Process-Product Research: A Cornerstone in Educational Effectiveness Research

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ABSTRACT

This article links the contribution of process-product studies in developing the theoretical framework of educational effectiveness by pointing out the importance of teacher behavior in the classroom. The role that Jere Brophy played in this evolving research is described within the various phases of teacher effectiveness research. Process-product studies revealed the importance of moving from investigating the personal characteristics of teachers to identifying characteristics of effective teaching practices. Research on factors other than the teacher behavior, conducted during the last three decades, have not generated empirical support to show that these factors have direct effect on student achievement and only few of them reveal indirect effects through influencing teacher behavior in the classroom. It is also argued that current models of educational effectiveness research drawn from Brophy's research further the development of constructs generated through process and product studies. We additionally refer to the dynamic model of educational effectiveness and show how the original ideas in the process-product studies were taken into account in describing and analysing the dynamic nature of effectiveness and expand them further by introducing a multidimensional approach to measure the impact of these factors and grouping of factors on student learning outcomes.

INTRODUCTION

Educational Effectiveness Research (EER) addresses the question on what works in education and why. During the last three decades EER has been developed rapidly and studies around the world attempted to identify factors operating at different levels that can explain variation in student achievement gains. Methodological and theoretical developments of EER have been presented in various review studies (Creemers, Kyriakides, & Sammons, 2010; Scheerens & Bosker, 1997; Teddlie & Reynolds, 2000) that show that the knowledge-base of EER has been substantially improved and models which can explain the complex nature of effectiveness have been developed (Scheerens, 2013). In this paper, we discuss the contribution that process-product studies had in the theoretical development of EER. In the first part of the paper, it is shown that these

studies had an impact initially on moving Teacher Effectiveness Research (TER) from investigating personal characteristics of teachers to searching for effective teaching practices and identifying the impact of teacher behavior in the classroom on explaining learning outcomes. Findings emerged from these studies had also an impact on the attempt of researchers to establish multilevel models which do not attribute educational effectiveness solely to what teachers can do in the classroom, but also refer to how school and system factors can create conditions for effective practices. In this section, we demonstrate how the main findings of process-product studies influence the development of the comprehensive model (Creemers, 1994) and later the dynamic model of educational effectiveness (Creemers & Kyriakides, 2008).

ESTABLISHING THE FIELD OF TER: MOVING FROM INVESTIGATING PERSONAL CHARACTERISTICS OF TEACHERS TO UNDERSTANDING EFFECTIVE TEACHING PRACTICES

Brophy and Good (1986) argued that research on effective teaching was slow to develop because of historical influences on the conceptualisation and measurement of teacher effectiveness. Medley (1979) identified five successive conceptions of the effective teacher: (a) possessor of desirable personal traits, (b) user of effective methods, (c) creator of a good classroom atmosphere, (d) master of a repertoire of competencies, and (e) professional decision-maker who has not only mastered required competencies, but learned when to apply them and how to orchestrate them. Table 1 provides a summary of the characteristics of effective teachers, identified by the various phases of TER. More information regarding studies investigating the impact of these factors upon teacher effectiveness is provided below.

A) PRESAGE-PRODUCT STUDIES: THE EARLY PHASE OF TER

Early studies concerned with teachers' personal traits led to presage-product studies and to an attempt to identify the psychological characteristics of an effective teacher, such as personality characteristics (e.g., permissiveness, dogmatism, directness and anxiety), even though gradually characteristics more related to education, like attitude (e.g., motivation to teach, empathy toward children, and commitment), experience (e.g., years of teaching experience, experience in the subjects and in grade level taught) and aptitude/achievement (e.g., professional recommendations, student teaching evaluations), were also studied.

