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ENDURING EFFECTS OF SCHOOLING - A neglected area in educational research

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I uppsatsen diskuteras tidigare försök att fastställa långtidseffekter av utbildning. Relativt få undersökningar avser kunskapsbehållning och kognitiva färdigheter i vuxen ålder. Där sådana mätningar gjorts har de vanligtvis inte kunnat relateras till individernas utgångsläge inför valet av utbildning.

Mot bakgrund av modern minnes- och informationsbehandlingspsykologi diskuteras vilka typer av kognitiva färdigheter som det är meningsfullt att mäta vid framtida undersökningar av långtidseffekter. Den slutsatsen dras att man i stället för skolkunskaper bör rikta in sig på mera allmänna färdigheter när det gäller tillägnande och behandling av information.

För sådana undersökningar krävs tillgång till longitudinella data genom vilka initiallägen kan fastställas och gången genom utbildningssystemet följas. Vidare krävs uppgifter om yrkeserfarenheter o d under perioden mellan avslutad formell utbildning och undersökningstillfället. Det vid institutionen bedrivna individualstatistikprojektet bör kunna ge möjligheter till sådana studier, vilkas uppläggning skisseras.

ENDURING EFFECTS OF SCHOOLING --
A NEGLECTED AREA IN EDUCATIONAL RESEARCH

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As an undergraduate in psychology some thirty years ago I served as a participant in many experiments, but the only one I now remember was a study of the retention of Latin vocabulary taught in the Gymnasium. My performance was rather disappointing and so was that of my co-participants, considering that only a few years had gone by since we had spent four hours a week for four years learning Latin vocabulary, and with a rather good immediate attainment as far as that goes. Everyone can cite similar experiences of how laboriously acquired knowledge is lost, but researchers still do not fully understand the determinants of this phenomenon.

We can also cite positive schooling experiences -- learning activities we were able to pursue later out of school and where we reached levels that vastly exceeded our performance at the end of formal education. But again we know little about the characteristics of schooling that enhance proficiency in life-long learning.

I have chosen this topic not because I have answers to these questions, but because I find it challenging to try to grasp some of the conceptual, methodological, and logistic problems that have hampered empirical study of the long-term effects of education.

I shall start with three examples of studies where knowledge among adults has been related to the amount of education received. The first example is from a study of adult work skills and knowledge (National Assessment of Educational Progress, 1976). A national sample of young

adults (age 26-35) was tested in 1973-74. The tests measured job knowledge, both general and specific, and basic skills in four areas: computation and measurement, use of graphic and reference materials, written communication, and manual and perceptual skills. The basic skills tested were all of the general type found in the standard curriculum for the eight first grades and required no special or advanced courses.

The frequency of correct answers was strongly related to amount of schooling. The college graduates in general scored 30-40 percentage units higher than those who had left school after ninth grade or earlier. High school graduates were found in between but closer to college graduates than to elementary school leavers.

The report is descriptive and does not aim at a causal analysis of differences. It can be estimated that the difference between the extreme categories of schooling would have decreased about 10 units if the comparisons had been made with parents' education under control. But the most important control that one would like to have is not possible with available data -- the control for initial differences in learning capacity between those who decided to finish school as early as possible and those who continued to higher levels of education. Another complication affecting these data is the distance in time between end of formal schooling and testing. The oldest persons in the elementary school group left school twenty years before they were tested, the youngest college graduates were only a couple of years out of college. They also belonged to different cohorts.

The second example attempts a causal analysis of differences but the data permit only partial controls (Hyman, Wright, and Reed, 1975). These researchers report a secondary analysis of responses to knowledge questions in public opinion surveys during the years 1949-1971, with a few questions repeated in 1974. The majority of the questions dealt with public persons and events, both domestic and foreign. There also were a number of questions of academic knowledge in history, literature, arts, geography, and civics. Some questions dealt with popular culture, mainly sports and entertainment; a few with occupations, and finally exposure to mass media was recorded among the "dependent" variables. The respondents were categorized according to schooling in three main groups: elementary education only, high school with graduation, and college with graduation.

