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Teaching strategies and differential effectiveness across learning contexts: Evidence from PISA 2012

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ABSTRACT

Modern educational theories emphasise effectiveness enhancing factors at the classroom level and differential effectiveness for sub-groups of students and across different learning contexts. Theoretical developments, however, are generally based on national evidence and have been criticised for lacking cross-cultural perspectives. This study used PISA 2012 data to examine how subject-specific teaching strategies related to mathematics performance of students across education systems whilst considering curvilinear associations and interactions with the socio-economic and instructional context. The results provide consistent evidence of a positive curvilinear relationship between cognitive activation strategies and mathematics performance. The association tends to be stronger in schools with a positive disciplinary climate and for students from advantaged socio-economic backgrounds, but not in every education system. Teacher-directed strategies are positively related to mathematics performance, but the association tends to become negative for high levels of teacher-directed instruction. Associations of student-oriented strategies with mathematics performance are inconsistent. The cross-national evidence contributes to the knowledge base of educational theory.

1. Introduction

Current advances in educational effectiveness theory advocate the study of classroom level processes with analytical models that recognise the multidimensionality of classroom, school and system characteristics and the complexities of education settings (Creemers & Kyriakides, 2008). Teachers' behaviours and what happens in the classroom are considered the most significant effectiveness factors for explaining academic outcomes and metacognitive skills of students. Particularly, effectiveness models differentiate between teaching strategies (e.g. teacher-centred, student-oriented, cognitively activating teaching strategies) and the instructional context (e.g. classroom management and climate and teacher-student relations) at the classroom level. Effectiveness factors at the school, student, and education system level are relevant to the extent that they moderate what happens in the classroom.

Theoretical models of educational effectiveness such as the dynamic model take into account the complex nature of education settings by considering non-linear relationships between effectiveness factors and student learning outcomes as well as same-level and cross-level interactions using advanced statistical techniques (Creemers & Kyriakides, 2010; Scheerens, 2013). It is thus acknowledged that effectiveness factors do not necessarily work equally for different groups of students, schools, and education systems and that their effectiveness may vary depending on the composition of other factors at the same and at different levels (Kyriakides, 2008).

Despite significant methodological and theoretical advances, educational effectiveness research has been criticised for its lack of cross-cultural perspectives (Reynolds, 2000). Most research has been conducted within countries, but evidence shows that some effectiveness factors may work in some countries and not in others. Further, national studies might not be able to capture curvilinear relations and significant interactions with effectiveness factors due to restricted amount of variability in the data. It is argued that cross-national studies are required in order to evaluate the validity of effectiveness models across cultures and explain how policies affect student outcomes in different settings (Creemers, 2006).

International assessment data provides a great source of variation within and between countries for studying the effects of classroom and school factors and their differential effectiveness across different learning contexts (Creemers, 2006). The

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Programme for International Student Assessment (PISA) is likely the most influential international assessment on educational debates and policies (Baird et al., 2011; Wiseman, 2010). And although PISA does not sample classes or collects observational data to measure instructional characteristics, results provide consistent evidence of the effectiveness of an instructional context characterised by a positive disciplinary climate (OECD, 2013b). Significant same-level interactions are also reported for school factors. For example, teacher participation in leadership has been shown to be related to a better perception of school climate (Sarafidou & Chatziioannidis, 2013) and in PISA, too, there is evidence of a positive interaction between school autonomy and teacher participation. This interaction suggests that the positive effects of school autonomy on mathematics performance are stronger in schools with greater teacher participation in school management.

Further, PISA introduced in 2012 a number of questions in the student questionnaire related to teaching strategies and the instructional context in the mathematics classroom that align well with the conceptual framework of educational effectiveness research (OECD, 2013a). Drawing on these data, this study examined the association between mathematics performance and teaching strategies as well as possible interactions with the classroom instructional context and the socio-economic context of students across education systems.

2. Educational effectiveness research and the dynamic model

What today is comprehensively called educational effectiveness research (EER) captures a range of research areas from different waves and strands (Creemers & Kyriakides, 2008; Reynolds et al., 2014). It represents an integration of the fields of school effectiveness (school organisation and educational policy) (Teddlie & Reynolds, 2000) and research aimed at the classroom level (teacher behaviour, instruction methods, and curriculum analyses) (Campbell, Kyriakides, Muijs, & Robinson, 2003; Opdenakker & Van Damme, 2006; Stronge, Ward, & Grant, 2011). With a proceeding awareness of contextual impacts on learning processes, approaches were elaborated that viewed effectiveness as a multilevel phenomenon integrating cross-level relationships in the theoretical models (Scheerens, 2013). This development promoted the blending of the former approaches (Creemers & Kyriakides, 2008; Scheerens, 1997) to what has commonly been called educational effectiveness. It has moreover yielded in the dynamic model of educational effectiveness as elaborated by Creemers and Kyriakides (2008), which refers to the student-, classroom-, school-, and context level to explain educational outcomes.

