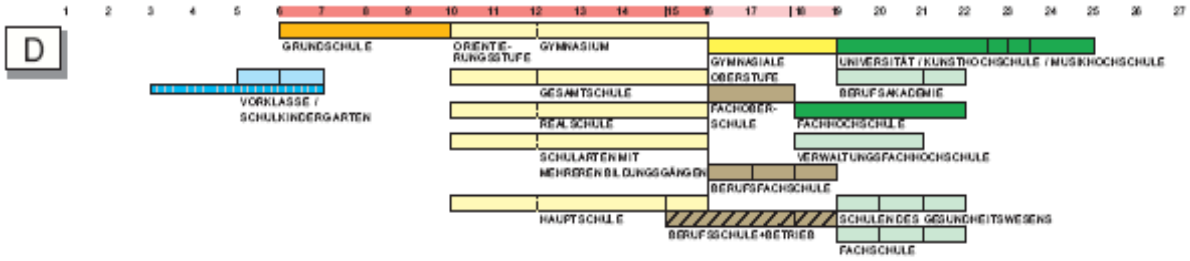
3. The national educational systems

This chapter describes the school systems of three European countries: Germany, Denmark and Luxembourg. In main and fundamental points they differ. The following chapter introduces the usual categories of cross country comparison and in the next part we illustrate the Hoffmeyer-Zlotnik/Warner matrix that compares the national education systems.

3.1 Education in Germany

In Germany, compulsory education lasts for 9 school years. From their 6 year of age onwards children attend "Grundschule" for 4 classes. After this primary part they can choose at least between three types of secondary schools: "Hauptschule" for the next 5 school years, the 6 school years long "Realschule" or "Gymnasium" for the next 9 classes.
After leaving "Hauptschule", having finished the lower secondary education, vocational training in the dual system or in vocational school is possible and became the normal school career. After finishing "Realschule" it is possible to continue with "Fachoberschule". "Abitur", the degree obtained in "Gymnasium", is the standard entrance diploma to university and finishes upper secondary education.
In Germany the lower secondary sector is differentiated, special institutions of education are differentiated, secondary and tertiary educational institutions for vocational education are marked-off.

Figure 1: Educational system of Germany



Source: Eurydice 2005a

Because of the paralleled general and vocational education, in German research we have to ask two interview questions about education during social surveys:

1. The *general education* with three or five types of lower secondary school (depending on method of counting) and two degrees of upper secondary school certificates.
2. The *vocational education* with answer categories for the dual system and for professional schools, for different types of schools and answer possibilities for vocational or technical full time school degrees and vocational colleges, and categories for university diploma.

Therefore, German social survey research needs a two dimensional matrix for the construction of a rank order concerning educational attainment or a hierarchical social order of educational levels

Table 1: General education by vocational education, Germany, ESS 1st round

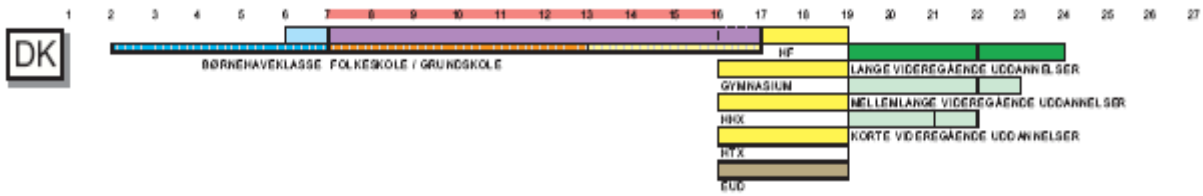
	vocational education by degree							total
general education by degree	non	dual system	voca-tional-school	voca-tional college	univ.of applied scien-ces	univer sity	others	col %
non	14,3	1,4	,7	,0	,0	,3	1,4	2,2
8th/9th class	64,8	49,2	31,6	27,0	3,8	1,4	28,2	37,4
10th class	11,5	42,2	46,3	49,2	24,6	2,4	52,1	34,9
restricted Abitur	,8	2,4	8,8	11,8	27,7	7,4	5,6	6,2
Abitur*)	7,0	4,7	11,8	11,5	41,5	86,1	9,9	18,5
others	1,6	,2	,7	,5	2,3	2,4	2,8	,9
row %	10,1	48,0	5,6	15,8	5,4	12,2	2,9	100,0
total	244	1161	136	382	130	296	71	2420

*) University-entrance diploma
Source: ESS round 1, computation by the authors

3.2 Education in Denmark

In Denmark, compulsory education starts at the age of 6 at "Folkeskole" and lasts for all pupils for 9 years (as comprehensive school). A voluntary 10th year or the Gymnasium (for 3 years) or vocational education follows.
The general upper secondary education is much diversified as in Germany, whereas the primary and lower secondary sectors are unified into one track of schooling and the tertiary sector offers three types of high schools.
In Denmark primary and lower secondary sector are interlocking each other. Secondary and tertiary vocational education are apart of each other.

