THE IMPACT OF TEACHER COMPETENCE IN PUBLIC AND INDEPENDENT SCHOOLS IN SWEDEN

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Abstract

The study investigates the influence of teacher competence on third grade students' reading achievement in public and independent schools in Sweden. The data derive from the Swedish participation in PIRLS 2001. Regression analysis was employed to explore the relative effects of several indicators of teacher quality. Teachers' sex, teaching experience, in-service training and co-operation with colleagues had no significant influence on student achievement. Teacher certification for teaching in early grades, though, was shown to have a strong effect on students' mean reading test scores. This effect was as strong in independent schools as in public schools. Students in independent schools performed better on the reading test than did students in public schools. Controlling for parents' education while entering the two variables teacher education and school type into the regression model, the effect of school type on student achievement disappeared. Though school type had no intrinsic influence it was a mediating factor for parents' education and teachers' education. These effects worked in opposite directions, however. While students in independent schools had better-educated parents, students in public schools had better-educated teachers.

INTRODUCTION

This study investigates the influence of teacher competence on third grade students' reading achievement. The effect of teacher competence on the mean difference in reading test scores between public and independent schools is also explored.

Since the Coleman report (Coleman et al., 1966), many have argued that students' family background and peers' background are the only important determinants of students' achievement. During the last decades however, a growing body of studies has revealed considerable differences related to teachers' efficiency in teaching

students. Hanushek (2002) found that having five years of good teaching can overcome the average achievement difference between low-income students and students from higher income families. Good teachers can thus make up for the typical deficits in preparation of students from low-income backgrounds. The question of whether teacher quality can be measured by observable variables has, however, lead to conflicting results, many arguing that teacher competence cannot be captured by different indicators.

Education and teaching experience have most often been used to measure teacher competence. Effects of salary and the amount of in-service training and its content have also been studied. There are classroom studies in which observation techniques have been used. Teacher education differs considerably, however, between countries, which makes comparisons difficult. In OECD countries, for example, teacher education for lower grades usually takes places outside of the universities, even though several countries, for example Greece, Spain and France, in recent years have moved teacher education to the universities (Gustafsson & Myrberg, 2002).

The effect of teacher education on student achievement

Hanushek, Kain and Rivkin (1998), like many other researchers (see for example Darling-Hammond, 1999), have concluded that the school effect on achievement derives mainly from variations in teacher quality. On the basis of longitudinal data from more than one-half million Texas students in grades 3 to 6, they concluded that school quality is an important determinant of academic performance and an important tool for raising the achievement of low-income students. Furthermore, variations among teachers dominated school quality differences, while school leadership or the organisation of schools did not have any measurable effect. Another result was that there were important gains in teaching ability over the first few years of teaching, but that these effects declined after the first several years. A master's degree was not found to be associated with improved teacher skills. The estimates in this study suggested that differences in teacher quality explained at least 7.5 percent of the variation in measured achievement. However, measured factors captured just a small proportion of the differences among teachers. From these results the authors drew the conclusion that teacher education is a small component of variation in school quality.

That a master's degree had no influence on achievement, at least in lower grades, is not a new result add space (see, for example, Monk, 1994; Darling-Hammond, 1999). According to Darling-Hammond (2000), subject-matter knowledge has often been found to be an important factor in teacher effectiveness. However, its relationship to teaching performance is curvilinear: it exerts a positive effect up to a threshold level and then tapers off in influence. Measures of pedagogical knowledge including knowledge of learning, teaching methods and curriculum have more often been found to influence teaching performance, and frequently these factors exert even stronger effects than subject matter knowledge. Doubts may, however, be raised concerning the interpretation of the results from the Hanushek et al., (1998) study as they may be biased due to omitted variables. With information on teaching experience and highest degree earned alone it is not possible to link the length and

content of teacher education to students' achievement. Without any information on teachers' pedagogical knowledge, and considering the heterogeneity of teacher education, the absence of casual effects is not surprising.