With very few exceptions the 250 questions showed differences between the educational groups. On average, the college graduates scored about 80 percent correct, the elementary school group 40 percent and the high school graduates were half-way in between. This was true in four broad age groups and during four different periods within the time span of the thirty years of polling covered. In the older group, differences in distance between schooling and testing can be regarded as negligible and this controls for one of the complications in the National Assessment Study. Likewise, a number of background factors that could be confounded with the differences in education were systematically

held constant. The differences between educational groups essentially remained intact when the comparisons were done among men and women separately, in different religious groups, and among native born Americans only. When the socio-economic status of the parents and the respondents' current social position were controlled for, the knowledge differences were reduced but still remained both regular and substantial.

Some other controls, however, could not be performed. Since, in general, different control variables were available for different questions it was not possible to control for the combined effects of the background factors which would have been a stronger test than controlling for one or two at a time. As with the NAEP data, however, no control was possible for initial differences in learning capacity between the educational groups. The control for social background was intended to substitute for this as far as possible, and truly, measures of learning capacity as well as self-selection or selection to educational programs are highly correlated with social background. But within each social group, differences still exist between those who continue and those who stop at a lower level of schooling. Such initial differences could not be excluded. The authors were quite aware of these difficulties and they devised a number of ingenious checks within the limits of available data, but despite this awareness it seems to me that their conclusions tend to underestimate the strength of remaining initial differences.

Moreover, influences that occurred after completed formal education were difficult to check in this study. Differences in knowledge can, at least partly, be ascribed to varying post-school experiences

rather than to school learning, since most of the questions dealt with topical persons and events. But this seems to me a minor complication compared to that of initial variation.

My third example of knowledge comparisons of adults with different amounts of schooling comes from my own country -- an investigation by Dahllöf (1960) of skills in reading, writing, and mathematics. Comparing educational groups was not a primary purpose of the study but the data also record such differences as a side result of a quasi-experimental design. The "experimental" groups were composed of young adults (age 18-30) in a dozen carefully selected and defined occupations, both manual-industrial and clerical, with either compulsory education only or graduation from a selective school at an intermediate secondary level (called Realskola). The test scores of these occupational groups at different levels of schooling were compared with test scores of a "control" group composed of students about to leave school at the same levels and with their achievement in school controlled by means of regressing scores on school marks. Thus Dahllöf could compute for each occupational group an estimated gain or loss in test scores during a ten-year period after the end of formal schooling.

At the end of formal schooling, secondary school leavers in the control group scored about 80 percent correct both in mathematics and in reading and writing. The adults at comparable levels of school attainment scored about the same in reading and writing but had "lost" about 10 percentage units in mathematics. The compulsory school leavers

in the control group scored about 45 percent in reading and writing and 35 percent in mathematics. The adults in the compulsory school group, and at the same levels of attainment, scored about the same in mathematics but had "gained" 10 units in reading and writing. To some extent the no-loss and no-gain results were affected by floor and ceiling effects in the tests, but still it seems evident that the two levels came closer to each other over the ten-year period after school. In mathematics there was an overall loss of skill over the period, in reading and writing a gain. The math scores that suffered most from the decrease were in fractions and geometry. Estimation scores -- that is estimation in contrast to exact calculation -- increased. Among the reading and writing scores, vocabulary gained most. Additional vocational training or type of occupation did not influence the size of gains and losses to any great extent.

Dahllöf's study makes it possible to analyze the differences between adults with different amount of education into two parts: differences in achievement at the end of schooling and differential development over a period after formal education. This is a step forward in the analysis. Still initial variation in learning capacity influences the differences between the educational groups, and no indicators were available to control for such influences. Moreover this source of variation can be assumed to be large since entry to secondary education, at the time of the study, was restricted and the selection competitive and based upon school marks in the elementary grades. As a matter of fact, the scores differ more between educational groups in this Swedish study than in the

American studies, that is, if one takes into account that the higher group in Sweden represents only an intermediate level of education, in years not even equivalent to high school graduation.

