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The effect of teacher effectiveness and home learning environment on student achievement gains in mathematics: a longitudinal study

Andria Dimosthenous and Leonidas Kyriakides
University of Cyprus

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Introduction

- This longitudinal study investigates the effect of **Home Learning Environment (HLE)** and **teacher effectiveness (TE)** on student achievement gains in **mathematics**.
- It is argued that there are studies investigating either the TE or the HLE effect on student achievement
 - but there is almost no study investigating the effects of both the TE and HLE.
- We therefore have almost no data on whether effective teachers can compensate for children with a poor HLE.

Home Learning Environment

- Researchers examined the impact of HLE on student achievement at the early years of education (e.g. Hartas, 2011; Melhuish et al., 2008).
 - The **effect of the HLE** at the **early years** was found to be **bigger**, than in other phases of schooling.
- Were investigated the impact of:
 - different **background characteristics** of parents, (i.e., educational and literacy level) (e.g. Christian et al., 1998)
 - **educational resources** that are available at **home**, such as books, computers and access to the internet (Hartas, 2012)
- However, some studies took a **broader view** of the HLE and investigated:
 - the **learning opportunities** offered to students at home
 - the **literacy habits of parents** which may also be related to student achievement
- Specifically, it is assumed that **through learning activities** that take place between parents and children (e.g. Bus, Van IJzendoorn, & Pellegrini, 1995), **student learning will be improved**. These learning activities are seen as components of the HLE.

Home Learning Environment

- For instance, when parents:
 - read books with their children
 - play games with letters or numbers
 - visit the library or a historical site
 - student **learning could be improved** (Bus et al., 1995)
- Also, **investments of parents on learning** at home (money spent on books or games, but also the activities that take place between parents and children)
 - are **correlated** with early **language** and **cognitive development** (Beals & De Temple, 1993)
- Therefore, all these studies are based on the assumption that the **learning activities that take place between parents and children promote learning**.
- In this paper, we take a broad view in measuring the HLE. We investigate the effect of:
 - background characteristics of parents, (i.e., educational level and occupational status),
 - the educational resources that are available at home,
 - learning opportunities that are offered to children (e.g., home learning enrichment activities, cultural activities, games with letters and numbers, and sports).

Teacher Effectiveness

- The **dynamic model of educational effectiveness** refers to eight factors that describe the teachers' instructional role and are associated with student outcomes: **orientation, structuring, questioning, teaching-modelling, application, management of time, teacher role in making classroom a learning environment, and classroom assessment.**
 - The dynamic model refers to skills associated with **direct teaching** and **mastery learning** (Joyce, Weil, & Calhoun, 2000) such as **structuring and questioning.**
 - Factors included in the dynamic model such as **orientation** and **teaching modelling** are in line with theories of teaching associated with **constructivism** (Schoenfeld, 1998).
 - Moreover, the **collaboration technique** is included under the overarching factor of teacher's contribution to the establishment of the **classroom learning environment.**
- an integrated approach to quality of teaching is adopted

Teacher Effectiveness

- The **dynamic model** is also based on the assumption that each factor can be defined and measured by using five dimensions: **frequency, focus, stage, quality, and differentiation**
 - **frequency** is a *quantitative* means of measuring the functioning of each effectiveness factor
 - **the other four dimensions** examine the *qualitative* characteristics of the functioning of the factors and help to describe the complex nature of effective teaching (Creemers & Kyriakides, 2015)
- The **dynamic model** is based upon **research evidence** (Sammons, 2009; Scheerens, 2013) and is empirically validated by an international (Panayiotou et al., 2014) and several national studies (e.g., Azigwe et al., 2016; Creemers & Kyriakides, 2010; Kyriakides & Creemers, 2008) testing the effects of classroom level factors upon student achievement on both cognitive and affective outcomes.

Methodology - *Sample*

- At the beginning of the school year **2013-2014**, 54 Cypriot primary schools were randomly chosen and **48 agreed to participate**.
- **All students of grade 1** of the school sample (**n=1444**) and their parents participated in this longitudinal study.
- To measure **student achievement**, **external forms of assessment** were administered to the student sample at the:
 - beginning of year 1 (September 2013)
 - end of year 1 (June 2014)
 - end of year 2 (June 2015)
 - end of year 3 (June 2016)
- Information was collected on three **student background factors**:
 - age
 - gender
 - SES: father's and mother's education level, the social status of father's job, and the social status of mother's job

Methodology – *measure of HLE*

- This **questionnaire** was also used to collect data about the **HLE** at the **beginning of year 1**.
- First part of the questionnaire:
 - **learning materials** which were available at home (e.g. books, musical instruments, computer, access to the internet and encyclopaedias)
 - **date of birth** of their child
- Second part:
 - parents were asked how often specific **home activities** take place between themselves and their children
 - A two-factor model was derived from exploratory factor analysis:
 - (1) home learning enrichment activities (e.g. reading books to their children and asking questions, telling stories to their children)
 - (2) games (e.g. sports, games with numbers)

Methodology – *measure of HLE*

➤ Parents were also asked how often **out of home activities** take place between themselves and their children.