Although this approach produced some consensus on virtues considered desirable in teachers, no information on the relations between these psychological factors and student performance was provided (Borich, 1992; Rosenshine & Furst, 1973). In addition, even if some personality characteristics, such as emotional stability or the way teachers deal with problems, are probably important for effective teaching, there are no clear findings on which emotional or social characteristics, as measured by personality tests, are actually essential. With regard to attitudes, the fundamental problem is that teachers' attitudes do not give much information as to their actual classroom behaviors (Walberg, 1986). It is more problematic to measure teacher attitudes in relation to effective teaching in a valid way than it is directly to observe teacher behavior that supposedly reflects attitudes. Teaching experience is also too global a characteristic to be used to distinguish effective teachers. Research shows that experience with specific curricula is more important than general teaching experience (e.g., Schoen, Cebulla, Finn, & Fi, 2003; Slavin, Lake, & Groff, 2009). Relationships between experience, achievement rates and the abilities of teachers, on the one hand, and effective teaching, on the other hand, are weak and not very meaningful with respect to actual classroom behavior (Kyriakides, Campbell, & Christofidou, 2002).

Table 1

The main factors associated with effective teaching examined by each phase of research into teacher effectiveness

Studies on Teacher Effectiveness	Factors Examined
Presage - Product Studies	**Psychological Characteristics** A) Personality characteristics B) Attitude C) Experience D) Aptitude/Achievement
Process-Product Model	**Teacher Behavior** ***A) Quantity of Academic Activity*** • *Quantity and Pacing of Instruction:* Effective teachers prioritize academic instruction and maximize amount of curriculum covered but at the same time move in such steps that each new objective is learned readily and without frustration • *Classroom Management:* Effective teachers organize and manage classroom environment as an efficient learning environment and thereby engagement rates are maximized • *Actual Teaching Process:* Students should spend most of their time being taught or supervized by their teachers rather than working on their own and most of teacher talk should be academic rather than managerial or procedural ***B) Quality of Teachers' Organized Lessons*** • *Giving Information:* The variables which were examined referred to structuring and clarity of presentation. • *Asking Questions:* The variables which were examined referred to the cognitive level of question, the type of question (i.e., product vs. process questions), the clarity of question, and the length of pause following questions. • *Providing Feedback:* The variables which were examined referred to the way teachers monitor students' responses and how they react to correct, partly correct or incorrect answers. • *Practice and Application Opportunities* **C) Classroom Climate** • Businesslike and Supportive Environment
Beyond Classroom Behavior Model	A) Subject Knowledge B) Knowledge of Pedagogy C) Teacher's Beliefs D) Teacher's Self-Efficacy

Therefore, research has concentrated on the question of what an effective teacher might be in terms of student knowledge and skills development. This research tradition acknowledges the importance of teacher characteristics for teaching, but research during the past four decades has ceased to concentrate on these 'good qualities' of teachers. Actual teacher behavior in classrooms was described and a search began for the behavior characteristics of effective teachers.

B) THE PROCESS-PRODUCT STUDIES

The subsequent focus produced experimental studies attempting to investigate the impact of specific teaching methods upon student achievement (Brophy, 1986). However, the majority of these studies produced inconclusive results because the differences between teaching methods were not significant enough to produce meaningful differences in student achievement (Medley, 1979). Furthermore, the significant differences that

did appear tended to contradict one another (Borich, 1992). In addition, the 1950s and 1960s brought concern about creating a good classroom climate and about the teaching competencies involved in producing student achievement. This led to an emphasis on measurement of teacher behavior through systematic observation and, by 1970, to a proliferation of classroom observation systems (Shavelson, 1973; Simon & Boyer, 1970).

The studies conducted in this period resulted in the publication of the third edition of the *Handbook of Research on Teaching*. The chapters ''Syntheses of Research on Teaching'' (Walberg, 1986), ''Teacher Behavior and Student Achievement'' (Brophy & Good, 1986), and ''School Effects'' (Good & Brophy, 1986) were important in showing that certain teacher behaviors were consistently correlated with student achievement and had an impact in developing the framework for EER (Scheerens, 2013). In this context, various effectiveness studies attempting to identify effects of teacher behavior in the classroom on student achievement have been conducted not only in U.S. (as in the past), but also in Europe. These studies were taken into account in recent meta-analyses that investigated the impact of generic (Kyriakides, Christoforou, & Charalambous, 2013; Scheerens, Seidel, Witziers, Hendriks, & Doornekamp, 2005) and domain specific teaching skills (Seidel & Shavelson, 2007). One can identify a very large number of effectiveness studies that took into account the teacher factors identified by Brophy and others.

