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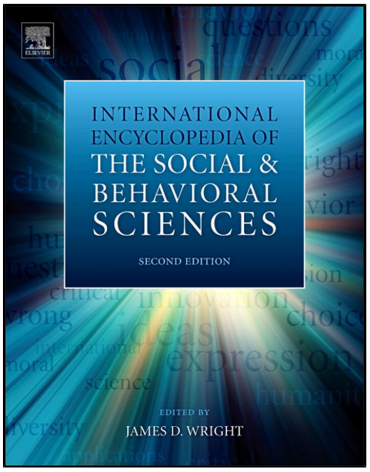

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From Luyten, H., 2015. Schooling: Total Impact of. In: James D. Wright (editor-in-chief), International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, Vol 21. Oxford: Elsevier. pp. 125–127.
ISBN: 9780080970868
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Schooling: Total Impact of

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Abstract

The total effect of schooling on the cognitive development of young people (its prime objective) has been addressed in a remarkably small number of studies. The available findings indicate that at least 50% of the learning gain across grades can be attributed to the effect of schooling. This figure contrasts sharply with the more frequently cited 'school effect' of only 15%. Some additional questions remain to be settled: for example, to what extent the impact of schooling varies across age ranges, content areas (e.g., language vs mathematics), background (e.g., by socioeconomic status or gender), and (last but not the least) across schools.

Introduction: The Importance of Schooling

Young people spend many hours in school. Thus it seems plausible that the impact of formal schooling on their cognitive development is considerable. However, one cannot assume that all progress made during the school years is due to formal schooling; for example, during their years at primary school children grow approximately 6 cm in length per year, but it seems hardly plausible that classroom instruction has any impact on this growth. In contrast, some cognitive skills developed during the school career are probably acquired in large part through classroom instruction (e.g., spelling and arithmetic), but other skills (e.g., vocabulary) may largely be learned outside school.

The theoretical underpinning of the presumed benefits of education (for personal income and nationwide economic growth) largely stems from the work by human capital economists (e.g., Becker, 1993). In human capital research the results of education are typically measured as qualifications attained or amount (i.e., years) of schooling received. Research in this field strongly focuses on the relationship between academic credentials and success on the labor market. The number of empirical studies that explicitly address the impact of formal schooling on the cognitive development of students (its prime objective) turns out to be surprisingly small.

One might expect to find extensive information on the impact of formal education on cognitive skills in the research literature on educational effectiveness. However, this line of research has traditionally focused on comparing schools, classes, and teachers and has yielded a considerable knowledge base on the variation between schools, classes, and teachers with regard to the outcomes of learning. More importantly, it has produced useful insights on the factors that may account for this variation and provide levers for improvement (Teddlie and Reynolds, 2000). However, assessing the impact of education on the development of children in its own right has never been an issue of major concern in this field.

A well-confirmed finding in educational effectiveness research is the percentage of variance in student achievement scores at the school level. This is usually referred to as the *school effect* and has been found to equal 15% on average over a huge number of studies. It is important to note that this school effect relates to differences in outcomes between schools. It is perfectly conceivable that all schools make a similarly large contribution to student development. This would produce a modest school effect even though the *total effect of schooling* is considerable.

Assessing the Total Effect of Schooling – Two Viable Alternatives

When trying to assess the contribution of schooling to the development of students, one is faced with the challenge that nearly everyone attends school. In order to estimate the contribution, one should compare those who attend school to an equivalent control group that receives no schooling, which is not feasible in practice. Ceci (1991) has reviewed a number of methods that may be helpful in assessing the impact of schooling on cognitive development. Most of these capitalize on exceptional circumstances, for example, (temporary) absence of schooling in remote communities, interrupted schooling during times of war, and changes in mandatory schooling. Studies based on these methods provide compelling evidence for a strong impact of schooling on the development of cognitive skills. Needless to say, such methods cannot be applied on a routine basis.

Regression Discontinuity

According to Ceci (1991), one of the best ways to document the impact of schooling is by comparing children of the same chronological age in different grades. This can be done by applying the logic of the regression-discontinuity design (Trochim, 1984). It capitalizes on the fact that assignment to grades is mainly determined by date of birth. In most education systems, students born just a few days before a certain cut-off date are much more likely to end up in a higher grade than the ones that are just a little younger. Such cut-off dates are clear examples of instrumental variables (Angrist and Pischke, 2009). They affect the score on the explanatory variable of interest (i.e., grade), but are not causally related to the outcome variable. Instrumental variables are sometimes said to produce 'natural experiments.' Thus they allow for unbiased estimates

International Encyclopedia of the Social & Behavioral Sciences, Second Edition, 2015, 125–127

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of the effect that is the focus of the analysis, even when data on confounding variables are not available.

Application of regression discontinuity requires hardly any background information of the students. Besides measures of learning outcomes (e.g., test scores), information on each student's date of birth and actual grade are needed. Two final requirements are that the dataset should relate to students in adjacent grades and that the outcome measures should relate to a common scale, even though the students are in different grades. When students from a wide range of grades (e.g., grades 1–6) are included in the analysis, one cannot expect all students to take the same tests, but this problem can be solved by making use of equated test scores so that all scores can be expressed on a common scale (Verhelst, 2010).