Hanushek (2002) argued that government policies targeting school resources, including raising qualifications of teachers do not effectively improve quality. Added requirements for teacher certification, for example, show no strong relation to teacher quality and student achievement. In addition, some good teachers may not want to take specific courses; thus, the group of people who might enter teaching is reduced. Darling-Hammond, Berry & Thoreson (2001) on the other hand, stressed the difficulty of generalisations about teachers' qualifications based on certification status only, since both regular certification and short-term certification operate under widely different standards in different states in the United States. There are three short-term licensing categories; temporary, emergency and provisional. These are handled differently in various states. Generally, temporary and emergency credentials are valid for at most two years and are non-renewable. These credentials are frequently developed to authorise individuals to teach when they have entered with credentials from other states or are in the process of completing minor coursework and test requirements. Emergency licenses are often granted to those with teaching licenses in another category and who have a bachelor's degree, upon request by the school district due to a shortage of licensed applicants. Some states provide provisional nine-months certificates for those who meet the requirements for a regular teaching, school service, or administrative certificate in another state, and who hold bachelor's degree (or higher). During the nine months, basic skills and subject matter knowledge tests must be taken. In other states non-standard credentials are good for one year during the training process, after which successful candidates receive a full standard license.

Goldhaber and Brewer (2000) found no differences in efficiency between teachers with standard certifications and teachers with temporary certification. Their study investigated 12th grade students' achievement in mathematics and science, and they concluded that there is little rigorous evidence that teacher certification is systematically related to student achievement. This result has been strongly criticised by Darling-Hammond et al. (2001). The sub-sample of teachers with short-term certification was very small and they were likely to vary substantially in preparation, some being fully qualified from another state and some having just a few weeks of summer courses.

Ferguson (1991) studied teachers' results on a license test measuring pedagogical skills as well as subject knowledge. They related the result to student achievement and found these variables to be more powerful than class size and school size. Teacher competence could, after controlling for students' social background, explain the difference in level of achievement between black and white students.

Elliot (1998) noted in a longitudinal study that well-qualified teachers had a significant influence on high school students' achievement in mathematics and science. In this study teacher qualification was measured by education, experience and teaching methods. Evertson, Hawley & Zlotnik (1985) compared well-educated

teachers with less educated teachers. The results showed achievement gains for students with well-educated teachers. They also showed that achievement was related to teachers' knowledge of the subjects taught.

In a study involving 7000 students Wenglinsky (2000) found that the quality of the teaching force has a comparable impact on students' test scores as socioeconomic status.

Darling-Hammond (1999) investigated students' test results in reading and mathematics. In the study 44 states with 65 000 teachers were included. The data comprised several variables indicating teacher competence, such as certification and experience. A number of other variables were included in the study such as education policy, demographics, student characteristics and school characteristics. Controlling for student background, teacher certificate and subject matter knowledge were shown to correlate with students' test results and to have great explanatory power. Teacher salaries or class size did not show any significant influence when holding students' background constant.

In a review, Wayne and Youngs (2003) examined the evidence on teacher characteristics and student test scores in a U.S. sample, controlling for students' prior achievement and socioeconomic status. Wayne and Youngs could not draw any conclusions about the importance of teacher degrees and coursework for elementary students since too few studies were available. Results showed, however, that high school students' mathematical achievement improved when their teachers had standard certification.

As mentioned earlier, for a given subject most states in the U.S. offer a variety of types of certification and there is uncertainty about the comparative effectiveness of teachers whose certification is of non-standard type (Wayne and Youngs, 2003). Proponents of alternative certification have argued that some lowering of the standards attracts persons with better qualities by reducing entry barriers. Darling-Hammond (2000) found that teachers from short-term programs have high attrition. Even more, these short-term programs tend to focus on generic teacher skills rather than on subject-specific pedagogy, on singular techniques rather than a range of methods and on specific immediate advice rather than on research or theory. Individuals who have had no strong teacher education intervention often maintain a single cognitive and cultural perspective that makes it difficult to understand experiences, perspectives and knowledge bases of students who are different from themselves. Teachers from extended programs (typically 5-year programs) are more satisfied with their preparation, colleagues and principals view them as better prepared, they are as effective with students as are more experienced teachers and they are more likely to stay in their profession. These teachers come to understand teaching as an inherently non- routine endeavour where they develop pedagogies that can reach different learners.

In their meta analysis, Wayne and Youngs (2003) concluded that they would like to see studies that explicitly distinguish between degrees in subjects and degrees in the teaching of particular subjects, as well as studies that distinguish between degrees in the teaching of particular subjects, and general degrees in teaching or education.

