School Process and Educational Outcomes in England

Amira ELasra[1]

Abstract

Most of the existing literature have shown that the educational production function approach hardly accounts for the school process variables. This paper examines the teacher and school effectiveness impacts on English students' both cognitive and affective outcomes using the Context-Input-Process-Outcome model. The primary implication of the findings is that teachers matter. Teachers play a significant positive moderate role in improving students' cognitive outcome and a much bigger role in improving their affective outcome. Although the paper proved that school process inputs are important in explaining students' outcomes, the moderate magnitude of some of these inputs on cognitive outcome reflected that student's related inputs such as academic self-schema and attitude towards continuing to higher education could play a major role in explaining such outcome.

Keywords: Educational outcomes, school process, teacher quality, school quality.

JEL Classification: I21, D12, D13.

1. Introduction and Motivation

There has been a long debate over the relationships between different inputs in the educational process and student's outcomes since 1966 with the release of the Coleman's report, which concluded that family background and peers were more important than schools and teachers in educational outcomes. Related research has included a number of disciplines, such as Economics, Sociology and Psychology. Despite the expansion of the literature on the implications that different inputs have on students' educational outcomes, empirical research has so far lacked, in some instances, the full capacity to provide unequivocal findings. Essentially, this deficiency is mainly attributed to two main factors; the lack of reliable data and the lack of full dimensionality in the theoretical model adopted to explain such data (Levaччićć and Vignoles, 2002; Knoeppel, Verstegen, and Rinehart, 2007; Kyriakides, 2005; Rivkin, Hanushek and Kain, 2005).

The theoretical model adopted to explain the data plays a major role in reaching unambiguous findings. In that regard, the analysis of the relationships between inputs and outputs of education has widely been the scope of research of many education specialists and economists. However, one of the main differences between the two streams of research lies in the variations between the methodological approaches of investigating such relationships. On one side, education specialists rely on what is known as school effectiveness analysis, while on the other side economists rely on more quantitative analysis under the general framework of educational production functions, also known as input-output or cost-quality analyses (Levaччićć and Vignoles, 2002; Knoeppel, Verstegen, and Rinehart, 2007; Kyriakides, 2005).

In order to understand the key difference between the two approaches, it is important to clarify the general theoretical model that explains the relationships between inputs and outputs of the educational process. The theoretical model that many researchers widely rely on to identify

[1] The Department of Economics, University of Warwick, England.

these relationships is known as the 'Context–Input–Process–Outcome' model (Teddlie and Reynolds, 2000); hereafter CIPO model. The idea and advantage of the model is to incorporate all the possible inputs that affect students' outputs or outcomes in one of the most appropriate framework for a rich analysis that controls for the high full dimensionality of the educational process. The model illustrates how students related inputs, school resources inputs, school context factors and the process of schooling influence students' outcomes.

Previous research has drawn the attention to the fact that both the school effectiveness approach and the educational production function approach focuses on certain components of the model. In essence, education specialists adopt the school effectiveness approach focusing mainly on the school process component in explaining the variations in schools' effectiveness unlike economists who adopt the educational production function approach, which pays more attention to resources inputs and their effect on school efficiency (Kyriakides, 2005; Levaččićć and Vignoles, 2002). Accordingly, each of the two approaches focuses its analysis to only one component of the model leading to methodological limitations.

A typical educational production function, identified by equation (1), follows a similar framework of the school effectiveness literature focusing on the school level production. Specifically, schools produce outcomes using school and teacher inputs including resources inputs and school context while controlling for students' inputs (Levaččićć and Vignoles, 2002)

$$O_{hij} = f(Z_{1hij}, \ldots, Z_{Mhij}) \tag{1}$$

where O_{hij} are H educational outcomes of student i at school j and Z_{Mhij} are M inputs allocated to the production of these outcomes including school resources, school context inputs and students' inputs.

In light of what has been observed in the literature, the paper identifies a number of gaps in the Education Economics literature. To begin with, most of the existing literature have shown that the educational production function approach hardly accounts for the school process variables (Glewwe, et al., 2011; Levaččićć and Vignoles, 2002; Teddlie and Reynolds, 2000). Instead, it focused on the effect of school resources inputs with limited attention to school process variables in which case the focus was on limited factors, such as principals' evaluation to teachers and leadership (Armor, et al., 1976; Murnane, 1975; Teddlie and Reynolds, 2000) or certain organizational aspects of the school, such as the student ability grouping scheme (Kerckhoff, 1986). Second, previous research has indicated that the joint teacher and school effectiveness research is needed in order to explain variations in educational achievement (Kyriakides, 2005), whereas both school effectiveness and teacher effectiveness were examined separately (Teddlie, 1994).

Third, earlier research has shown that an important objective of examining the effect of school process inputs is to incorporate such effect on both cognitive and non-cognitive outcomes (Sammons, Hillman and Mortimore, 1995; Teddlie and Reynolds, 2000). However, only few researcher have met such objective either by fully studying the framework for explaining the two outcomes as in the books of both Mortimore, et al. (1988) and Rutter, et al. (1979) or by examining an application for the effect of school process variables on the two outcomes as in the case of the Netherland (Knuver and Brandsma, 1993) and Greece (Kyriakides, 2005).

Last but not least, most of the earlier research on the effect of the full dimensional school process concept on students' educational outcomes has generally been less focused on the case of England (Levaccićć and Vignoles, 2002) and/or has been focused on the effect of limited organizational aspects of the school, such as the student ability grouping scheme (known as streaming) on cognitive outcomes of British students (Kerckhoff, 1986) or the effectiveness of post-16 educational institutions like assisted places scheme school (Tymms, 1992). Another study examined the effect of teacher quality (Slater, Davies and Burgess, 2009). Other studies examined the effect of school attended on both primary and secondary test scores and its continuity over time using Inner London Education Authority's Junior School Project sample showing that such effect is greater on the former than the latter with smaller effect on continuing from primary to secondary (Sammons, et al., 1995).

In light of the aforementioned gaps, the paper answers four research questions: What is the teacher influence on student's cognitive and affective outcomes? Which aspect of school quality in the school process component is more predictive of student's cognitive and affective outcomes? What is the effect of overall school quality on student's cognitive and affective outcomes? How important is the school process component in the CIPO model? And whether other factors are more important in explaining student's outcomes?