These studies revealed that the teaching factors are important for explaining variation in student achievement in various European countries (e.g., Bosker, Kremers, & Lugthart, 1990; Brandsma & Knuver, 1989; de Jong, Westerhof, & Kruiter, 2004; Galton, 1987; Hugener et al., 2009; Kyriakides, 2005; Kyriakides & Tsangaridou, 2008; Muijs & Reynolds, 2000; Opdenakker et al., 2002; Westerhof, 1992; Wubbels, Brekelmans, & Hooymayers, 1991). One could therefore claim that during the last four decades, researchers both in U.S. and Europe have turned to teacher behavior as a predictor of student achievement in order to build up a knowledge base on effective teaching. The paradigm dominating research on teaching for several decades has been the process-product paradigm, also known as the "criterion for effectiveness" paradigm (Gage, 1963). This approach looks for processes (teacher behavior, such as teaching skills, techniques or strategies) that predict or preferably cause products (educational results, such as growth in student knowledge and skills). At first, most studies were of a descriptive nature. Later, many correlational studies were conducted, but experimental studies which introduced certain behaviors and then tested whether they caused the expected effects on students were also undertaken (mainly in U.S.) (Gage & Giaconia, 1983).

This research has led to the identification of a range of behaviors which were found to be positively related to student achievement (Borich, 1992; Brophy & Good, 1986; Doyle, 1986; Everston, Anderson, Anderson, & Brophy, 1980; Galton, 1987; Muijs & Reynolds, 2000). Many of these findings have been validated experimentally, but experimental findings are weaker and less consistent than correlational findings (e.g., Griffin & Barnes, 1986; Good & Grouws, 2004). Additionally, it was not possible to record all teacher behavior, and therefore it was not possible to create a purely scientific basis for teaching by extensively summing up factors, variables and the characteristics of effective teachers (Scheerens, 2013). However, scientific evidence has been collected that shows which behaviors can be effective. It is also shown that teachers themselves can make a choice from behaviors that have proven to be effective, depending on their classroom contexts (Hugener et al., 2009).

Brophy and Good (1986) argued that the most consistently replicated findings in American studies link student achievement to the quantity and pacing of instruction. Amount learned is related to opportunity to learn, and achievement is maximised when teachers prioritise academic instruction, expect their students to achieve the curriculum aims, and allocate available time to curriculum-related activities (Brophy

& Evertson, 1976). Consistent success is another significant factor associated with student achievement. To learn efficiently, students must be engaged in activities that are appropriate in terms of difficulty level and suited to their current achievement levels and needs (Bennett, Desforges, Cockburn, & Wilkinson, 1984; Stallings, 1985). Thus, there is a tension between the goal of maximising amount of curriculum covered by pacing the students through the curriculum as rapidly as possible and the need to move in small steps so that each new objective can be learned readily and without frustration. Brophy and Good (1986) argue that the pace at which a class can move should depend on the students' abilities, developmental levels, and the nature of the subject matter, since students' errors should be held to a minimum.

Since opportunity to learn is related to student engagement--and time on task and engagement have been used as criterion variables in classroom management studies (Emmer & Evertson, 1981)--effective teachers are also expected to organise and manage the classroom environment as an efficient learning environment and thereby to maximise engagement rates (Creemers & Reezigt, 1996). Doyle (1986) points out that key indicators of effective classroom management include good preparation of the classroom, installation of rules and procedures at the beginning of the year, smoothness and momentum in lesson pacing, consistent accountability procedures, and clarity for students about when and how they can get help (including what options are available when they finish a teaching task).