Figure 2: Educational system of Denmark



Source: Eurydice 2005b

In Denmark, the ESS surveys highest level of education by a 10 category answer scheme of school leaving qualifications. They look already being created in advance for the recodes into the International Standard Classification of Education (ISCED 1997) demanded by the coordinators of ESS.

Table 2: Highest level of education, Denmark, ESS 1st round

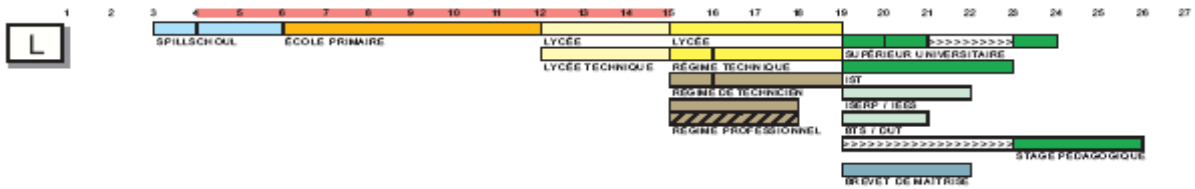
Categories		total	Valid Percent
0	No school education, no vocational education	2	,1
1	1.-6. class in school, no vocational education	18	1,2
2	7.-10. class in school, no vocational education	351	23,5
3	Upper secondary school, no vocational education	103	6,9
4	Vocational education and training, apprenticeship training	594	39,8
5	Work leader education for vocational educated	32	2,1
6	Further education of 2-3 years after upper secondary school	137	9,2
7	Further education of around 4 years after upper secondary sector	149	10,0
8	Bachelors or masters degree from university	98	6,6
9	Further university education i.e. Ph.D	10	,7
Total		1494	100,0

Source: ESS round 1, computation by the authors

3.3 Education in Luxembourg

In Luxembourg, the primary school starts at the age of 6 and ends at the age of 12. The secondary sector is divided into complementary, technical and general schools. The duration of "lycee" varies between 3 and 7 classes.
Several vocational schools and a university of applied sciences do also exist. The upper secondary education is very diverse and the third sector contains several professional educational institutions.
In Luxembourg the lower secondary sector is differentiated. Secondary and tertiary vocational education are apart of each other.

Figure 3: Educational system of Luxembourg



Source: Eurydice 2005c

In Luxembourg, the fieldwork for ESS used 19 different answer categories to obtain the information about the highest level of education. On a first glance, the proposed certificates are much more detailed than in Germany and Denmark and they do not summarize the national educational system. The labour market in Luxembourg is characterized by a very high proportion of non-Luxembourg's employees and workers who are not educated and trained in the national education system. Therefore the response categories of the survey question on highest level of education must also cover qualifications obtained in the neighbouring countries of Luxembourg.

Table 3: Highest level of education, Luxembourg, ESS 1st round

Categories		total	Valid Percent
0	Pas de diplôme/qualifications	20	1.3
1	Ecole primaire	254	16.7
2	Primaire supérieur	120	7.9
3	Enseignement complémentaire	98	6.4
4	Certificat d'enseignement secondaire technique inférieur	52	3.4
5	Certificat d'apprentissage	22	1.4
6	**C**ertificat de **C**apacité **M**anuelle	22	1.4
7	**C**ertificat d'**I**nitiation **T**echnique et **P**rofessionnelle :	36	2.4
8	**C**ertificat d'**A**ptitude **T**echnique et **P**rofessionnelle :	237	15.6
9	Diplôme de technicien (jusque 13e dans le régime tech.)	36	2.4
10	Bac technique (jusque 13e ou 14e du régime technique)	50	3.3
11	Enseignement secondaire général inférieur	115	7.6
12	Diplôme de fin d'études secondaires	139	9.1
13	Brevet de maîtrise artisanale	32	2.1
14	Enseignement supérieur - BAC +2	53	3.5
15	Enseignement supérieur - BAC +3	57	3.7
16	Enseignement supérieur - BAC +4	57	3.7
17	Enseignement supérieur - BAC +5 ou plus	57	3.7
18	Enseignement supérieur - Doctorat	11	.7
19	Autre: Précisez	43	2.8
Total		1523	100.0

Source: ESS round 1, computation by the authors

4. Measurement instruments for cross-national comparison

Today, in comparative research two often used instruments measuring and comparing highest level of education can be identified (Hoffmeyer-Zlotnik & Wolf, 2003):

- years of schooling (ESS round 1 question F7; NORC and Roper, 1996: 49)
- the "International Standard Classification of Education" (ISCED 1997)

4.1 Years of schooling

In surveys for cross-country comparison the instrument "years of schooling" is the most used one for the measurement. But various surveys use different questions and wordings and focus on the information in slightly different manners:

- the *European Social Survey (ESS)*, round 1, question F7 asks: "How many years of full-time education have you completed?";
- the *International Social Survey Programme (ISSP)* is asking about "years (of full time) schooling including university but not vocational training";
- the *General Social Survey (GSS) of the U.S.* asks about "grades" and "years of college" (NORC and Roper, 1996: 49.