In order to answer these questions the paper examines the effect of school process variables on students' both cognitive and affective educational outcomes using a more comprehensive theoretical framework based on the Context-Input-Process-Outcome model (Teddlie and Reynolds, 2000) controlling for both school context and student's inputs (Link and Ratledge, 1979; Rivkin, Hanushek and Kain, 2005). Particularly, the analysis adjusts equation (1) to (2) by studying the effect of *K* school process variables; P_{Kij} on the student level outcome rather than the school level, where C_{Lij} are *L* school context variables for student *i* at school *j* and X_{Nij} are *N* student input variables.

$$O_{hi} = f(P_{1ij} \ldots P_{Kij}, C_{1i} \ldots C_{Li}, X_{1i} \ldots X_{Ni}) \quad (2)$$

Additionally, the paper combines both the teacher and school effectiveness by examining the school process inputs at both the school level and the teacher level that are not financial resource oriented inputs. In short, the analysis combines teacher influence variable measuring student's perception of his/her teacher and school quality variable(s), to examine their effect simultaneously on students' educational outcomes.

The analysis of the paper is based on a dataset built comprising data from the Longitudinal study of Young People in England (LSYPE), the National Pupil Database (NPD) and the Ofsted database, hence including new school information that have been lacked in the literature covering a wide range of school process variables in the analysis. The paper proceeds with a review of empirical literature of the effect of school process inputs on educational outcomes in section 2 followed by data, statistical method and model specification in section 3. Main findings are discussed in section 4 and the paper ends with conclusion and discussion in section 5.

2. Review of Empirical Literature

Numerous studies in the education economics literature were conducted to estimate the effect of one or more inputs on the educational outcomes of students relying on the use of educational production functions. Among the first application of such functions was the one in the Coleman's et al. report (1966), which investigated the relationships between inputs and outputs of education in the USA concluding that student's inputs or more specifically families and peers inputs are the most important determinant of variations in students' educational outcomes rather than school inputs.

As has been stated earlier, most of the educational production functions examining the effect of school inputs in the literature have focused on school resources inputs rather than school process inputs following Coleman's (1966) analytical framework. The early studies of Hanushek (1971; 1981; 1986, 1989; 1991; 2008) and followed by the work of other researchers such as (Dolton and Vignoles, 1999; Fuchs and Woessmann, 2007; Galiani and Perez-Truglia, 2011; Hakkinen, Kirjavainen and Uusitalo, 2003; Hanushek and Kimko, 2000) are prominent examples of school resources inputs effect. Despite the pessimistic view of resources effect indicated in these studies, others have shown more positive impact of such inputs (Barro and Lee, 2001; Newman, et al., 2002; Pugh, Mangan and Gray, 2008).

A number of studies have also investigated the effect of school non-teacher inputs such as class size (Angrist and Lavy, 1999; Browning and Heinesen, 2007; Dolton and Vignoles, 1999), teacher's training (Angrist and Lavy, 2001), teacher's absence (Das, et al., 2007), instruction time (Bellei, 2009) and school type/phase (Dearden, Ferri and Meghir, 2000; Dolton and Vignoles, 1999; Dustmann, Rajah and Soest, 1998; Feinstein and Symons, 1999). Other studies have focused on examining the effect of both student's inputs and school inputs combing both school level inputs and teacher level inputs (Kyriakides, 2005).

Following the aforementioned findings of Coleman's report (1966), Hanushek's studies and others' that there is no strong positive relationship between school financial resources and students' outcomes, several studies were conducted to further investigate the effect of school inputs on students' outcomes. Specifically, a number of researchers examined school process effect rather than school financial resources using inputs that are associated with the human and organizational aspects of the school (Mortimore, 1993; Mortimore, et al., 1988; Reynolds and Creemers, 1990; Sammons, Hillman and Mortimore, 1995).

During the last three decades, a considerable body of research evidence has been accumulated showing that although family backgrounds of students and their academic self-schema are major determinants of their educational outcomes, schools have significant though small contribution in explaining variations in students' outcomes (Daly, 1991; Mortimore, et al., 1988; Reynolds, 1982; Rutter, et al., 1979; Sammons, Hillman and Mortimore, 1995; Wilkins and Raudenbush, 1989). For example, student sense of control of their environment, quality of teachers' education, and teachers' high expectations for students are types of school process factors that tend to have significant positive relationships with students' outcomes (Link and Ratledge, 1979; Summers and Wolfe, 1977; Winkler, 1975). The following review focuses on key empirical studies examining the effects of school process inputs, specifically school quality inputs and teacher inputs on student's educational outcomes.

School Process Inputs: School Level (Quality)

Most researchers who examined the effect of school process variables focused on urban elementary schools with low socioeconomic status because they believed that success stories of these schools would dispel the belief that schools made little or no difference (Teddlie and Reynolds, 2000). One example of these studies is that of Weber (1971) showing that ongoing school process variables, such as leadership, expectations, school atmosphere and evaluation of pupil progress are important factors in determining students' outcomes. Similarly, Murnane (1975) indicated that principals' evaluations of teachers were also found to be a significant predictor of students' outcomes (Armor, et al., 1976; Teddlie and Reynolds, 2000).

Previous literature especially that related to school effectiveness has identified a wide range of school process factors that determine such effectiveness. Sammons, Hillman and Mortimore (1995) provide a summary of the main broad factors examined in the literature. These include professional leadership (Mortimore, et al, 1988; Rutter, et al, 1979), shared visions and goals (Mortimore, et al, 1988), a learning environment (Rutter, et al, 1979; Weber, 1971), concentration on teaching and learning (Mortimore, 1993), purposeful teaching (Mortimore, 1993; Rutter, et al, 1979; Stalling, 1975), high expectations (Edmonds, 1979; Rutter, et al, 1979), positive reinforcement (Walberg, 1984), monitoring progress (Edmonds, 1979; Weber, 1971), pupil rights and responsibilities (Mortimore, et al, 1988), home-school partnership (Mortimore, et al, 1988) and a learning organization (Armor, et al., 1976).