I have found no longitudinal studies where knowledge has been measured in adult age and the influence of amount of schooling has been weighed against early differences in learning capacity, social background, etc. There are, however, two rather well developed clusters of research that use longitudinal approaches for studying the effect of education on other types of variables.

One such cluster deals with the impact of college education on attitudes and values and this, in turn, can roughly be divided into two subareas. The output of different kinds of colleges has been measured in relation to input characteristics of the students. This approach, to a large extent associated with Astin (1972) and his coworkers, is important but it has rather little to do with "enduring effects of education" since the output mainly has been measured directly upon graduation. The other tradition in studying college impact has been summarized by Feldman and Newcomb (1969). These studies deal primarily with values, attitudes, orientations, interests, personal and social adjustment. Changes are studied from freshman to senior year in college. In some cases such changes are related to curriculum, but in general these affective outcomes seem to be associated with the rather special conditions for socialization that prevail in the college environment more than with academic and instructional experiences in a narrow sense. Few studies follow this development during a longer period after college.

Few studies compare the development of college students with that of their contemporaries on the labor market. In the present connection the studies of college impact are of interest as a source of variables and hypotheses outside the cognitive area that might be used also in other educational groups.

The second cluster of research on educational impact outside the retention-of-knowledge area deals with the attainment of occupational status and income. Different sets of longitudinal data have been updated with information on occupation and earnings, and causal analyses, often according to path models, have been performed. Duncan, Featherman, Hauser, and Sewell among sociologists; Bowles, Hause, and Taubmann among economists are some of the names associated with this research. One difficulty has been to find representative sets of data for adults far enough advanced in their careers so that meaningful comparisons become possible.

As an example from this research consider Ingemar Fägerlind's (1975) analysis of adult earnings in a longitudinal study initiated by Torsten Husén. Education was used to explain men's occupational status and income at the age of 25, 30, 35, 41 and 43 years. Father's education and socio-economic status, number of siblings, and IQ at ten years of age -- that is before any educational differentiation took place -- functioned as control variables for background and for initial diferences in learning capacity. Education had a strong direct effect on occupational status, but the early background characteristics influenced occupational status only via education, that is early background influenced education,

and education in its turn occupational status, but there was no direct path from early to adult characteristics. Both education and occupational status influenced earnings, and this effect was stronger when education was measured as academic level attained than as number of years of schooling. The influence also increased over the years and was considerably stronger when the men were in their forties than earlier in their careers. The research on status and income effects definitely deals with long-term effects of education but the outcome variables studied hardly can be regarded as central from a pedagogical point of view.

Into this set of examples I would like to introduce one of my own studies (Härnqvist, 1968) dealing with changes in intelligence test scores over a five-year period in groups that obtained different amounts and types of education in the meantime. In 1961 we collected basic data for a ten percent sample of all Swedes born in 1948, that is when they were 13 years old and normally were in the sixth grade of elementary school -- the last year before any tracking took place in the educational system. Among the information collected in 1961 were achievement scores in reading, writing, and mathematics, mental test scores in verbal, reasoning and spatial abilities, family background and educational plans. New information has been recorded ever since, mainly about educational attainment. In 1966 we also were able to add to our register the scores of the young men in tests taken at the time of their enrollment for military service -- in principle for the entire sample of men, about 5000 of them. I used this information to study the changes in intelligence over the five-year period in relation to education and home background.

Since the two sets of tests compared were different in composition, only relative changes and not absolute gains or losses could be studied. This was done for two components based on the test scores -- one component measuring general intellectual level which correlated about .8 over the period, and one component indicating profile differences along a bipolar dimension from verbal to spatial test content. This difference component correlated only about .4 over the five-year period. The sample was divided into a large number of fairly specific educational groups, mainly along a non-academic - academic continuum. For each group, expected final scores were computed by means of the within-group regression of final on initial scores, and differences between observed and expected final scores were taken as a measure of relative change due to education. The results were also checked with home background under control.