As far as the actual teaching process is concerned, research has revealed that students achieve more in classes where they spend most of their time being taught or supervised by their teachers rather than those where they work on their own (Good & Brophy, 1986). Thus, effective teachers should spend most of their teaching time presenting information and attempting to develop concepts through presentation of information and demonstration. Moreover, research into classroom discourse reveals that the classes of effective teachers, although there is a great deal of teacher talk, most of it is academic rather than managerial or procedural, and much of it involves asking questions and giving feedback rather than extended lecturing (Cazden, 1986).

The findings summarized above deal with factors associated with the quantity of academic activity. The variables presented below concern the form and quality of teachers' organized lessons, and can be divided into those that involve giving information (structuring), asking questions (soliciting), and providing feedback (reacting). As for structuring, Rosenshine and Stevens (1986) pointed out that achievement is maximised when teachers not only actively present materials, but also structure it by: a) beginning with overviews and/or review of objectives; b) outlining the content to be covered and signalling transitions between lesson parts; c) calling attention to main ideas; and d) reviewing main ideas at the end. Summary reviews are also important since they integrate and reinforce the learning of major points. It can be claimed that these structuring elements not only facilitate memorizing the information, but allow for its apprehension as an integrated whole with recognition of the relationships between parts. Moreover, achievement is higher when information is presented with a degree of redundancy, particularly in the form of repeating and reviewing general views and key concepts (Kyriakides, 2005).

Clarity of presentation is also a consistent correlate of student achievement (Borich, 1992). Effective teachers are able to communicate clearly and directly to their students without digression, speaking above students' levels of comprehension or using speech patterns that impair the clarity of what is being taught (Smith & Land, 1981; Walberg, 1986). Muijs and Reynolds (2000) indicate that the focus on teachers actively presenting materials should not be seen as an indication that traditional lecturing and drill approach is an effective teaching approach. Effective teachers ask a lot of questions and attempt to involve students in class discussion. Although it was discovered that the cognitive level of questions was not consistently correlated to students' achievement (Redfield & Rousseau, 1981), it was pointed out that question difficulty could be expected to vary

with teaching context. There should also be a mix of product questions (i.e., expecting a single response from students) and process questions (i.e., expecting students to provide explanations), but effective teachers are expected to ask more process questions (Askew & William, 1995; Creemers & Kyriakides, 2006; Evertson et al., 1980).

Clarity of question is also a factor, and length of pause following questions should vary directly with their difficulty level. For example, a question calling for application of abstract principles should require a longer pause than a factual question. Once the teacher has asked a question and called on a student to answer, the teacher has to monitor the student's response and react to it. Correct responses should be acknowledged for the purpose of other students' learning, while responses that are partly correct require affirmation of the correct part, and rephrasing of the question (Brophy, 1986; Rosenshine & Stevens, 1986). Following incorrect answers, teachers could begin by indicating that the response is not correct, but avoid personal criticism and show why the right answer is correct (Rosenshine, 1971). In general, effective teachers are expected to answer relevant student questions or redirect them to the class and incorporate relevant student comments into the lesson (Borich, 1992; Brophy & Alleman, 1991; Flanders, 1970).

Effective teachers also use seatwork or small group tasks since they provide required practice and application opportunities (Borich, 1992; Creemers, 1994). The effectiveness of seatwork assignments is enhanced when the teacher explains the work that students are expected to do; once the students are released to work independently, the teacher circulates to monitor progress and provide help and feedback (Brophy & Good, 1986; Creemers & Kyriakides, 2006).

Finally, Muijs and Reynolds (2000) point out that classroom climate is a factor that TER has found to be significantly associated with student achievement. The classroom environment should not only be businesslike, but also supportive for the students (Walberg, 1986). Effective teachers expect all students to be able to succeed and their positive expectations should be transmitted to students (Brophy, 1986).

The process-product paradigm was the leading model for research on teaching for years, even though it was criticised from different angles. Because of the definitions of process and product variables, the process-product paradigm preferred empirical research of a quantitative nature (Brophy & Alleman, 1991). Critical advocates of the qualitative approach stated that the quantitative approach did not do enough justice to the "richness" of education at classroom level (Guba, 1978). Ethnographic, detailed descriptions of education processes at classroom level were presented as an alternative to paying very little attention to the outputs of education.