Other measures of teacher competence

One common indicator of teacher competence is teaching experience. However, according to Wayne and Youngs (2003), the findings regarding experience are difficult to interpret for several reasons. First, experience captures the effect of whether teachers were hired during a shortage or a surplus. Cohorts will have experienced similar competition, and selection effects are likely to confound effects of experience. Secondly, experience measures capture differences in teacher motivation resulting from time constraints on parents during years when their own children require more attention. Finally, if there are differences in effectiveness between those who leave the profession and those who stay, experience measures would capture those as well. Such differences are probably dynamic, changing with labour markets and cultural trends.

Several studies have found a positive relationship between teacher experience and student achievement (e.g., Murnane & Philips, 1981; Klitgaard & Hall, 1974). This relationship is not simple and linear however. According to Darling-Hammond (1999), teachers with less than three years' experience are less efficient than are colleagues with more experience. After five years the additional contribution weakens. Andrew and Schwab (1995) noted that inexperienced teachers from lengthy teacher education programs can be as efficient as experienced teachers. Teachers' age may also be of importance for effectiveness but this variable is of course highly correlated with experience.

Postlethwaite and Ross (1992) observed in analyses of data from the IEA Reading Literacy study that female teachers were more efficient than male teachers. In these analyses though, no control for teacher education was made.

There is some evidence indicating that teacher in-service training may be positively related to student achievement. Angrist and Lavy (1998) have reported considerable gains. The program they studied in Israel was quite lengthy and included pedagogical instruction for teachers once a week, and during the last year of the program the training comprised 12 hours a week. Results from this high quality program may be difficult to generalise to more modest efforts of in-service training but Angrist and Lavy found the benefit to be higher than the cost. It would thus be more expensive to achieve corresponding student achievement gains with a reduction in class size or increased lesson time. Wiley and Yoon (1995) also found positive effects of in-service training in California. Wenglinsky (2000) observed certain types of in-service training, such as working with different student populations and higher order thinking, to be related to students' test results.

Research on teacher co-operation in efficient schools has been shown to correlate with student achievement (Rutter et al., 1979; Mortimer et al., 1988). In this type of research the importance of school climate for students' results has often been stressed. However, research on efficient schools lack theoretical constructs that can explain the processes involved. The studies are primarily descriptive and, according to Levin (1995), effective schools research has not led to any improvement in student achievement when attempts have been made to implement the characteristics of efficient schools.

Voucher systems

Since Friedman (1962) introduced the idea of competition among schools as a method for improving educational quality, many have argued that the best way to raise the quality of education is to encourage competition among schools and to introduce voucher systems (Goldhaber, 1999). With a larger proportion of independent schools in a region, the quality of both independent and public schools is supposed to be improved (Bergstrom & Sandstrom, 2001; Bjorklund, Edin, Fredriksson & Kreuger, 2003). An increase in pedagogical variation is expected and this should inspire and develop educational practice (Skolverket, 2003). This research has paid scant attention to teacher quality. When discussing the advantage of private schools it has been argued that the quality of instruction is enhanced by fewer bureaucratic constraints, small schools, clearer goals, more fruitful co-operation with parents and a better school climate (Rees, 1999; Chubb & Moe, 1988). Private schools are also supposed to put greater stress on academic excellence (Chubb & Moe, 1988). While the importance of enthusiasm among teachers and school leaders is emphasized, formal teacher education is not considered of particular significance for student achievement. Johansson (2003), the president of the Swedish association for independent schools, claimed that with a freer pedagogy, dedicated teachers and focus on the task, independent schools have great opportunities to succeed where others fail. Wahlstrom, the managing director for the Swedish association for independent schools, found formal teacher background to be unimportant to the fulfilment of duties (cited in Bee, 1999). Quality in education is measured by student results and not by teachers' certification according to Wahlstrom.

In Sweden a voucher system was adopted in 1992. It is one of the most common systems: "the funding follows the children", also adopted in, for example, the Netherlands, New Zealand and Chile (West, 1997). The share of students in independent schools is 6 percent on a compulsory level and the proportion is increasing. Teacher certification is less common in independent schools than in public schools. Research on effects of the fast growing independent schools is so far sparse, and in Sweden as well as internationally it has focused mainly on effects of competition or social selection and cream-skimming (see, for example, Belfield and Levin, 2002; McEwan, 2000; Myrberg & Rosén, 2003). No studies that we are aware of examine teacher competence in public and independent schools in relation to student achievement.