Numerous researchers examined the effect of some of these factors on students' educational outcomes. However, given the variety of school process variables, most studies tend to focus on the effect of one or more of these variables on students' educational outcomes. For example, faculty cooperation and cohesion in general and teaching staff cooperation in relation to teaching methods and pupil counselling in particular are seen as key components of a productive school climate and culture that have positive impact on students' cognitive and affective outcomes. Also, they are important with respect to meeting central organisational goals that in return affect students' outcomes (Anderson, 1982; Opdenakker and Van Damme, 2000; Sammons, Hillman and Mortimore, 1995). On the other hand, some school process variables tend to have mixed effect such as attention to pupil differences and development (Opdenakker and Van Damme, 2000; Scheerens & Creemers, 1996).

Empirical support for the effectiveness of an orderly learning environment in the school has been confirmed from qualitative and quantitative reviews showing that it has a positive influence on students' both cognitive and affective outcomes (Opdenakker and Van Damme, 2000; Scheerens, 1992). Similarly, school process factors, such as 'focus on discipline and subject matter acquisition' and 'focus on cultural education and creativity' though not much studied, were found to have only significant positive effect on affective outcomes of students with initial high cognitive and affective characteristics and negative effect for students with initial low cognitive and affective characteristics (Opdenakker and Van Damme, 2000).

Among the school process factors covered in the literature that were examined for its effect on non-cognitive aspects of education is the 'focus on education and personality development'. One of the studies that examined such factor indicated a positive effect on the motivation towards (and interest in) learning tasks. On the other hand, it had a differential effect on the

attitude towards homework, where it was negative for initially high motivated pupils, and a positive effect for initially low achievement-motivated pupils. Additionally, the school focus on education and personality development was suggested to have a negative effect on mathematics cognitive outcomes (Opdenakker and Van Damme, 2000).

In general, a review of school process inputs as reflected in its management showed that decentralization and giving more autonomy to school management enhances students' outcomes (Faguet and Sanchez, 2006; PISA, 2009; Woessmann, 2003) and attendance and probability to continue schooling (Jimenez and Sawada, 1999; 2003), though better-off communities tend to benefit more from such policy (Galiani, Gertler and Schargrodsky, 2008; Galiani and Perez-Truglia, 2011). However, few studies suggested that decentralization increased the drop-out rates and failure rates among primary school students in Brazil even if it increased enrollment levels (Madeira, 2012)

The effect of school quality on students' outcomes was also examined in terms of quality of instructions, rules about time use and the opportunity to learn through consensus about the ''mission'' of the school. One of the studies that followed that framework showed that quality variables at the teacher level, such as 'rules and agreements about aspects of classroom instruction', 'rules and agreements about ways of improving affective outcomes', and 'assessment system focused on formative purposes' (also at the head teacher level) were significant predictors of students' cognitive and affective outcomes. On the other hand, 'rules about time use' and 'consensus about the ''mission'' of the school' were not significant for cognitive outcome, while the latter was only significant for affective outcome (Kyriakides, 2005).

In a way of summarizing the general impact of school inputs on students' outcomes and time in school, Glewwe, et al., (2011) provided a meta-analysis by reviewing both educational and economic literature from 1990 to 2010. The literature was filtered in a number of stages focusing mainly on high quality studies applied to developing countries using quantitative methods. The findings showed that school infrastructure, pedagogical materials and teacher and principal characteristics mostly have a significant positive impact, while most of the school organization inputs were found to have an ambiguous impact.

From the previous review, there tends to be no general consensus on the choice of certain school process input(s) to be studied as key determinant(s) of students' outcomes. Moreover, there is no clear consensus as well on the direction of the possible impact of school process inputs on students' educational outcomes, where it tends to differ either by type of outcome or by group(s) of students investigated. However, it could be concluded that it is still important to examine their impact in the educational production function, even if such impact was not of great importance.

School Process Inputs: Teacher Level

Previous empirical research has shown that in general teachers may not have a strong role in determining students' achievement mainly because of lacking consensus on the exact link between observable teacher characteristics and such achievement (Rivkin, Hanushek and Kain, 2005). To illustrate, teacher characteristics, such as teacher experience and teacher education demonstrated no consistent effect on student achievement (Hanushek, 1971; 1981; 1986;

Hedges, Laine and Greenwald, 1994a; Rivkin, Hanushek and Kain, 2005). On one hand, some researchers suggested a weak relationship between teacher experience and students' test scores (Hanushek and Luque; 2003). On the other hand, teacher experience had a positive significant impact on student's test scores in reading subject areas in the USA (Rockoff, 2004) and mathematics (Rivkin, Hanushek and Kain, 2005).

The quality of teacher's education has also been debated in the economic literature. On one hand, some researchers proposed a positive impact on student's outcomes (Summers and Wolfe, 1977). In a similar fashion, a positive significant association was found between raising the proportion of teachers graduating from prestigious colleges and students' achievements (Winkler, 1975). However, a review of Hanushek's studies showed that only 7% of them found a positive significant relationship between teacher's education and students' outcomes (Hedges, Laine and Greenwald, 1994a).

Other characteristics of teacher input into the learning process were found to have little contribution in poor learning environment as in the case of Zambia. However, after controlling for unobserved child and teacher heterogeneity, teachers' absence was found to have a negative impact on students' test scores (Das, et al., 2007). Teachers' wages were also found to have a statistically significant positive impact on students' attainment in Brazil (Menezes-Filho and Pazello, 2007). Equally, teacher training was found to have a positive impact on elementary schools students' achievements in Jerusalem and that it was more cost effective than reducing class size or lengthening school day (Angrist and Lavy, 2001). Similarly, lengthening the instruction time in public schools in Chile had a positive significant effect on students' achievement with a larger effect in rural areas (Bellei, 2009).

Studying teacher's effect on student's educational outcome from a school process perspective has shown that earlier emphasis on more traditional teacher characteristics such as teacher's years of education or experience may have been misplaced. For example, it was indicated that there is a large positive relationship between outcome and student's perception of a positive teacher's attitude towards him/herself. Such influence was coupled with no significant impact of teacher education or experience (Link and Ratledge, 1979).

In a similar framework, the effect of teachers on students' outcomes was also examined in terms of how effective the teacher is with respect to student's perception of the teaching quality, the time spent on tasks in the classroom and the opportunity to learn with the homework assigned. One of the studies that followed that framework showed that teaching quality variables, such as maintaining appropriate classroom behaviour, maintaining attention on lesson, creating a supportive environment, maintaining positive relationships with students, classroom management, and classroom climate in addition to the amount of home work assigned were significant predictors of students' cognitive and affective outcomes. Also, teacher practices like giving information, asking questions, providing feedback, providing practice and application opportunities and the quality of organized lessons were significant predictors of students' cognitive outcome, while time spent on teaching was not significant for such outcome (Kyriakides, 2005).