All three questions generate different answers. ESS and ISSP obtain the number of years spent in educational institutions, and the ISSP does not include years spent in vocational education. The question about years only makes sense in cases where

the repetition of classes is not foreseen and allowed. In this case a question about grades like in the American GSS produces the informative measure.

4.2 International Standard Classification of Education – ISCED 1997

The "International Standard Classification of Education – ISCED", (UNESCO, 1997) was developed in the seventies by UNESCO. The major aim was to unify international statistics on educational levels of the population. The actual version of this classification was revised in 1997 and offers a common set of concepts, definitions and classifications establishing a frame for collecting data and presenting indicators on outcomes of the school systems. It covers all teaching activities organized in educational institutions for pupils and adults from pre school education to continued schooling and training as well as general and vocational education. Seven categories are offered by this classification.

Table 4: International Standard Classification of Education – ISCED 1997

Name of the Level	Code
Pre-primary education	0
Primary education; First stage of basic education	1
Lower secondary education; Second stage of basic education	2
(Upper) secondary education	3
Post-secondary non tertiary education	4
First stage of tertiary education (not leading directly to an advanced research qualification)	5
Second stage of tertiary education (leading to an advanced research qualification)	6

see: UNESCO, 2003: 203

5. A proposal for level of highest education based on a matrix with 10 categories

5.1 Building the Hoffmeyer-Zlotnik/Warner matrix of education

The Hoffmeyer-Zlotnik/Warner matrix of education (Hoffmeyer-Zlotnik & Warner 2005) has the advantage to minimize the errors of misclassifications described above.
The matrix is built on the answers to the interview question on the highest general educational level obtained and the vocational education degree. One dimension presents the general education and the other axis the professional education including high school and university diploma. All national possible degrees relevant in the national educational system are rank ordered from not applicable, lowest level to highest certificate.
The second step for creating the matrix is to bring the combination from general and vocational degree together with the social prestige that a person can gain on the labour market. The prestige scores are also ranked from low to high. Grouping together combinations of degrees with the similar prestige we come up with 10 valid categories and the 0 represents combinations not possible in the national system of education.

Table 5: Hoffmeyer-Zlotnik/Warner matrix of education – in general

		general education – grades, no certificates				
vocational education	ISCO skill level	non	basic degree	second degree	third degree	univ.-entrance diploma
non	9,8	1	2	3	6	7
school/workplace	8,7	4	4	5	5	5
vocational school	4,5	4	4	5	5	5
vocational college	3,4	0	5	5	8	8
college of higher educ.	2,3	0	0	9	9	9
university	2	0	0	0	10	10

- "non" means: leaving educational system before reaching accepted basics in general or vocational education;
- "general education" is measured by grades;
- "basic degree" means the first exit of general education which allows starting with vocational education;
- "highest degree" means: last exit of general education licensing university entrance;
- steps of "vocational education" are geared to "ISCO skill levels";
- categories 4 to 10: steps qualifying for an occupation – from low to high;
- categories 2, 3, 6, 7: grades of general education without vocational qualification

Table 6 shows the matrix for Germany, Denmark and Luxembourg. Common to the three countries are the dimensions of the matrix ranking the school leaving certificates: general graduation by vocational education diplomas. Only not existing and not applicable categories are removed. In Denmark, pupils obtain the basic degree after the 10th grade. In Luxembourg, the distance between basics and university-entrance diploma is bigger than in Denmark. The German educational system knows two general school qualification levels between the basic degree and the university-entrance diploma.
Missing national certificates lead to missing codes on the 10 categories scale. But the not existing codes emphasize the singularity and individuality of the national education scheme. Some school systems (e.g. the German structure) offer a great number of combinations with different prestige to gain; some national arrangements offer fewer patterns in combining general and vocational certificates.
The Danish matrix still illustrates the need of a two step survey instrument: the question for general education level obtained and the question about the vocational graduation. The ESS questionnaire, fielded in Denmark, groups the answer categories closely to the ISCED 1997 classification. A more detailed survey instrument separating out the general and professional dimension of education may produce a finer defecated measurement of the attained school leaving grades.