As can be concluded from this overview, findings on the influence of teacher education on student achievement are ambiguous. Research in the United States has come to contradictory conclusions, likely related to the extensive variety in teacher education and certification requirements. Studies finding that teacher education does not matter appear to be afflicted with methodological problems such as omitted variables. A number of studies have found that teacher education is related to students' test results in different subjects. Teacher competence is likely to be a mix of subject-specific knowledge and pedagogical skills where a crucial skill is the ability to use different teaching approaches adapted to individuals and groups. There

is some evidence that lengthy teacher education programs can provide teachers as efficient as more experienced ones. The effects of experience have been proven difficult to measure, even though some studies have found positive effects of experience. In-service training, at least if it is high quality, may be positively related to student achievement. Effects of teacher co-operation have not yet been clarified.

Though several studies have identified effects of teacher education on achievement, one hypothesis frequently expressed among advocates for voucher systems, is that formal teacher education is not as significant in private / independent schools. Instead, the importance of other teacher characteristics that are supposed to characterise these schools are highlighted, including: greater enthusiasm and motivation amongst teachers, a more homogeneous teaching force working in the same direction with clearer goals, greater stress on students' academic performance and, in general, better co-operation among colleagues, parents, teachers and head masters.

Previous research thus leads to the hypothesis that although teacher certification most certainly influences student achievement in public schools, this influence is likely to be less or nonexistent in independent schools. This issue is investigated in the following analyses.

METHOD

This section outlines the study design and describes the sample, variables, analysis procedures and methods.

Data source – the IEA PIRLS 2001 study, design and samples

The data for this study derives from the Swedish participation in the PIRLS 2001 study conducted by IEA. Sweden participated with three separate samples of students in this study. Two of the samples were in grade 3, one for PIRLS and one for the repeat of the RL study in 1991. The third sample was in grade 4 for PIRLS. The design of the international study is described in the PIRLS framework (Campbell, Kelly, Mullis, Martin, & Sainsbury, 2001) as well as in the PIRLS 2001 technical report (Mullis, Martin, & Kennedy 2003). Table 1 briefly outlines the design of international instruments.

About 50 percent of the students in this study took the tests developed for the PIRLS 2001 study and in addition they took one of two test-booklets developed for the IEA literacy study 1991. The students in the other half of the sample took both the two test-booklets from 1991. Questionnaires were distributed to students, parents, teachers and principals.

Table 1: Instruments used in the IEA PIRLS 2001 study

INSTRUMENT (and responding informant)	*Content*	*PIRLS 2001*	*RL 2001*
RL 2001 Reading achievement test (students)	Eight text passages distributed across 10 booklets, each holding two passages in a matrix sample design. Each student took one of the booklets during 2 x 40 minutes.	✎	
RL 1991 Reading achievement test (students)	Fifteen mostly short text passages divided into 2 booklets in a simple design. Each student took both booklets at different occasions, and used 40 minutes for each.		✎
PIRLS 2001 student questionnaire (students)	School and teaching experiences, reading homework, self concept of reading abilities, attitudes towards reading, reading habits on leisure time, reading resources at home, and questions aiming at social background characteristics.	✎	
RL 1991 student questionnaire (students)	Questions similar to those in PIRLS student questionnaire, although less in number and detail.		✎
PIRLS 2001 home questionnaire (parents)	Reading activities with child, reading resources at home, parents attitudes towards reading and own reading habits, co-operation with school and social background questions.	✎	
PIRLS 2001 teacher questionnaire (teachers)	Questions about class characteristics, teaching reading and reading material, reading assessment and collaborations with parents. Own education, teaching experience, and teacher collaboration.	✎	
PIRLS 2001 school questionnaire (principals/head masters)	School characteristics, demographics, availability of cultural and educational resources, school resources, school policy's regarding teaching reading, socio-economic mixture, school-home collaboration, school climate, school management.	✎	

Sampling and samples

The sampling procedure is described by Mullis et al., (2003) and Rosén, Gustafsson, & Myrberg, (2003). In Sweden independent schools were oversampled to allow analysis of differences between public and independent schools. The proportion of independent schools at the time for sampling was less than 4 percent. The relatively higher proportion of independent schools in relation to public schools is adjusted in the analysis with sampling weights. The proportion of students who were absent at the time of testing or who did not receive parental permission to participate in the study was less than 5% in all three samples. Missing data for each of the questionnaires was less than 10%.