Teacher quality was found to have a positive impact on student's cognitive outcomes in the USA (Rivkin, Hanushek and Kain, 2005). Such positive impact could substantially offset

disadvantages associated with low socioeconomic background. Moreover, they showed that little of the variation in teacher quality was explained by observable characteristic, such as education or experience. Similar findings were reported in England (Slater, Davies and Burgess, 2009). Specifically, they indicated that teacher quality makes a big difference in the outcome of students and can reduce the socio-economic gap between students' GCSE outcomes. Moreover, the importance of teacher quality reflected that family background factors are not all that counts when studying student's outcomes.

From the previous review one could conclude that most of the previous education economics literature has focused on either studying the teacher effect from a financial resource oriented perspective or by putting more emphasis on teacher's education and experience. This has been coupled with lack of investigation of other teacher effects, especially in terms of the student's perception of the teacher. Accordingly, it could be proposed that studying the teacher effect from a new perspective suggested by the student's perception is important in examining his/her educational outcomes.

3. Data, Econometric Method and Model Specification

The data used for the analysis in this paper is an integrated dataset of the LSYPE, the NPD and the Ofsted database comprising a wide range of information about the student's educational and behavioural indicators, family background factors and school context and process factors. The analysis explains the effect of school process inputs on two main educational outcomes of students; namely cognitive outcome and affective outcome. The analysis captures the student's cognitive outcome by his/her key stage 4 (KS4) total GCSE/GNVQ new style point score for the year 2005/2006 using a sample of 1664 students in 187 schools and measures the student's affective outcome by his/her average score of attitude towards school given by the answers to five questions, where for each question the student can answer one of 5 categories: 'strongly disagree', 'disagree', 'I don't know', 'agree' and 'strongly agree' using a sample of 1520 students in 183 schools.

Independent Variables

The analysis examines two key school process variables; teacher influence variable and school quality variable.

Teacher Influence

One of the contributions of the current analysis is the use of data about student's perception of his/her teacher to measure teacher influence. Specifically, three variables were constructed based on data from the LSYPE; student-teacher relationship, teacher quality and overall teacher index. The student-teacher relationship variable as reflected by the name, measures the student's perception of such relationship, where higher values would reflect better student-teacher relationship with Cronbach's alpha ($\alpha = 0.21$). The teacher quality variable measures the student's perception of his/her teacher quality ($\alpha = 0.82$). The last teacher related variable measures the overall teacher index by basically summing the two previously constructed variables to provide the overall student's perception of his/her teacher ($\alpha = 0.71$).

School Quality

The Ofsted database provides information about school performance for the year 2005/2006[2] using nine key judgements covering 56 questions. Nine indices were constructed for the nine judgements reflecting school overall effectiveness (OE, α= 0.80), achievement and standards (AS, α= 0.86), personal development and well-being (PDW, α= 0.94), the quality of provision (QP, α= 0.81), leadership and management (LM, α= 0.89), the extent to which schools enable learners to be healthy (ESELH, α = -0.56), the extent to which providers ensure that learners stay safe (EPELS, α= -1.35), the extent to which learners make a positive contribution (ELMPC, α= 0.80) and the extent to which schools enable learners to achieve economic well-being (ESELEW, α= 0.22). An overall school quality index was also constructed to measure the overall school performance using the above nine indices and to overcome the internal inconsistency of the three inconsistent indices (α = 0.96).

Given the nature of the variables used to construct the previous nine school quality indices, it could be argued that only the AS and PDW indices could suffer from a possible endogeneity problem with the KS4 outcome variable, where they were more or less measured around similar time point. To illustrate, the two indices were based on variables reflecting the academic standards (AS) and personal development of the student such as behaviour and attendance (PDW), which in turn could depend on the students' KS4 scores. However, a counter argument suggests that despite the possible existence of such two-way relationship, the number of students per school is very small (a maximum of 32 students per school) compared to the true number of students that could exist in the school, which could be a minimum range of (1-500)[3] students. Although that minimum range could take values less than 500, still 32 students will not be representative enough to the true number of students to reflect the overall Ofsted performance of the school. Accordingly, one can argue that even if there is possible endogeneity it would not be a severe problem. As for the affective outcome variable, it was measured at a time point after the school information was observed, so one would not expect a source of endogeneity.

Following the model specification indicated in equation (2), the analysis controlled for a number of school context inputs, student's inputs, family background factors and home learning environment factors.

Econometric Method and Model specification

Given the discrete nature of the two dependent variables on one hand and the categorical nature of most of the independent variables on the other hand, this paper uses discrete choice modeling methodology to examine the proposed models. The first cognitive outcome variable is a count variable that follows a negative binomial distribution, hence the analysis uses a negative binomial regression model defined as

[2] The Ofsted inspection was conducted between September 2005 and July 2006.

[3] For more details, see < https://www.gov.uk/government/publications/number-of-secondary-schools-and-their-size-in-student-numbers>. Notice that although the statistics available is for 2012, there was no available detailed data for the year 2005/2006. However, it is suggested that the statistics would not change dramatically between the two years.

$$\eta_i = \ln(\mu_i) = \sum_j \beta_j x_{ij} \qquad i = 1, \cdots, N \text{ and } Y \sim NegativeBinomial \tag{4}$$

The second affective outcome variable is an ordinal variable; accordingly, the analysis uses an ordinal logit model given by

$$\eta_i = \ln(\mu_i / 1 - \mu_i) = \sum_j \beta_j x_{ij} \qquad i = 1, \cdots, N \tag{5}$$

Based on the theoretical framework explained by equation (2), the first phase of the analysis started by examining the teacher's effect on school cognitive outcome model (eq. 6), via three main specifications, each examining one of the three previously constructed teacher indices. Specifically, student-teacher relationship index, teacher quality index and overall teacher index.