Those who left school with only compulsory education -- which at that time could be seven, eight, or nine years long, different in different school districts -- showed declines from their initial intellectual level with about 30 percent of a standard deviation. Those who had at least partly completed the Gymnasium (a university preparatory school) showed increases of about 30 percent. Whether these were absolute losses and gains cannot be determined from the tests used. But the total difference of 60 percent of the standard deviation is of interest and it corresponds to about 10 IQ units, which seems to me to be a considerable effect. When home background, measured with a strong composite of family and residence variables, was controlled the difference was reduced to 7-8 IQ units. One additional year in compulsory school meant 2-3 IQ units.

Also the profiles changed along the verbal vs. spatial dimension as a result of type of schooling, for instance, clerical vs. mechanical vocational education. But these differences were smaller and the measurement less reliable.

At the time I did the study I looked upon it as a contribution to the discussion of intelligence and experience that started to get lively in the sixties. Only later did I begin to think about it as an attempt to measure eduring effects of education. Certainly the comparison was over a relatively short period in a lifetime, but intelligence is usually assumed to remain fairly constant for a long period after adolescence. And during adolescence, differences in schooling are likely to be the main differentiating factor in the environment -- a statement which is supported by my comparisons between the effects of home background and those of education. Therefore I consider it proper to include the study under my topic, particularly since there are so few attempts to study cognitive effects by longitudinal methods.

This is where my examples end. Practically none of them came from studies initially planned to analyze enduring effects of education, and in some cases the authors have not used them for that purpose afterwards either, so it may seem somewhat unfair of me to quote them in this context and then discuss their weaknesses in relation to my topic. Still the examples serve as a point of departure for a more systematic development of paradigms for research on long-term effects. In the present context I will limit myself to cognitive outcomes of education, such as knowledge and skills, intelligence and special aptitudes, cognitive styles

and information processing behavior. This means that I won't explicitly deal with affective outcomes of different kinds, neither with external criteria such as occupational status and income, even though some of my remarks will apply also to such variables.

My comments in connection with the different examples were based on ideas how knowledge and skills are acquired and under what conditions they are maintained or deteriorate over time. I now will try to make these ideas more explicit in a few propositions related to the model in Figure 1.

Insert Figure 1 about here

Students enter a certain stage of the educational system with a given repertoire of knowledge and skills, with basic psychological characteristics and with characteristics in their out-of-school environment that make learning more or less easy. Together these form the entry characteristics of the students.

At each stage in the educational system the students distribute themselves over different programs and instructional contexts. This distribution can be the result of placement decided by the school, or application followed by selection, or self-selection to different options. No matter how this distribution is brought about, it is influenced by the entry characteristics of the students, and different programs and treatments get different kinds of students. Even so, a large part of the variation between students remains within each program and treatment.

In the next phase learning takes place. Achievement measured at the end of learning varies between the students. The differences are

correlated with their entry characteristics, and they are merged with them to form the entry characteristics for the next stage.

This cumulative process goes on for different numbers of cycles for different students, in general more cycles for those who initially had the most favorable situations.

At the end of formal education the final level attained influences entry into various occupations, social circles, avocational experiences, and level of living in general. Some of these experiences make direct use of some specific knowledge and skills that have been taught in school, or even add to them. Other experiences make use of abilities or habits that have been trained as by-products of the acquisition of specific knowledge and skills. Some experiences make little use of any of these. In general the status attainment process in society functions in such a way that those groups who attained most in the educational system get most opportunities to maintain their school learning through practice.

The model that I have tried to describe thus contains

initial characteristics,
sorting processes in school,
learning processes in school,
both repeated for different numbers of cycles,
sorting processes in society, and
learning processes in society.

At each stage of this sequence there is a positive correlation between entry characteristics and achievement. The adult level of knowledge and skills is influenced by all these processes.