The analyses in this study were based on the two grade 3 samples only, of which one was selected for the repeat of RL1991 study (RL 2001), and the other for PIRLS. Table 2 presents the number of schools, classes and students.

Table 2: Number of schools, classes, teachers and grade 3 students

	Public schools	*Independent schools*	*Total*
Schools	238	54	292
Classes	641	76	717
Teachers	956	111	1 067
Students	9 598	1 034	10 632

The sample comprised 292 schools, 717 classes, 1 067 teachers and 10 632 students of which 1 034 attended independent schools. All analyses were based on the full sample.

Variables

The variables used in this study were selected primarily from the teacher questionnaire representing teachers' reports, but the home questionnaire representing parents' reports was also used. Selected variables from the questionnaires and from the school register are described in Table 3.

"School type" is a dummy coded variable where 0 equals public schools and 1 independent schools.

The variable "certified" is a dummy coded variable constructed from a question with nine alternatives that was a Swedish national option in the study. As teacher education has undergone a number of changes since the fifties (e.g., since the seventies it has been a function of universities or university colleges), the exams for teachers differ depending on when their teacher education took place. Teachers with any kind of Swedish certification for teaching in the lower grades are recognised in this study to be certified and are coded 1, while the rest of the teachers are coded 0.

Table 3: Indicators of reading achievement, student background and teacher competence

Variable label	*Information/Question/Statement*	*Source*
School characteristics		
SCHOOL TYPE	Public or Independent	Register
Students' home background		
MOTHER' EDUCATION	Mother's educational level	Parent
FATHER'S EDUCATION	Father's educational level	Parent
Teacher characteristics		
TEACHER SEX	Are you female or male?	Teacher
TEACHER AGE	How old are you?	Teacher
TEACHER EXPERIENCE	How many years have you been teaching altogether?	Teacher
TEACHER READ SEMINARS	In the past two years, how many hours in total have you spent in seminars that dealt directly with reading or teaching reading?	Teacher
TEACHER MEEETING	About how often do you have meetings with other teachers to discuss and plan reading curriculum or teaching approaches?	Teacher
TEACHER EDUCATION	What kind of teacher education do you have?	Teacher
Students' reading achievement		
TOTACH	Total achievement on PIRLS 2001 or RL 1991/2001 reading achievement tests (IRT-scores)	Student

A total IRT score was used as an outcome variable. The two total reading achievement scores for RL 2001 and PIRLS 2001 were transformed into the same scale by equating the percentile scores of the two scales ("Totach"). The appropriateness of such equating is supported by another study where a multivariate analysis of the dimensionality of the two reading achievement tests showed that the general reading achievement dimensions correlated .99 between tests (Gustafsson & Rosén, 2003).

Methods of analysis

In the first part in student reading achievement in relation to teacher education according to school types is described. A sequence of regression models was then fitted to data where the difference in mean achievement was modelled by the use of "certified" and other possible explanatory variables indicating teacher competence as independent variables. These variables were inserted separately one at a time as

possible mediators of teacher competence on achievement. Finally a regression model was fitted where school type and teacher education were used as independent variables, controlling for the effect of parents' education. The aim was to study to what degree different aspects of teacher competence account for the mean difference between school types.

Regression imputations of missing values were made using the SPSS missing value analysis program. Missing data do not exceed 10 percent and there were no differences in the prevalence of missing responses for the two school types. To account for design effects caused by the cluster sampling, the Mplus program (Muthén & Muthén, 2001) was used under the modelling environment STREAMS 2.5 (Gustafsson & Stahl, 2001).

RESULTS

All results are presented at student level. This part begins with a description of the differences in teachers' education and students' mean test scores between school types. Next we present a regression model where possible interaction effects between teacher education and school type were explored. In a series of regression analyses, the test-score was then modelled by entering indicators of teacher competence as possible explanatory variables to the mean achievement score. Finally, the effect of teacher education on achievement between school types was analysed with the use of *Parental education* as a control variable.

The influence of teacher education on students' achievement

Table 4 presents reading achievement differences and differences in teacher education between school types. As earlier mentioned, all teachers with a Swedish certificate for teaching in the lower grades are coded as certified. Among students in public schools 84% had teachers certified for teaching in lower grades, while in independent schools only 58 percent of students had certified teachers.