$$\ln(\mu(co)_{it}) = \alpha + \gamma T_{i,t-1,t-2} + \sum_L \zeta_L (C_{it} + C_{i,t-2}) + \sum_N \beta_N (X_{i,t-1} + X_{i,t-2}) + \varepsilon_i \tag{6}$$

where $\mu(co)_{it}$ represents the expected value of the *co*gnitive outcome variable of young person *i* measured at time *t* corresponding to year 2005/2006 when the KS4 outcome was measured (around wave three), $T_{i,t-1,t-2}$ is the teacher influence index measured via three different indices (each constructed by a mix of variables measured at both wave one (*t-2*) and wave two (*t-1*)), C_{Li} (L=2) are the school context variables; one representing the school phase of education at time *t* and the other representing a dummy for whether the school attended at wave one (*t*-2) was an independent or maintained school, and X_{Ni} (N=17) are student's input variables measured at either wave one (*t-2*) or wave two (*t*-1). The same model is examined for the affective outcome (eq. 7), where $\mu(af)_{i,t+1}$ represents the expected value of the *af*fective outcome variable of young person *i* measured at time (*t+1*) corresponding to wave four when the outcome was measured.

$$\ln(\mu(af)_{i,t+1} / 1 - \mu(af)_{i,t+1}) = \alpha + \gamma T_{i,t-1,t-2} + \sum_L \zeta_L (C_{it} + C_{i,t-2}) + \sum_N \beta_N (X_{i,t-1} + X_{i,t-2}) + \varepsilon_i \tag{7}$$

The second phase of the analysis examined the full model after adding the school quality effect measured at year 2005/2006 (eq. 8 examining the cognitive outcome and eq. 9 examining the effective outcome). Specifically, the model was examined via ten specifications each examining one of the ten school quality indices (*SQ*) explained earlier.

$$\ln(\mu(co)_{it}) = \alpha + \gamma T_{i,t-1,t-2} + \lambda SQ_{ijt} + \sum_L \zeta_L (C_{it} + C_{i,t-2}) + \sum_N \beta_N (X_{i,t-1} + X_{i,t-2}) + \varepsilon_i \tag{8}$$

$$\ln(\mu(af)_{i,t+1} / 1 - \mu(af)_{i,t+1}) = \alpha + \gamma T_{i,t-1,t-2} + \lambda SQ_{ijt} + \sum_L \zeta_L (C_{it} + C_{i,t-2}) + \sum_N \beta_N (X_{i,t-1} + X_{i,t-2}) + \varepsilon_i \tag{9}$$

where SQ_{ijt} represents the school quality index for young person *i* at school *j* at time *t*.

As for the rest of the additional covariates used in the model, one can argue that some of these variables could suffer from an endogeneity problem despite the lagged term. However, a number of justifications could yet be provided. First, the use of these variables as controls or even mediators has been supported by the literature. To mention a few; family socioeconomic status by (Ven Ploeg, 2013); parents' occupation and income by (Duncan and Brooks-Gunn, 1997; Hill and Duncan 1987; Krein and Belier 1988; Martin, 2012; McLanahan 1983, 1985; Shaw, 1982); neighbourhood effect by (Bowen, et al., 2008; Teachman and Paasch, 1998), which is the one variable reported at the same time point as the outcome variable and is measured by the income deprivation index, which could likely be considered exogenous since one could assume that it is not expected that the educational outcome of one adolescent measured in the model is likely to cause the deprivation index of the entire neighbourhood where the adolescent live to be high or low. Other variables that could be argued to be endogenous include parental involvement in school life that has been used by (Muller, 1995; 1998). Second, these variables are known as extraneous or confounding variables that need to be controlled for in order to avoid any biased results (Kish, 1959; Vandenbroucke, 2004). Third, even if one does not control for these confounding variables, it is likely to lead to an omission bias that could be another source of endogeneity.

In light of the previous arguments, one can state that since these confounding variables are not the main variable of interest in the model, the study does not attempt or claim to solve their potential endogeneity. Having said that, the analysis acknowledges the limitations caused by such endogeneity. As such and since the exogeneity assumption is often violated, yet to widely varying degrees, in the analysis of educational production functions, as in most other areas of empirical economic research, what one learns about important relationships is not devoid of meaning; however, attributing causality to the estimates should be done with extreme caution. Accordingly, the following findings of the models do not claim such causality, rather they explain the association between the teacher and school quality and adolescent's outcome controlling for other confounding covariates. Lastly, it is worth noting that as with the related literatures on educational production function studies, such functions are not completely known and must be estimated using imperfect data, which makes any estimates subject to considerable uncertainty (Hanushek, 1986) and unassailable estimates of causal relationships explaining the underlying process are not yet attainable (Haveman and Wolfe, 1995).

4. Findings

4.1. Students' Cognitive Outcome

Examining the teacher influence model[4] defined in equation (6) via three specifications for the three teacher influence indices showed that the student-teacher relationship index, the first model in table (1), is not a significant one and that the other two teacher indices could be better indicators for such impact. Indeed, the teacher quality index indicated a significant positive contribution in explaining the student's KS4 score. However, such impact was relatively small

[4] Table (A.1) provides descriptive statistics for the variables examined in the estimation sample of the cognitive outcome analysis covering 1664 students.

in size indicating that with each 1 standard deviation increase in teacher quality the expected value of KS4 score goes up by 6.3%. Finally, the third model examining the overall teacher index also indicated a significant positive contribution in explaining the student's KS4 score with a similar size effect of almost 6%. These findings support those of Aaronson, Barrow and Sander (2007), Glewwe, et al., (2011), Kyriakides (2005), Link and Ratledge (1979) and Rivkin, Hanushek and Kain (2005) even though such influence is relatively small in size (Aaronson, Barrow and Sander, 2007; Kyriakides, 2005; Rivkin, Hanushek and Kain, 2005) indicating that student's inputs may play a bigger role in explaining his/her cognitive outcome.