The paradigm seems to concentrate on the frequencies of teacher behavior, which stems from a preference for the measurement of so-called "low-inference" behavior, which can be observed directly and without any interpretation by the observer. Doyle (1986) suggests that too little importance is attached to what behavior means for the actors in education at classroom level. The process-product paradigm and the quantitative approach also prefer to deal with teacher behavior that is consistent over time, although of course instability and inconsistency of behavior are known to occur and can be of great influence on classroom procedures and student achievement. Results of research on teacher behavior in the process-product paradigm might lead to (overly-directive) recommendations for educational practice, the same kind of directions observed formerly with "teacher-proof" curricula. Alternative models or paradigms, trying to meet the restrictions of the process-product paradigm, emphasise the intermediary processes between teaching and learning (Doyle, 1986), the ecology of classrooms (which leads to descriptions of classroom contexts) and the necessity of finding out why students learn (Creemers, 1994).

C) BEYOND CLASSROOM BEHAVIOR

The process-product paradigm emphasises the importance of directly observable teacher behavior, although other variables in the general area of teacher variables

(such as training and experience) have also been considered important. Research on non-directly observable behavior related to the hidden factors of teacher thinking and judging has also taken place, and research on a more cognitive approach to teaching—focusing on thinking, cognitive processes and decision-making—has been promoted in studies by Clark and Yinger (1979), Shavelson (1983) and Shulman (1986). This approach concerns not only teachers but students as well, and shows some similarity to Doyle's (1986) mediating paradigm.

Consequently, factors other than classroom behavior have been the focus of considerable research effort, especially during the last three decades. Although these factors can be classified in a variety of ways, the category system adopted here follows that used by Wang, Haertel and Walberg (1990). Wang and her colleagues evaluated 179 authoritative papers examining the factors associated with student learning. The papers encompassed 228 items organised into 30 scales within six categories. Four of the categories related to beyond-classroom factors and are discussed below.

1) Subject knowledge. Two kinds of professional knowledge have been identified: subject knowledge and teacher's general knowledge of pedagogy (Fennema & Loef-Franke, 1992). Subject knowledge is widely perceived as a factor affecting teacher effectiveness (Scriven, 1994), but the evidence is problematic (Monk, 1994). Borich (1992) points out that teachers' prior achievement, regardless of how it is measured, has rarely correlated strongly with classroom practice and student achievement. Darling-Hammond (2000) argues that a number of studies on the relationship between teachers' scores on the National Teacher Examinations and the performance of their students have found little or no effect. Similar results are reported from a study conducted recently (Konstantopoulos & Chung, 2011), which makes use of data that emerged from an experimental study (i.e., the STAR project) in which subject knowledge was not found to be associated with student achievement. This could be attributed to the fact that subject knowledge could be treated as a minimum requirement for effective teaching, but teachers with a high level of subject knowledge may not necessarily have better teaching skills than others. Thus those with a high level of subject knowledge may not necessarily be more effective than those who meet the minimum requirements for teaching (Monk, 1994).

2) Knowledge of pedagogy. In addition to subject knowledge, teachers possess a body of specialized pedagogical knowledge acquired through training and experience related to teaching methods, subject matter, and child behavior, together with other information resulting from their experience of working with children in numerous contexts (Calderhead, 1987). Although it is unclear how preservice or inservice training contributes to such knowledge, two studies in England (Askew, Brown, Rhodes, Johnson, & William, 1997; Medwell, Wray, Poulson, & Fox, 1998) have shown that pedagogical knowledge is a more significant characteristic of effective teachers than subject knowledge in itself. However, the impact of pedagogical knowledge on student achievement is indirect, since it has a relatively small impact on quality of teaching, and thus on student achievement. This can be attributed to the fact that some teachers may be aware of effective teaching practices and of the knowledge base of TER, but may not be able to apply this knowledge in their classroom practice. Although teacher training and professional development courses should aim to improve teacher pedagogical knowledge, its impact on promoting quality of teaching depends on the extent to which training courses help teachers to improve not only their pedagogical knowledge, but also their teaching skills (Creemers, Kyriakides, & Antoniou, 2013).