In attempting to draw the consequences of this model for the design of studies of long-term effects of education let me begin with isolating a section of the model: the change in knowledge and skills that occurs between end of schooling and a measurement of retention in adult age. Let me further delimit the study to just one group that is fairly homogeneous both in schooling and out-of-school experiences. Its members have gone through roughly the same sorting and learning processes. No comparisons with other groups are intended. We just try to measure in adult age retention of knowledge and skills that the group mastered to a certain extent at the end of schooling.

What requirements would it be natural to set up for the construction of the retention test? It is hardly meaningful to measure the retention of something that never was learned, nor, in this design, to measure retention of such knowledge for which it is impossible to determine where the learning took place. As a consequence it seems to me that the outcome measures have to be closely related to the curriculum for a given education. The measures must have content validity for the knowledge taught, preferably at the more advanced stages of the sequence of instruction in the area. Measuring elementary knowledge after an advanced course hardly tests for retention in the specific contents of that course. On the other hand the tests have to cover content that once was mastered by a reasonably large proportion of the students, but rather with some variation between items or subscales so that not only losses but also gains after school can be assessed.

These specifications look almost like requirements for the construction of a test to be used for evaluation of a course or program of

study, only with the exception that this evaluation is postponed for ten or twenty years. And this makes me stop and think: Is that really a worthwhile procedure? What information is likely to be gained from it?

The results of such postponed evaluation cannot reasonably be of much use for decisions about curriculum and instruction. The conditions that gave rise to the learning are likely to have changed on other grounds already long before the postponed measurement. And as far as that goes, even immediate measurements have difficulties in tracing effects of variations in curriculum and instruction. Furthermore the retention scores are likely to be confounded by the use the person made of that particular knowledge in the meantime and they might well tell more about such effects than the effects of schooling. But most important: measurement of retention after a long period with instruments similar to those used in immediate measurement builds on an overly static concept of learning and memory.

To qualify that statement I have to make a brief excursion and try to describe the notion of memory in recent psychological literature (cf., e.g., Norman, 1969; Postman, 1975; Tulving & Donaldson, 1972). Current research on memory most often makes a distinction between three kinds of processes: sensory processes that selectively attend to stimuli, short-term memory that holds a limited amount of information for a very short time, and long-term memory that stores information which has been properly attended to and processed. In this long-term storage information stays indefinitely long.

The information stored in long-term memory is, however, difficult to retrieve. To what extent retrieval succeeds depends on the availability of cues and the efficiency of organization and search procedures.

Like books in a library, information has to be stored in a systematic way. To retrieve it, one must have access to at least some information, which like the card catalogue of a library tells that a book belongs to the collection and guides one's further search for it.

New acquisitions to a library change the location of cards in the card catalogue and books on the shelves, and new information changes the long-term storage of information. But here the library metaphor ceases to be valid because new information that is brought into the memory store does not only affect the location (in a metaphorical sense) of old information but can give the old information a new meaning or even change the whole organizational structure of the segment where it fits in. If the old information is not integrated in a structure it can easily be mixed up with the new information and never be found again.

Several attempts have been made to construct models that simulate the organization of memory. Most of them work with interconnected networks of concepts at varying levels of abstraction. Some very ingenious experiments have been done where the duration of search processes has been used for getting a picture of how information is stored (e.g., Collins & Quillian, 1969). It is clear that search for information in the long-term storage is an active process, much like problem solving where information is reconstructed with the help of partial information and the organizational structure, rather than merely brought forward from a collection of ready-made answers.

It is well known that different types of retention tests -- recall, recognition, saving -- give different assessments of the amount of

retention. The more the attributes of a retention test correspond to that of the memory trace, the more retention is likely to be demonstrated.

The points I would like to make on the basis of this excursion are three:

(1) It is not easy to retrieve information even if it is there, somewhere in the long-term store. In a long-postponed measurement of retention, more and different types of cues are likely to be needed, and therefore a repeated measurement with the same instrument as directly after learning is not very informative and fair.

(2) Since information is not just stored away until it is retrieved, but undergoes qualitative changes in the meantime, other things are likely to come out from the store than those originally put in, and such changes are not just distortions by a faulty memory but might very well be improvements also.