Table 1: Teacher Influence on Cognitive Outcome

VARIABLES	(1) IRR	(2) IRR	(3) IRR
Teacher Influence			
Student/teacher relation index	1.003		
	(0.00243)		
Teacher quality index		1.007***	
		(0.00197)	
Overall teacher index			1.005***
			(0.00156)
Student Inputs			
KS3 score (Z)	1.396***	1.385***	1.392***
	(0.0338)	(0.0316)	(0.0325)
Likelihood of the young person applying to university (reference level: not at all likely)			
Not very likely	1.161***	1.150**	1.148**
	(0.0660)	(0.0654)	(0.0651)
Fairly likely	1.238***	1.213***	1.210***
	(0.0671)	(0.0657)	(0.0651)
Very likely	1.224***	1.190***	1.189***
	(0.0662)	(0.0643)	(0.0638)
	(0.0562)	(0.0501)	(0.0538)
Constant	1.899e+07***	3.499e+07***	3.359e+07***
	(3.400e+07)	(5.826e+07)	(5.974e+07)

Standard error (Eform) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
The models control for whether an independent school, school phase of education, highest qualification of family, family ns-sec class, mean income, IDACI score, type of household tenure, urban/rural indicator, how the young person's expenses would be paid if stayed on in education- parent(s) will support or give money, how involved is the MP in the young person's school life? whether or not there is internet access from home, whether or not there is home computer in the household, family structure, young person's religion, ethnicity, gender, young person has special educational needs and age. estimates of these variables reported in appendix table (A.2).

The most important student's input in model (3) was his/her academic self-schema or prior attainment measured by KS3 score, which had a significant positive impact on KS4 score, where one standard deviation increase in KS3 score was associated with 39.2% increase in the expected value of KS4 score. Such impact is highly expected and matches the general conclusion in the literature (Duran and Weffer, 1992; Glick and Sahn, 2010; Tymms, 1992). Similar conclusion was found in an earlier UK study (Chowdry, Crawford and Goodman, 2010). Similarly, the likelihood of applying to university had also a positive significant impact on cognitive outcome, where students who were very likely to apply to university were more likely to have higher expected value of KS4 score by almost 19% compared to those who were not likely at all to apply to university. The same applied for those who were fairly likely to

apply to university (21%) and not very likely to apply to university (15%). This finding matches a similar one reported in the UK (Chowdry, Crawford and Goodman, 2009; Chowdry, et al., 2010). The rest of the school's, student's and family demographic variables are used in the analysis primarily as a ''noise reduction'' strategy when examining the relationship between teacher effect and the two school outcomes. Consequently, no specific expectations are offered about how these variables may have influenced the dependent outcomes.

Since the overall teacher index is significant and by default reflects the influence of the other two teacher indices, it is more appropriate to use it as the main teacher influence index for the second stage of analysis. In that stage, the analysis examined the model defined by equation (8), where the school quality effect is introduced to the model. As has been explained earlier, the model was investigated via ten specifications for the ten school quality indices. As indicated in table (2), all school quality indices had a significant positive impact on the student's cognitive outcome aside from the two indices reflecting the extent to which schools enable learners to be healthy (ESELH) and the extent to which learners make a positive contribution (ELMPC).

Table 2: School Quality Effect on Cognitive Outcome

VARIABLES	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR	(7) IRR	(8) IRR	(9) IRR	(10) IRR
School Process										
SchOE_A	1.009***									
	(0.00261)									
SchAS_A		1.007***								
		(0.00250)								
SchPDW_A			1.005***							
			(0.00153)							
SchQP_A				1.011***						
				(0.00317)						
SchLM_A					1.007***					
					(0.00231)					
SchESELH_A						1.010				
						(0.00690)				
SchEPELS_A							1.024***			
							(0.00461)			
SchELMPC_A								1.007		
								(0.00592)		
SchESELEW_A									1.016**	
									(0.00695)	
Overall school quality										1.002***
										(0.000432)
Overall teacher index	1.005***	1.005***	1.005***	1.005***	1.005***	1.005***	1.005***	1.005***	1.005***	1.005***
	(0.00149)	(0.00153)	(0.00150)	(0.00150)	(0.00149)	(0.00157)	(0.00156)	(0.00157)	(0.00155)	(0.00149)

All models control for school context variables and student's inputs examined in the teacher effect models. Estimates provided in table (A.3).
The goodness of fit[5] test for the full model (10): F(64, 96) = 69.42***.
Standard error (Eform) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The findings indicate that school process factors are generally important to determining students' cognitive outcome, which matches the results of previous studies such as that of

[5] R^2 was not be reported since the estimation is based on a survey designed dataset, where cases are not independent and so estimating R^2 would not be appropriate.

Weber (1971) showing that ongoing school process variables, such as leadership, expectations, school atmosphere and evaluation of pupil progress are important factors in determining students' outcomes. Moreover, empirical support for the effectiveness of an orderly learning environment in the school has been confirmed from qualitative and quantitative reviews showing that it has a positive influence on students' cognitive outcomes (Kyriakides, 2005; Opdenakker and Van Damme, 2000; Scheerens, 1992).

Despite the positive significant impact of most of the first nine school quality indices, the magnitude of such importance was relatively small ranging between almost 2% for one standard deviation increase in the extent to which providers ensure that learners stay safe index (EPELS) and 5.4% for the overall effectiveness index (OE). However, given that the former lacked sufficient internal consistency, it could be concluded that the latter (OE) is the most important aspect of school performance in explaining cognitive outcome. The last column in table (2) examined the impact of the overall school quality index, which reflects all the previous nine indices. Despite the significant positive impact of the overall index, it as well had a small magnitude of only 6.2% on cognitive outcome.

In light of findings of the previous 10 models and since the overall school quality index is significant and by default reflects the influence of the other nine indices, the rest of the discussion focused on the analysis of the full model (10) reflecting the two school process variables; the overall teacher index and the overall school quality. In essence, the overall teacher index in the full model did not change indicating again a small positive significant impact of almost 6% on cognitive outcome. Accordingly, given the small contributions of both teacher effect and school quality (almost 6%) on cognitive outcome, one can again conclude that other factors could have greater importance in explaining student's cognitive outcome. Indeed, the same student's inputs and school context variables that were reported in the overall teacher index model were found to be the most significant in the overall school quality full model with similar size effects.

In general, based on the previous findings one can conclude that school process inputs are important inputs in explaining the cognitive outcome of students. However, the relatively small magnitude of these variables reflected that student's related inputs such as academic self-schema and attitude towards continuing to higher education play a major role in explaining such outcome. Also, looking at the insignificance of the majority of family background factors in model 10 of table (A3), one could suggest in line with what has been reported in the literature regarding the case of England that teacher quality (Slater, Davies and Burgess, 2009) and school quality do make a difference in the cognitive outcome of students. Moreover, as they also concluded the significance of school process inputs reflected that they should be controlled for when studying student's cognitive outcomes and not restricting the explanation of such outcomes to just family background factors.