Table 4: Total reading achievement by teacher education and school type

	Certified teachers			Non-certified teachers		
	Mean	N	Std. deviation	Mean	N	Std. deviation
Public	512	8 251	94	487	1 524	101
Independent	540	188	90	507	139	110

Students in public schools whose teachers were not certified for teaching in the lower grades had a mean of 487 points while those with certified teachers had a mean of 512 points, a difference of 25 points. For students in independent schools the relationship between achievement and teacher education was even stronger. The mean for students with non-certified teachers was 507 points and for those with certified teachers the mean was 540 points, a difference of 33 points. The standard deviation was smaller for students with certified teachers in both school types. For

students with non-certified teachers, the variation was larger in independent than in public schools. Altogether, there were sizeable differences between students who were educated by certified teachers and those who were not and this result held true for public as well as for independent schools.

To establish whether there was any interaction effect between "Certified" and "School type", a product variable was entered into the regression model together with the other two dummy variables. The result showed a main effect of both Teacher education and School type but no significant interaction (t = .51). The influence of teacher education thus was the same in both school types. In a model in which the product term was not included, the regression coefficient for school type was 24,3 (t = 3.3) and for teacher education 25,6. (t = 4.4). These results indicate that there was quite a strong influence of teacher education on student achievement. However, as was shown by Myrberg and Rosén (2003), the achievement advantage of independent schools over public schools, which was of the same magnitude, may be accounted for by social selection effects in the recruitment of students to independent schools.

The descriptives presented previously showed extensive differences in achievement scores between students with certified and students with non-certified teachers in both school types. The results presented in this section support the argument that teacher education, in contrast to what has been claimed by several advocates for voucher systems, has the same effect on students' achievement regardless of school type. Even though the null-hypothesis cannot be proven, the test result differences between students with and without certified teachers surely makes it difficult to claim that these are a consequence of a power problem.

Influences of other indicators of teacher competence

The teacher questionnaire in PIRLS included a number of indicators of teacher competence that in recent research have been shown to relate to student achievement. Several variables were explored as possible explanatory or mediating variables of the mean test score difference between certified and non-certified teachers. Every separately inserted variable may have its own contributing effect on the dependent variable ("Totach") and through correlations with teacher education might account wholly or partially for the difference in average reading performance scores between students of certified and non-certified teachers. As was described in the introduction, teacher competence can be a function of several factors such as sex or age; therefore, a number of possible mediating effects were explored.

First, the influence of teacher gender on the mean reading score was investigated. A significant advantage (t = 2.38) for female teachers was found, their students scoring on average 16 points higher than students of male teachers. However, the gender effect disappeared when "certified" was entered into the model (t = 1.65). The reason for this was that the male teachers to a greater extent than the female teachers were non-certified, so the effect of the teacher gander was in fact due to differences in amount of teacher education between male and female teachers. There was no correlation between "Teachers sex" and "School type". The proportions of female teachers were thus the same in both school types.

Neither "Teacher age" (t = 1.42) nor "Teacher experience" (t =1.53) had a significant effect on student achievement scores. Teachers' age and experience are of course correlated. It is interesting that teacher experience did not seem to have any effect on student reading achievement, even though there was a tendency towards a positive influence of experience. A possible explanation supported by evidence from among others Darling-Hammond (1999), is that the effect of teacher experience decreases substantially after the first years of professional experience.

Previous research has demonstrated that in-service training might improve teacher competence. The teacher questionnaire included a question where teachers stated how many hours they spent in workshops or reading seminars that dealt directly with reading or teaching reading during the last two years (with response alternatives from "None" to "More than 35 hours"). The result showed no significant effect of in-service training on student test scores. A possible explanation of this result might be that in-service training can vary in design and it can also vary substantially in quality.

Analyses also were made of the impact of teacher co-operation. Teachers meeting with colleagues, discussing problems and sharing experiences can be presumed to develop teacher skills. In the teacher questionnaire, teachers stated how often they have meetings with colleagues to discuss and plan reading curriculum or teaching approaches. There were five response alternatives from "Never" to "Every day". The t-value was not significant (1.68) so no relationship between teacher co-operation and student test scores could be established, even though the t-value indicates a tendency towards an effect of co-operation.

From these analyses it can be concluded that teacher education had a considerable effect on student achievement, and that this influence cannot be explained by any of the other variables measuring teacher competence in the present analyses. As no significant effects were found from the possible indicators of teacher competence besides teacher education, the former are not included in the subsequent analyses.