(3) For both reasons a quantitative measurement of gains and losses over time is likely to be misleading. Only on a superficial operational level is the difference a difference between two comparable things. Qualitative studies of how knowledge becomes organized and retrieved over long periods of time would, on the other hand, be of great interest not only as a more naturalistic counterpart to the laboratory experiments on memory, but also for education generally. Whether one should call such research a study of enduring effects of schooling or not may be left open.

As an example of a more qualitative approach to the measurement of outcomes I should like to mention the work of my colleague Ference Marton

and his group at Göteborg University (cf., e.g., Marton, 1975; Marton & Säljö, 1976). They study what they call non-verbatim learning of texts. The research participants, mostly university students read texts of some complication in various fields of subject matter. The recall is tested both immediately and a couple of months afterwards in individual interview sessions. Retention is measured in terms of the depth of understanding of central concepts and ideas presented and not, as usually is the case, in number of units of information recalled. For each topic it has been possible to categorize levels of understanding the message along a linear or hierarchically ordered continuum, certainly specific, as far as content goes, to each topic, but with some common characteristics from topic to topic. In the interviews the participants are also asked how they went about their learning task and how they study under normal conditions. Indications of deep level processing in the learning situation are shown to result in a deeper understanding and better retention. I think that an analysis of outcomes along these lines would be highly profitable also in research on retention over longer periods of time.

Now I would like to return to my model and see what happens if one tries to compare groups of adults that left formal education with different amounts and types of schooling. As regards curriculum content they have, almost by definition, learned either more or less of the same thing, or they have learned different things. Therefore it is not very meaningful to compare their retention of curriculum-specific knowledge. Other types of variables measuring more generalized outcomes have to be found. General intelligence and special aptitudes, critical thinking

ability and basic communication skills meet this requirement. And so does acquisition of new knowledge -- the major target variable in Hyman's study -- and a number of characteristics of cognitive styles, information processing and problem solving. All these variables refer to rather general characteristics in an individual's psychological make-up, and many of us are much more accustomed to see them as input variables than as outcome variables in educational research. Therefore some justification for their placement also on the criterion side may be needed.

A basic assumption behind this use is that psychological characteristics are modifiable and that they develop and change in continuous interaction with the environment. During school age up through the college years differences in schooling are likely to be the major differential influence on cognitive traits even though home environment and other sources of impact may continue to affect them. Most instruments used for assessing cognitive traits consist of tasks that require mastery of basic communication skills and/or methods or styles in problem solving. Somewhere along the path from primary acquisition of a skill to its overlearning and mastery, a successful completion of the task involved, changes from being a sign of educational attainment to becoming an indicator of a cognitive trait. Most curricula are based, implicitly or explicitly, upon ideas of how the ways in which subject matter is taught and learned affect general characteristics of the students, how knowledge of content is developed into skills in understanding and application which are transferred to new content and new situations.

So much about the choice of outcome variables. Now to the controls of other influences than those of level or type of education. According to the model these are of two kinds -- sorting processes and learning processes after school. Sorting influences the characteristics of those that enter a certain program and treatment. To some extent this sorting can be controlled for by means of initial measures from the time before any sorting took place. The efficiency of this control depends on how well these initial measures can predict differences in the outcome. This can probably be achieved to a moderate level for outcomes like general intellectual performance. The control is likely to be rather weak for outcomes that are based on more specific variables. Even in the most efficient case, however, such controls cannot remove all threats to the internal validity of the comparison because there is no way to control for such initial characteristics of the group members which in addition to those checked may have influenced their distribution between the educational programs and their completion or drop-out from them. Length and type of education are not conditions that a researcher can vary by means of randomization and the design can only be correlative. One simply has to make the most efficient use of prior information and live with the remaining ambiguity, but it is likely that it can be reduced considerably compared to earlier attempts.