4.2. Students' Affective Outcome

Following the same model specifications of the cognitive outcome analysis, the results indicated that all three teacher influence indices did have a significant positive impact on

student's affective outcome[6]. Specifically, the three models in table (3) indicated that such impact was large in magnitude with both the teacher quality index and the overall teacher index having a large impact of almost 119% and 112% respectively. Having said that, along with the positive significance of the teacher influence, its large magnitude (Kyriakides, 2005) was found to be much larger than other student's inputs like his/her prior attainment while other factors were found to have a bigger role in explaining his/her affective outcome as well.

The most important student's input was his/her likelihood of applying to university having a positive significant impact, where students who were very or fairly likely to apply to university were likely to have higher attitude by almost 119% and 107% respectively compared to those who are not likely at all to apply to university. The same applies for those who were not very likely to apply to university (34%). Similarly, his/her academic self-schema had also a significant positive impact on his/her attitude towards school, where one standard deviation increase in KS3 score was associated with almost 34% increase in the odds of having higher attitude score. This matched the results of Murdoch and Phelps (1973) indicating that students with low academic self-schema have low school commitment. Moreover, an improvement in the deprivation index by one standard deviation was associated with almost 26% improvement in the odds of having higher attitude score towards school.

Table 3: Teacher Influence on Affective Outcome

	(1)	(2)	(3)
VARIABLES	OR	OR	OR
Teacher Influence			
Student/teacher relation index	1.059***		
	(0.0144)		
Teacher quality index		1.094***	
		(0.00858)	
Overall teacher index			1.068***
			(0.00618)
Student Inputs			
KS3 score (Z)	1.409***	1.259**	1.342***
	(0.146)	(0.136)	(0.142)
Likelihood of the young person applying to university (reference level: not at all likely)			
Not very likely	2.053**	2.074***	1.868**
	(0.592)	(0.557)	(0.536)
Fairly likely	2.638***	2.271***	2.067**
	(0.733)	(0.623)	(0.589)
Very likely	2.971***	2.350***	2.195**
	(0.905)	(0.705)	(0.676)

Standard error (Eform) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
The models control for whether an independent school, school phase of education, highest qualification of family, family ns-sec class, mean income, IDACI score, type of household tenure, urban/rural indicator, how the young person's expenses would be paid if stayed on in education-parent(s) will support or give money, how involved is the MP in the young person's school life? whether or not there is internet access from home, whether or not there is home computer in the household, family structure, young person's religion, ethnicity, gender, young person has special educational needs and age. estimates of these variables reported in appendix table (A5).

[6] Table (A.4) provides descriptive statistics for the variables examined in the estimation sample of the affective outcome analysis covering 1520 students.

In the second stage, the school quality effect was introduced to the model via ten specifications for the ten school quality indices. As indicated in table (4), only three indices were found to have a significant impact on student's affective outcome. Specifically, school achievement and standards (AS), quality of provision (QP) and leadership and management (LM) were found to have a positive influence on student's attitude towards school. Such findings are likely to occur since students with better attitude towards school are likely to have better academic achievement (Murdoch and Phelps, 1973), which in turn would be reflected in the school overall level of achievement (AS). Also, the school quality of provision and its leadership and management are likely to improve students' attitude towards school, where one would expect students to better value the time they spend at school as long as the school provides better environment for students to be willing to attend school and devote more effort for school work (Kyriakides, 2005; Opdenakker and Van Damme, 2000; Scheerens, 1992).

Besides such positive impact, it was moderate reflecting a range of 18% and 15% (AS and LM respectively) and 21% (QP) improvement in student's attitude with each 1 standard deviation increase in those school quality indices. These magnitudes are larger than those of the same indices explaining cognitive outcome. Consequently, though the analysis does not intend to empirically compare between the two-analysis given the nature of the two samples used, one could intuitively indicate that these quality aspects of the school are likely to have relatively more sizable influence on student's affective rather than cognitive outcome.

Table 4: School Quality Effect on Affective Outcome

VARIABLES	(1) OR	(2) OR	(3) OR	(4) OR	(5) OR	(6) OR	(7) OR	(8) OR	(9) OR	(10) OR
School Process										
SchOE_A	1.015									
	(0.0145)									
SchAS_A		1.031**								
		(0.0152)								
SchPDW_A			1.007							
			(0.00966)							
SchQP_A				1.043**						
				(0.0182)						
SchLM_A					1.024*					
					(0.0142)					
SchESELH_A						0.967				
						(0.0254)				
SchEPELS_A							0.970			
							(0.0218)			
SchELMPC_A								0.959		
								(0.0348)		
SchESELEW_A									0.993	
									(0.0311)	
Overall school quality										1.003
										(0.00281)
Overall teacher index	1.067***	1.067***	1.067***	1.067***	1.067***	1.068***	1.068***	1.068***	1.068***	1.067***
	(0.00608)	(0.00613)	(0.00612)	(0.00609)	(0.00610)	(0.00620)	(0.00619)	(0.00622)	(0.00618)	(0.00609)

All models control for school context variables and student's inputs examined in the teacher effect models. Estimates provided in table (A.6).
The goodness of fit test for the full model (10): F(64, 91) = 12.10***
Standard error (Eform) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The last model (10) in table (4) examined the impact of the overall school quality index, which was found to be insignificant arguably due to the insignificance of six out of the nine involved indices it reflects. In that regard, there is some evidence in the literature that schools which are among the most effective in enhancing cognitive outcomes are not necessarily among the most effective in helping their students achieve non-cognitive outcomes (Opdenakker & Van Damme, 2000; Kyriakides, 2005). It could also be explained by the likelihood that other school factors and student inputs could have more significant importance in explaining students' attitude towards school. To explain, consider the overall teacher index in the full model (10) indicating again a huge positive significant impact of 109% on such attitude. This implies that the teacher effect on attitude was not affected by the overall school quality and that such effect is the leading school process factor that could significantly explain such attitude as has also been observed in the teacher effect models earlier. Accordingly, given the huge contribution of the teacher effect, one can conclude that it was found to be bigger than other student's inputs like his/her prior attainment while other factors were found to have a bigger role in explaining his/her affective outcome as well. Indeed, the same student's inputs and school context variables that were reported in the overall teacher index model were found to be significant in the overall school quality full model with similar size effects.