The dynamic model of educational effectiveness regards schooling as a dynamic and ongoing process (Creemers & Kyriakides, 2010; Slater & Teddlie, 1992). Educational institutions are viewed as active actors that adapt to changing contexts in order to remain effective (Doolaard, 2002). Over time, they identify weaknesses and take actions towards the improvement of structures, practices, and policies (Creemers & Kyriakides, 2010). Effectiveness factors are not captured as unidimensional constructs, but are rather measured along five dimensions: frequency, focus, stage, quality, and differentiation (Creemers & Kyriakides, 2008).

Further, the dynamic model considers curvilinear relations and interaction effects on student achievement. For example, the relationships of student achievement with frequency of classroom evaluations and with teacher knowledge are expected to be curvilinear if initial positive effects reduce at higher levels, that is, when too many evaluations reduce teaching time and very sophisticated knowledge might be harder to communicate. Likewise, class practices and school policies could interact with or vary in their effectiveness for the characteristics of students and educational contexts. For example, students from dissadvantaged backgrounds are more likely to be influenced by teachers' expectations (Trouilloud, Sarrazin, Bressoux, & Bois, 2006). Interaction effects moreover refer to relations between effectiveness factors acting at the same level. Rather than a single factor, it might be a grouping of factors that promotes effective teaching (Creemers & Kyriakides, 2008; Reynolds et al., 2014). With that, the dynamic model recognises the complexities of educational settings, where effectiveness factors may work differently at different levels and may work for some students, schools, and education systems, but not for others (Sammons, 2009). That is, what works in education does not work in all contexts and levels.

The multilevel structure is an essential characteristic of the dynamic model of educational effectiveness. Within this structure, most emphasis is given to the classroom-level as previous studies have shown that the classroom level is more significant in explaining educational outcomes than the school or context level (Kyriakides, Campbell, Gagatsis, & Campbell, 2000; Teddlie & Reynolds, 2000). School factors are considered only to the extent that they affect classroom processes (Creemers & Kyriakides, 2008; Opdenakker & van Damme, 2007; Stevens, 2005). Within the classroom level, special attention is given to observable teacher behaviours and actions as opposed to other less dynamic factors, like teacher knowledge or teacher qualifications. The actions and behaviours of teachers are viewed as shaping the quality of teaching and, in turn, student learning. Teacher behaviour and actions at the classroom level include teaching strategies as well as teacher efforts to create an orderly and positive learning environment (instructional context) (Creemers & Kyriakides, 2008). This distinction is also made in research particularly focused on instruction which differentiates between "teaching practices and global factors of classroom process quality" (Decristan et al., 2015) and "enacted regimes and quality of enactment" (Raudenbush, 2008). Based on research into teaching quality this distinction has also been incorporated in the PISA 2012 questionnaire framework, particularly for the study of mathematics instruction (Klieme et al., 2013). This study aims to examine the interactions between teaching strategies and characteristics of the instructional context. It therewith follows aims of EER to investigate the effectiveness of a combination of teacher behaviour factors and actions, an area that is under-investigated in the field (Reynolds et al., 2014).

3. Teaching strategies

Teaching strategies encompass teaching practices that orient mainly along traditional or more constructivist paradigms of teaching and learning (Cobern et al., 2010; Van de Grift, 2014). Traditional approaches are related to direct teaching (or *teacher-directed instruction*), where the teacher is assumed to control the learning process and add to students' knowledge by routine drill and practice (Li, 1999; Schunk, 2008). There is an explicit connection of new content with students' prior knowledge, criteria for learning goals are explicit and set transparently, content is often presented in small structural units and its acquisition is repeatedly checked (Van de Grift, 2014; Hattie, 2009; Opdenakker & van Damme, 2006).

Teaching strategies based on constructivist ideas promote students' active engagement in learning and in the construction of knowledge (Terhart, 2003; Schunk, 2008). The teacher's role is to support the processes that are necessary for the student to construct knowledge. *Student-oriented instruction* for example promotes activating and cooperative learning environments trough discussions between students and the teacher, as well as among students themselves. Activities are also adapted to the needs of different students in the classroom and emphasise student-initiated and student-regulated learning activities (Cornelius-White, 2007;