For the control of out-of-school learning an intermediate outcome measure at the end of schooling would be helpful. In addition it seems necessary to use qualitative information about occupational and other activities after formal education that makes it possible to define

subgroups with different experiences in order to sort out such influences. The technique for such analysis is much less formalized than that for entry characteristics, and it has to be developed for each situation, more or less as cross-tabulations are used in survey research.

It appears that the problems of design and analysis are such as might discourage most researchers, especially those who are used to experimental situations. A certain optimism is good to start with, and it seems that I always get involved in research that relies heavily on that characteristic -- whether it is an enduring effect of my own education or not.

I don't think, however, that lack of optimism is a major reason why educational researchers have done so little about long-term effects of education. They have gotten involved in too many other adventurous enterprises for that to be a good explanation. It is more likely that logistic problems have come in their way. It takes a long time to wait while students in the elementary grades grow up, distribute themselves over the different levels and sectors of education, and then get established in their adult roles. It takes many of them to be able to compare educationally homogeneous groups with sufficient precision. And finally, and this is perhaps the hardest requirement to meet, it takes a large amount of time and cooperation from the adults to collect outcome information.

Finally I shall sketch how I plan to deal with these problems in my own future research. In the study of intelligence changes that was one of my examples earlier in the presentation I used data from a cohort study that

we started 16 years ago. These persons are now 29 years old, and before we have made the necessary preparations they will be in their early thirties. The initial measurements before tracking in the school system cover a broad range of variables. The sample is large, about 10,000 people, and highly representative for the age cohort, since they were sampled according to birth dates (the 5th, 15th and 25th in each month of 1948). The register has, at several points in time, been updated with educational attainment. Through the national population register it is easy to get current addresses. In earlier follow-up studies of special segments of the sample, mainly those with minimum education, the identification and response rates have been very high. The information available about their education makes it possible to concentrate further studies on selected and carefully defined target groups and skip categories in between that, because of their small size or other properties, would be of little use in the analysis of results compared to the costs of information collection. This means, on the other hand, that the control of initial status cannot be done with the usual regression or path analysis methods which require information without such gaps in the distributions. Instead some sort of grouping according to several variables -- a quasi-factorial design -- has to be used.

It seems to me that the collection of new data has to be done in two waves: a mail questionnaire to rather large subsamples for establishing contact and securing additional information about their present educational and occupational status. On the basis of this information the definitions of the target groups can be refined so that some control is imposed on experiences after the end of formal education. The collection

of data on adult cognitive performance has to be done in personal interviews, and in this step it might be possible to use an organization of trained interviewers, maintained by the National Bureau of Statistics and covering a representative set of Swedish communities. A couple of years ago, as part of an interview on living conditions in a nationwide sample, they used vocabulary questions and this functioned quite well. (13) Naturally the interview time that we might be able to buy will not permit very long tests, but repetition of our initial battery or addition of new full-length tests are hardly needed since reliability on an individual level is important only in the initial measurements to be used for control purposes. The composition of such an interview takes much preparation and pretesting, and before that is done it would be only guesswork if I tried to go into more detail at present. What I wanted to show you is that some basic preconditions exist that should make studies along the lines I have sketched possible. With a similar reasoning I also have to convince the research councils and foundations that have to pay for it. My optimism also covers that aspect of my research. (14)

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In conclusion I should like to stress once again that the topic of this address, enduring effects of schooling, is an appropriate and challenging area for educational research, where so far rather little has been done. Those who engage in such research will find a lot of conceptual, methodological, and logistic problems -- some of which I tried to foresee and discuss but naturally I was not able to solve them. Many of them will turn out to be unpleasant surprises, I am sure, both for me and for other researchers. It certainly is a high risk area,

and to begin with one cannot expect clearcut and indisputable results even if the work is done with craftsmanship and sophistication. Also in a future when the field hopefully has reached some scientific maturity, the step will be difficult to take between results and their application in educational decisions because it will never become easy to trace the processes that intervene between treatments and outcomes. Even so I think it highly worthwhile to do such research. Indeed it is almost an obligation for some members of the educational research community to devote serious work and attention to the long-term impact of the educational enterprise.