In general, based on the previous findings one can conclude that school process inputs especially teacher's inputs are important inputs in explaining the affective outcome of students. However, the insignificance of the overall school quality index reflected that student's related inputs such as attitude towards continuing to higher education play a major role in explaining such outcome. Also, the insignificance of the majority of family background factors in model (10) could suggest that teacher quality mainly and certain school quality aspects do make a difference in the affective outcome of students. Moreover, the significance of school process inputs reflected that it would be ideal to be controlled for when studying student's affective outcomes and not restricting the explanation of such outcomes to just family background factors.

5. Conclusion and Discussion

This paper introduced the school process component of the CIPO model to the educational production function approach by examining the effect of school process inputs on English students' educational cognitive and affective outcomes controlling for both school context and student's inputs. Specifically, the paper examined the school process inputs that are not financial resource oriented at both the school level and the teacher level simultaneously, thus combining teacher influence variable(s) measuring student's perception of his/her teacher and school quality variable(s).

The primary implication of the findings is that teachers matter. Teachers play a significant positive moderate role in improving student's cognitive outcome (Aaronson, Barrow and Sander, 2007; Glewwe, et al., 2011, Kyriakides, 2005, Link and Ratledge, 1979; Rivkin, Hanushek and Kain, 2005) and a much bigger role in improving their affective outcome (Kyriakides, 2005). Moreover, the teacher effect on attitude was not affected by the overall school quality and that such effect is the leading school process factor that could significantly explain such attitude. Additionally, comparing teacher effect with the overall school quality

effect, it was found that the first was slightly smaller than the latter when it comes to cognitive outcome, while it was much bigger in the case of affective outcome. Such findings were coupled with another indicating that student's inputs may play a bigger role in explaining his/her outcomes.

These findings do not necessarily imply that the school does not matter. Rather they imply that teachers within school play a major role in affecting both students' cognitive and affective outcome. Accordingly, both schools and teachers should invest more in teachers' non-financial and/or human qualities, such as teacher effectiveness in monitoring students' performance in terms of homework doing and his/her availability for student support outside class. Also, schools should pay more attention and put more emphasis on the teacher performance in terms of how he/she influences students' social conduct and how far he/she is being fair with students from different cultural backgrounds. Perhaps, a common proposed policy would be to link teachers' compensation with their performance in terms of the aforementioned aspects rather than just their education and level of experience (Aaronson, Barrow and Sander, 2007)

Most school quality aspects were found to have positive significant contribution in explaining student's cognitive outcome but not necessarily his/her affective outcome. Despite the positive impact of most school quality indices, their magnitudes were moderate for the cognitive outcome and bigger for the affective outcome. Consequently, one could indicate that these quality aspects are likely to have relatively more sizable influence on student's affective rather than cognitive outcome. Moreover, the findings reveal the importance of investigating the extent to which similar factors at school level are associated with the effectiveness of schools in achieving both cognitive and affective outcomes. In that regard, the findings have shown that the school achievement and standards (AS), the quality of provision (QP), and its leadership and management (LM) had positive significant contributions in explaining both outcomes.

During the last three decades, a considerable body of research evidence has been accumulated showing that although family backgrounds of students and their academic self-schema are major determinants of their educational outcomes, schools have significant contribution in explaining variations in students' outcomes (Daly, 1991; Mortimore, et al., 1988; Reynolds, 1982; Rutter, et al., 1979; Sammons, Hillman and Mortimore, 1995; Wilkins and Raudenbush, 1989). The findings of this paper have reached a similar conclusion, where by looking at the insignificance of the majority of family background factors, one could suggest in line with what has been reported in the literature regarding the case of England that teacher quality (Slater, Davies and Burgess, 2009) and school quality do matter for the cognitive and affective outcomes of students. Moreover, the significance of school process inputs reflected that it would be ideal to be controlled for when studying student's outcomes and not restricting the explanation to just family background factors (Tymms, 1992). Ideally, students from any family background could have better cognitive and affective outcome if they were taught by better teachers in better schools.

Despite the aforementioned importance of school process inputs, some studies have shown that in deciding which school to enrol their children, English parents mostly choose the schools that have the highest test scores results while hardly taking into account what their children really

feel about the school or what can be called child's wellbeing in the school (Gibbons and Silva, 2011). Their claim was that there is no relationship between such attitude and the average level of test scores in the school. In that regard, the findings have shown that student's attitude towards school or put differently their perception of the school was significantly positively related to the overall academic achievement of the school, which would make both parents and the children somehow equally happy when making the decision of which school to join. However, it was found as well that other school quality aspects such as the quality of provision plays a somewhat greater role in affecting both children's cognitive and affective outcomes. Accordingly, parents should not form their decision entirely based on just the level of academic achievement of the school but also on other factors such as the quality of how effective will teaching and learning be in meeting the full range of their children's needs, how well do the curriculum and other activities meet the range of needs and interests of the children and how well their children are going to be cared for, guided and supported.

Although the analysis has adopted the CIPO model to control for the full dimensionality of the educational process, a clear limitation exists with the lack of evidence about the effect of school resources inputs, which comes as a result of the lack of the necessary data about school related expenditure indicators. Relatedly, similar to the findings proposed by (Slater, Davies and Burgess, 2009) that teachers matter a great deal, it could be argued that the lack of data about other teacher inputs such as teacher's education, experience, length of tenure and salary could have helped explain more such teacher effect. In that regard, it would be important for future research to examine the overall teacher index combining both observable teacher inputs about his/her level of education, experience and salary with the student's perception of his/her teacher so that a clearer conclusion could be drawn about the full nature of the teacher effect.

Previous school and teacher effectiveness research has shown that the influences of schooling on students' cognitive and affective outcomes are multilevel. That is, classrooms have unique influences on students' outcomes, independently of factors operating at the school and student levels. Furthermore, by controlling for both student inputs and classroom contextual inputs, variables at the school level could explain variation in achievement at the school level (Kyriakides, 2005). Consequently, another limitation of the analysis is that it lacked information on the classroom level restricting the implementation of such multilevel analysis. As such, further research would be of great value with richer data at the classroom level and with multilevel modeling, which may well uncover some important elements of both the teacher and school influences on outcomes.

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