3) Teacher beliefs. Currently, an increasing amount of research into teacher effectiveness is focused on the beliefs of teachers (Askew et al., 1997; Creemers, 2008). It is argued that teachers' own beliefs about and attitudes toward teaching and the subject they teach are more important than immediately observable behaviors. The relationship between teachers' beliefs and practice is expected to be a dynamic two-way relationship. It is assumed that beliefs are also influenced by practical experience (Rose, Cousins, &

Gadalla, 1996; Thompson, 1992). Teachers' beliefs were included as one factor in the design of international studies under the auspices of IEA (e.g., TIMSS and PIRLS) in order to investigate factors affecting student performance. Teacher beliefs have been seen as an explanation for the high performance of East Asian students (e.g., Philippou & Christou, 1999; Stevenson, Chen, & Lee, 1993), but secondary analyses of international studies have not shown that teacher beliefs can explain variation in student outcomes (Kyriakides & Charalambous, 2005). Schoenfeld (1992) argues that the area of beliefs is under-conceptualised and needs new methodological and explanatory frames. This is reflected in the fact that instruments measuring teacher beliefs do not usually have satisfactory psychometric properties (Creemers et al., 2010). Another explanation has to do with the fact that teacher beliefs do not have a direct impact on student outcomes; if there is any impact, it could be indirect through encouraging teachers to take actions in order to improve their behavior in the classroom. A teacher could also have positive attitudes toward teaching as a profession but may not be aware of how to improve his/her behavior in the classroom. Thus, we argue here that teacher professional development should be focused on improving quality of teaching through providing opportunities to improve teaching skills. This might have a positive side-effect on teacher beliefs. Concentrating on improving teacher beliefs is very unlikely to have an impact on improving the quality of teaching since there is no clear relation between the development of teacher beliefs and the improvement of their teaching skills.

4) Teachers' self-efficacy. During the last 15 years, teachers' sense of efficacy has become a focus for research. Bandura (1997) defines perceived self-efficacy as 'beliefs in one's capabilities to organize and execute the courses of action required to produce given attainment' (p. 3). In the same sense, teaching efficacy can be defined as teachers' beliefs in their capabilities to organise and orchestrate effective teaching-learning environments. Soodak and Podell (1996) found that teacher efficacy is composed of three factors: Personal Efficacy (PE), Outcome Efficacy (OE) and Teaching Efficacy (TE). Self-efficacy has been shown to be the best predictor of behavior to accomplish the task (Bandura, 1997; Guskey & Passaro, 1994; Hoy & Woolfolk, 1993; Pajares, 1996). It is supported that self-efficacy influences several aspects of behavior that are important to teaching and learning. For example, Schunk (1991) revealed that teachers' self-efficacy beliefs were positively associated with their students' achievement in mathematics and language. It was also found that students with teachers who scored high on self-efficacy did better in standardised tests of achievement (Anderson, Green, & Loewen, 1988; Dempo & Gibson, 1985). Moreover, low teacher efficacy beliefs have been linked to low expectations of students, which are expected to predict student achievement. Further, teacher self-efficacy has been found to be related to student self-efficacy and student motivation. However, effectiveness studies conducted in different countries did not manage to demonstrate a relation between teacher efficacy beliefs and their effectiveness as measured through student learning outcomes (e.g., de Jong et al., 2004; Kyriakides & Tsangaridou, 2008). Drawing on the literature on efficacy beliefs (e.g., Bandura, 1996, 1997; Marsh & Parker, 1984; Muijs, 1997; Pajares & Schunk, 2001), one may also claim that this association could be negative. As Bandura (1997) argues, one could be quite competent in a certain domain, but still harbor low-efficacy beliefs.