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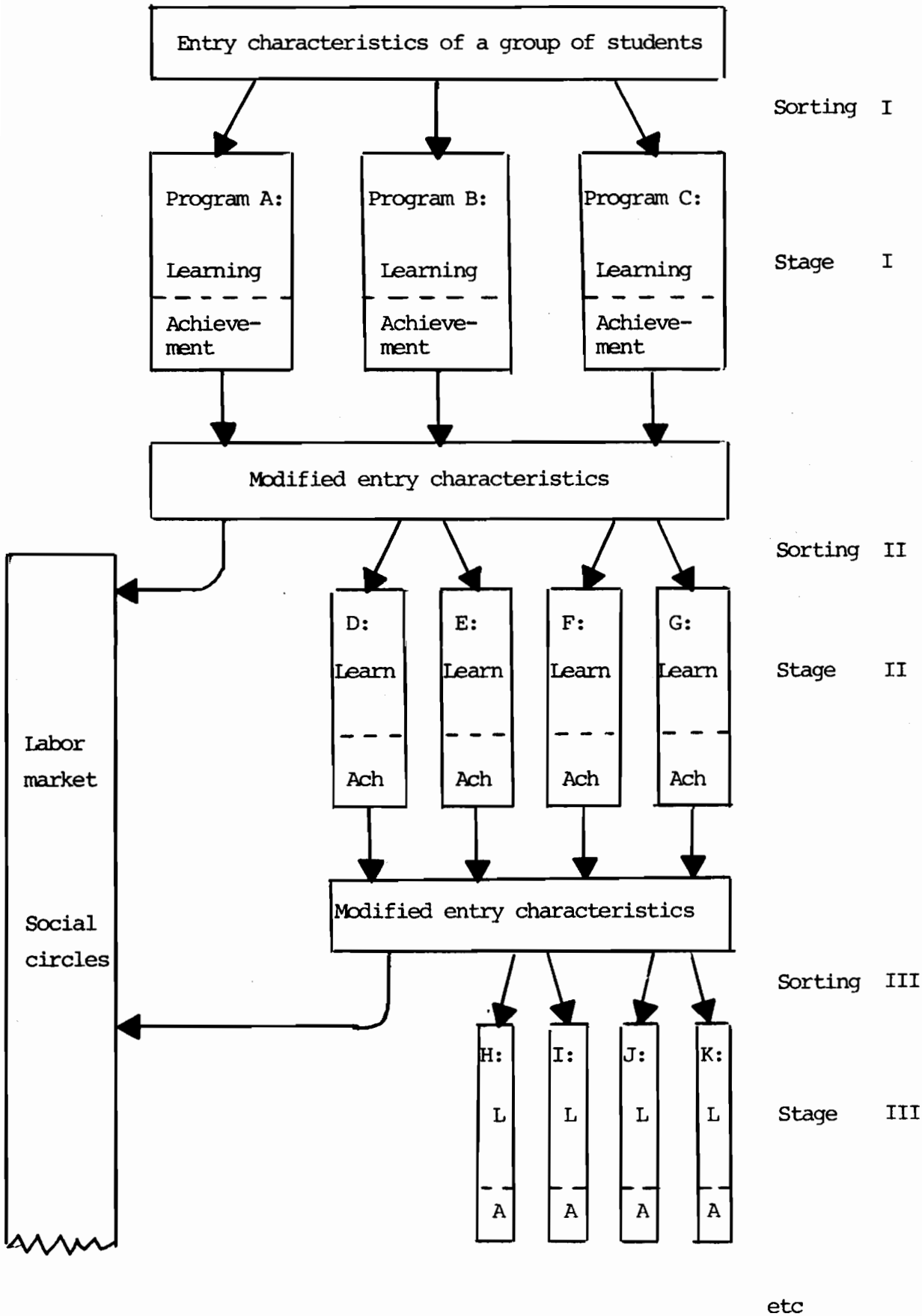
Figure 1. Model of the educational system



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