Table 6: Hoffmeyer-Zlotnik/Warner matrix of education – for **Germany**

	general education				
vocational education	non	basic degree	second degree	third degree	univ. entrance diploma
non	1	2	3	6	7
dual system	4	4	5	5	5
vocational school	4	4	5	5	5
vocational college	0	5	5	8	8
university for applied sciences	0	0	9	9	9
university	0	0	0	10	10

– for **Denmark**

vocational education	general education			
	non	basic degree	second degree	univ. entrance diploma
non	1	3	3	7
school/workplace	4	5	5	5
vocational school	4	5	5	5
vocational college	0	5	5	8
university for applied sciences	0	7	7	9
university	0	0	0	10

– for **Luxembourg**

vocational education	general education			
	non	basic degree	second degree	univ. entrance diploma
non	1	2	3	7
school/workplace	4	4	5	5
vocational school	4	4	5	5
vocational college	0	5	5	8
university for applied sciences	0	0	9	9
university	0	0	0	10

5.2 The validity of the Hoffmeyer-Zlotnik/Warner matrix of education

The new measurement of education based on the 10 categories matrix is highly correlated with ISCED 1997 classification and the measurement based on "years of schooling". Table 6 also gives the correlation between the occupational prestige (SIOPS) and the household total net income (hh-income). For the correlation of ISCED 1997 and SIOPS we have to consider that the skill levels of International Standard Classification of Occupation (ISCO 88) incorporates the ISCED measurement. Therefore we use the empirical prestige scores of an occupation from the survey data and not the theoretical possible value to which a school carrier may end. Only in Germany, we find a relation between household income and the respondent's educational attainment. In Luxembourg and Germany we detect a strong relation between occupational prestige and our matrix measurement; in Denmark we achieve a lower correlation, but still visible. Comparing the education measurements, our matrix measurement of education is stronger correlated with prestige than the alternative scales in Germany and Luxembourg. In Denmark, the correlation of our proposal is slightly lower than the years of schooling or ISCED 1997. This may change by using two questions: one about general education and the second about the vocational education.

Table 7: Validity of Hoffmeyer-Zlotnik/Warner matrix of education: Correlations

GERMANY	HZ/W	years	ISCED	SIOPS
Years of education	.77			
ISCED	.83	.70		
SIOPS*)	.64	.54	.54	
Household income	.35	.35	.35	.33

DENMARK	HZ/W	years	ISCED	SIOPS
Years of education	.71			
ISCED	.93	.77		
SIOPS*)	.49	.50	.53	
Household income	.06	.08	.06	.08
LUXEMBOURG				
Years of education	.74			
ISCED	.93	.75		
SIOPS*)	.61	.56	.58	
Household income	.06	.09	.08	.05

*) SIOPS= Standard International Occupational Prestige Scale by D.J. Treiman
Source: ESS, round 1, computation by the authors

Having the answers on both questions, it is easy to construct the Hoffmeyer-Zlotnik/Warner matrix of education by ranking the answer categories. The codes inside the matrix are common across the observed countries and using the prestige score of each combination the national certificates can be reclassified. This limits the researcher's freedom of interpretation of national degrees.

6. Conclusion

Does cross national comparative social research need a new measurement of highest level of education? Looking on the usually applied instruments we found:

- "Years of schooling" is an adequate measure when survey researcher and interview respondent have "grades" in mind at the same time. In comparative surveys the question wording must be highly standardized and the translation must be carefully monitored to assure that in all observed countries the same fact is measured.
- ISCED 1997 is in most modern and western countries a useful scheme to classify school leaving certificates. In countries with complex educational systems, like Germany, the ISCED 1997 categories cover hardly the social situation. Another disadvantage of ISCED 1997 is the risk misclassification, how national diplomas are sorted into the ISCED 1997 codes. Asking the respondent about the ISCED codes increases the interview burden for the respondent.

The Hoffmeyer-Zlotnik/Warner matrix of education requires a two step questionnaire, asking for general education followed by a question on vocational education. The table "general" by "vocational" establishes the matrix of educational codes and decreases the risk of misclassification into comparative standard codes by the interviewer and/or the data input, as long as the researcher is guided by the answers given to both questions.
Table 7 shows high correlations between the newly proposed matrix and the ISCED 1997 classification over all countries. Even for Germany, we observe this strong link. This observation confirms the easy use and the low risk of misclassification of our matrix.
A strong relationship between the Hoffmeyer-Zlotnik/Warner matrix of education with "years of schooling" is present in all countries. This linkage between the matrix and "years of schooling" exists also in countries where "grades" are surveyed; and the relation is higher than the connection between the matrix and ISCED 1997.

Finally, total household net income is independent from all used education scales and from occupational prestige measured by SIOPS.

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