A two-factor model was also derived from exploratory factor analysis:

- (1) cultural activities (e.g. visit a museum, historical site, and gallery)
- (2) enrichment experiences (e.g., go to the cinema, zoo, and park).

Methodology – *measure of TE*

- The **teacher factors** of the dynamic model dealing with teacher behavior in the classroom were measured:
 - by four independent observers
 - during each of the three school years
 - observed three mathematics' lessons
- To measure the five dimensions of each effectiveness factor, were used:
 - one **high-inference**
 - covers the five dimensions of all teacher factors of the dynamic model
 - two **low-inference** observation instruments
 - generate data for all the factors but classroom assessment
- For **each teacher factor** of the dynamic model, separate **confirmatory factor analysis (CFA)** was conducted in order to identify the extent to which data emerged from different observation instruments **can be used to measure this factor**.
 - Based on the results of the CFA analyses, nine factor scores for the performance of each teacher were estimated.

Methodology – *statistical analysis*

- **Multilevel modelling techniques** (Goldstein, 2003; Snijders & Bosker, 2011) were employed to investigate the **short-term effect** of **teachers** and **HLE**.
- **Three separate multilevel analyses** of student achievement:
 - at the end of year 1,
 - at the end of year 2
 - at the end of year 3to **measure the effects** of **teacher** factors and the **HLE** on student achievement gains during a school year.
- The data were conceptualized as a **three-level model**:
 - student at the 1st level
 - teacher at the 2nd level
 - school at the 3rd level

Methodology – *statistical analysis*

- Empty model:
 - Determine the variance at the individual, teacher, and school without explanatory variables
- Model 1:
 - prior achievement, gender, and age of the student were entered into the empty model.
- Model 2:
 - the HLE factors were added into model 1
- Models 3a-3i:
 - all the teacher factors were added separately into model 2

Results

Table 1. Parameter estimates and (standard errors) for the analysis of mathematics achievement (students within classes, within schools) at the end of Year 1

Results

- In all three analyses, the **variance** was found to be **statistically significant** at **each level**.
 - Almost 60% of the variance was situated at the student level.
 - The variance at the classroom level was bigger than the variance at the school level.

- Model 1:

Prior achievement, gender and age as well as aggregate scores at the classroom and school level were added to the empty model.

- **Student background factors but gender**, have statistically **significant effects** on final achievement.
- **Prior knowledge** has the **strongest effect** in predicting student achievement at the end of the school year.
- **Prior achievement** is the only contextual variable that had a **consistent effect**

Results

▪ Model 2:

HLE factors were added in model 1

- Only two aspects of the HLE (i.e., home learning materials, home learning enrichment activities with parents) were associated with student achievement gains in mathematics at the end of year 1
- However, only one of these aspects of the HLE (i.e., the home learning materials) had a direct effect at student achievement at the end of year 2 and at the end of year 3

▪ Model 3:

Factor scores of the CFA models, which refer to the teacher factors of the dynamic model, were added one by one to model 2.

- Variables measuring the teacher factors have significant effects on student achievement at the end of year 1, year 2 and year 3.
- Time stability in their effects can be identified

Discussion

- Results revealed from this study, point out the **importance of the home learning materials**
- **Home learning enrichment activities** were found to be associated with achievement in mathematics but only when students were at the **end of year 1**
 - This finding reveals that home learning activities that parents provide to their children matter for student learning only during the first year of primary.
- In opposition to most aspects of the HLE, **the teacher factors** of the dynamic model were found to have a **statistically significant effect**

Discussion – *policy implications*

For teacher evaluation, teacher allocation and teacher professional development:

- **Teacher evaluation**: identifying effective teachers and recruiting them to schools where they will be able to make a larger impact on students coming from poor HLE
- **Teacher allocation to schools**: based on specific criteria should be established
- **Through evaluation mechanisms**: teachers' ability will be identified in order to increase learning opportunities and the same time reduce the gap among students coming from different socio-economic background and HLE.
- **Continuous teacher professional development**: help teachers adjust to changes in social composition and improve their effectiveness status in terms of both the quality and equity dimensions.

Thank you for very much for your
attention!

Andria Dimosthenous
adimoso1@ucy.ac.cy

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