As the teachers in public schools were on average better educated than were the teachers in independent schools, the mean performance advantage for public schools can be expected to increase when teacher education is entered along with school type into a regression model. This is indeed the case, even though the increase is modest. The mean difference between school types rises from 17 points to 23 points (t = 4.39). Given that the relative proportion of certified teachers was the same in both school types, the mean difference in reading score would have been about 23 points.

Student background has long been known to have a strong effect on achievement. In any analysis of other factors it is hence of importance to control for this effect. In a previous study (Myrberg & Rosén, 2003), using the same data set as in the current study, multiple regression analysis was employed to explore the impact of parental education on students' mean reading achievement difference between public and independent schools. The results showed that the latent variable Parental education derived from "Fathers' education" and "Mothers' education" had a mediating effect that could fully explain the mean difference in achievement between school types. Parental education was used to control for the influence of student background when

investigating effects of teacher education on reading achievement. Descriptive differences in parents' educational level between school types are presented in Table 5.

Table 5: Parents' highest educational level. % of students.

	Fathers		*Mothers*	
	Public Schools	*Independent Schools*	*Public Schools*	*Independent Schools*
Not finished compulsory school	1,3	1,0	,8	,3
Compulsory school	16,1	9,9	10,3	5,6
Two years of upper secondary school	27,8	16,2	24,9	15,4
Three years of upper secondary school	13,8	12,9	14,1	13,4
Some schooling after secondary school	12,9	12,2	15,6	15,7*
Two years of university studies	4,2	6,9	5,5	5,9
Between two and three years of university studies	6,5	9,2	12,8	16,4
Bachelor's or Master's exam	16,1	30,4	15,1	25,9
Not applicable	1,4	1,3	,9	1,3

The proportion of students in public schools where parents had no more than two years of upper secondary education was 28 percent for fathers and 25 percent for mothers. In independent schools the corresponding figures were 16 percent for fathers and 15 percent for mothers. The proportion of students in public schools with parents who had at least a bachelor's degree was 16 percent with respect to fathers and 15 percent with respect to mothers. The corresponding figures for students in independent schools were 30 percent regarding fathers and 26 percent regarding mothers. On the whole, the fathers' and mothers' educational levels for students in independent schools were higher than for parents of students in public schools.

In this step the latent variable *Parental Education* was kept under control while entering the two variables "Certified" and "School type" into the regression model, using "Totach" as the outcome variable. The result showed that the effect of school type disappeared (t = .38). Thus, the initial difference of 17 points is fully accounted for when adding parental education and teacher education to the model. Though school type has no intrinsic influence, it is a mediating factor for both parental and teacher education. These effects work in opposite directions, though. While students in independent schools have better-educated parents, students in public schools have better-educated teachers.

DISCUSSION AND CONCLUSIONS

The main conclusion to be made from the above analyses is that teacher education is of great importance for students' reading achievement. The results show that students in both school types perform better when they have certified teachers.

Furthermore, the influence of teacher education seems to be of the same magnitude

in public and independent schools. The effect of teacher education is a disputed question, as some have claimed that teacher competence is an individual characteristic not much affected by education. It has also been argued that the circumstances for education and learning in independent schools differ substantially from those in public schools. The independent schools are supposed to attract highly motivated and devoted teachers with various backgrounds and with the ability to shape a positive educational environment for students.

The results in this study instead stress the significance of high quality teacher education program that prepare for teaching in specific grades. Advocates for less standardised teacher requirements have argued that a variety of teacher educational routes and experiences may develop and vitalise students' education. Our findings do not support this belief. Instead, effectiveness has been shown to be closely connected to appropriate teacher education.

One possible explanation for the strong relationship between teacher education and students achievement for Swedish third graders is that most of these children have had the same teacher for almost three years of schooling. Another explanation might be that teacher certification in Sweden is still subject to nationwide regulations.

School type has no influence over student achievement in itself. It is however, a mediating factor for parental education as well as teacher education. While students in public schools have better educated teachers, students in independent schools have better educated parents. These two influences work in opposite directions and are of the same magnitude. When controlling for parental background, the mean reading test score advantage for students in independent schools is wiped out. Furthermore, the results indicate that students in independent schools are underachieving due to the relative shortage of certified teachers.

Other teacher characteristics such as sex, teacher experience, the amount of time spent in in-service training and teacher co-operation, have in this study, not been shown to be related to reading achievement.

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