It is also necessary to reflect on the meaning of the effect of education as assessed through regression discontinuity. The effects estimated actually reflect the difference in achievement due to assignment to a higher or lower grade. It should be acknowledged that this possibly includes components that may not be considered effects of education in a more narrow sense. For one thing, the grade effect will also include a peer group effect. It is also conceivable that parents make adaptations in the way they support their child when (s)he is assigned to a higher grade. It should be noted, though, that all these effects are *caused* by assignment to grades. In that sense they still are effects of schooling. However, one may consider these as side-effects of schooling rather than its core effects.

Seasonality of Learning

If one assumes that during the school year learning gain is affected by both school and nonschool factors, whereas only nonschool factors are at work during the summer vacation, the effect of schooling can be estimated by means of a comparison between the per month learning gain during the school year and the summer vacation (Heyns, 1978). Although this approach seems useful for estimating the total effect of schooling, it is also important to point to some problems.

The main problem relates to the assumption that the summer period presents a useful alternative for the control condition in a randomized trial. This is valid if we can be sure that the impact of nonschool factors (e.g., parental support) during the summer vacation provides a reliable indication of their impact in the (hypothetical) absence of schooling, but it is conceivable that certain parents (e.g., the well-educated ones) engage more in academically stimulating interactions with their children than they would otherwise during the summer vacation. It remains an open question whether the summer period presents an equally viable alternative for a control condition for all students. Another implicit assumption of the approach is that the effect of schooling stops as soon as the summer vacation starts. Most teachers would hope that their efforts have a more enduring effect and that learning still continues out of school due to their teaching efforts.

The main focus in seasonality research has been on the summer gain/loss itself and particularly on inequalities in this respect. The bulk of the studies have been conducted in the USA (probably because of the long summer vacations).

Findings

Numerous studies on the seasonality of learning have consistently shown much stronger gains during the school year than during the summer vacation. Sometimes zero learning gains and learning losses have been reported for the summer period. A consistent finding is the large variation in learning gains during the summer vacation. When school is in session, the differences in cognitive growth between students are much smaller than during periods without schooling. Especially students from disadvantaged backgrounds appear to make relatively little progress during the summer period. This suggests that education presents an equalizing force of considerable importance (Downey et al., 2004; Alexander et al., 2001).

The number of studies based on regression discontinuity is much smaller, but these studies focus explicitly on the total effect of schooling. One of the first well-known studies was conducted by Cahan and Davis (1987) and relates to mathematics and reading comprehension in grades 1 and 2 of primary education in Israel. The findings indicate that about $^2/_3$ of the difference in achievement between grade 1 and 2 students is due to schooling versus $^1/_3$ due to the 1-year difference in age. A study using the same approach to assess the impact of schooling on IQ development of Israeli children in grades 4 to 6 (Cahan and Cohen, 1989) reports larger effects for verbal than nonverbal tests. It relates to 12 different tests and for nine of these the effect of schooling outweighed the age effect.

A more recent study by Luyten (2006) applied regression discontinuity within a multilevel framework in a secondary analysis of TIMSS-95 data (http://timssandpirls.bc.edu/) for eight different countries. The effect of schooling on mathematics achievement in grades 3 and 4 of primary education was modeled as random at the school level. This approach yields both an assessment of the average effect of one year of schooling and an estimate of its variation across schools. In line with the Israeli studies, this study reports larger effects of schooling than age in most countries. It also reveals that in most countries a substantial minority of schools could be discerned that failed to show a positive effect of being in a higher grade (4 vs 3).

Most studies based on regression discontinuity assume a sharp cut-off date, which implies that students with delayed or accelerated school careers are excluded from the analyses. A study by Luyten and Veldkamp (2011) applies a methodology that does not assume a sharp cut-off date and takes into account the effect of unmeasured factors that affect both learning outcomes and assignment to grade (i.e., delay or acceleration of school careers). Their reanalysis of TIMSS-95 data includes 15 countries. They report that for mathematics and science, respectively, 54% and 47% of the differences between grades are due to schooling. When expressed as an effect size (Cohen's d), the average effect of grade level across 15 countries is 0.46 and 0.35 for mathematics and science, respectively. By themselves these are not particularly large effect sizes, but if they apply to all grades in primary education, the total effect for all six grades would fall between 2.00 and 3.00, whereas 0.80 is generally considered a very large effect.

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Concluding Remarks

Although the total effect of schooling on the development of students has been the explicit focus of a limited number of studies, there can be no doubt about its impact. The effect of schooling appears to be clearly stronger than the effect of physical maturation and at least half of the cognitive growth that occurs during primary education should be considered an effect of schooling. This implies that the effect of schooling is much larger than the 'school effect' (i.e., 50% vs 15%). The latter relates to differences in outcomes between schools. Studies on the seasonality of learning suggest that formal education works as an equalizing force. Disparities in knowledge and skills tend to widen mostly during periods when school is not in session.

Nevertheless some additional questions remain to be settled. It is unclear to what extent the effect of schooling varies over different age ranges. It seems likely that the effect of age decreases as children grow older. How far this applies to the effect of schooling is still an open question. Whether the effect of schooling differs for students from various backgrounds (e.g., low vs high SES) has hardly been addressed, although the findings from seasonality of learning suggest that the effect is similar for all students. Last but not the least, little is known about the variation of the effect of schooling across schools. The only study that has addressed this issue (Luyten, 2006) suggests substantial variation between schools, even though the effect of schooling appears to be considerably larger than the school effect.

See also: Data Bases and Statistical Systems: Education, Statistical Systems; Education, Economics of; School Effectiveness Research.

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