CONCLUDING COMMENTS

The review of the literature on factors of teacher effectiveness seems to reveal that teacher behavior in the classroom has a direct impact on student learning outcomes. Searching for factors beyond teacher behavior may help us to discover those that may be related to teacher behavior. Research on factors other than the teacher behavior, conducted during the last two decades, has not generated empirical support to show that these factors have a direct effect on student achievement. In addition, those studies that reported indirect effects of these factors on student outcomes managed to show

that the teacher behavior in the classroom was the mediating variable and thereby the reported effect sizes of these factors on student achievement were very small. Thus, in modeling educational effectiveness, teacher behavior in the classroom has a central role, and current models further developed the constructs generated through the process and product studies (Scheerens, 2013). In the final section of this paper, we refer to the dynamic model of educational effectiveness (Creemers & Kyriakides, 2008), which is one of the most recent theoretical models of EER, and show how the original ideas in the process-product studies were taken into account in describing and analysing the dynamic nature of educational effectiveness.

BUILDING ON PROCESS-PRODUCT STUDIES TO ESTABLISH AN EVIDENCE-BASED AND THEORY-DRIVEN APPROACH TO TEACHER PROFESSIONAL DEVELOPMENT

The second part of this paper deals with two conceptual problems of teacher effectiveness in the research literature: the need to search for relations among teacher factors, and the disconnection of TER from research on teachers' professional development. In this paper, it is argued that these weaknesses are addressed through the establishment of the dynamic model of educational effectiveness. A major constraint of the existing approaches of TER is the fact that the process has not managed to contribute significantly to teachers' professional development or to improving their effectiveness (see Creemers et al., 2013). This is partly due to the fact that correlational research findings are based on variation in existing practices, and even most of the experiments involved practices previously observed. Thus, even if most of the results of TER are transferable to the classroom (Brophy & Good, 1986), and several professional development programs such as the Active Mathematics Teaching (Good, Grouws, & Ebmeier, 1983) and the Teacher Effectiveness Enhancement Project (Muijs & Reynolds, 2000) have been developed, prescriptions for applications derived from these studies usually remain within the ranges of teacher behavior which were observed. Since the criteria for teacher effectiveness have been primarily generated by the researchers through naturalistic classroom observations, specific needs for professional development are not necessarily identified, and only a few intervention studies that may have an impact on teacher professional development have been conducted so far (see Kyriakides et al., 2013; Seidel & Shavelson, 2007). In this context, the dynamic model of educational effectiveness has been developed.

Although the dynamic model is multilevel in nature and refers to factors operating at four levels (student, teacher, school and context)--whereas the process-product studies were concerned with factors operating only at the teacher level--one can see some similarities between the process-product studies and the dynamic model and may identify the impact that these studies have on EER. After 1990, when the attention of EER moved from the school-level variables to the classroom factors that could explain differences in student learning outcomes (Teddlie, 1994), the knowledge base provided by research on teaching undertaken initially by Gage, Brophy and Good (and later by a number of scholars in Europe) was guiding the developments of conceptual frameworks and the instruments used in effectiveness research (e.g., Mortimore, Sammons, Stoll, Lewis, & Ecob, 1989; Scheerens, 1992; Stringfield, Teddlie, & Suarez, 1984; Teddlie & Stringfield, 1984; Teddlie, Stringfield, & Desselle, 1984; Van de Grift, 2014). Moreover, the theoretical models of EER that emerged during 1990s (Creemers, 1994; Scheerens, 1992; Stringfield & Slavin, 1992) took into account the process-product paradigm in defining effectiveness factors. For example, the comprehensive model of educational effectiveness (Creemers, 1994) takes the Carroll model for learning (Carroll, 1963) as an overall frame and develops the classroom level using the results of TER as reviewed by Brophy and Good (1986), among others. The research done with this and similar models resulted in new ideas about learning and teaching. The construction of the dynamic model and especially the measurement of quantitative and qualitative characteristics

of teacher factors can be seen not only as a further step in the development of a theory about educational effectiveness (Scheerens, 2013) but also as the development of a promising theory about effective teaching, which can guide new research in the area of teaching and teacher professional development (Creemers et al., 2013).

By focusing on the impact that Brophy's studies had on the development of the dynamic model of educational effectiveness, one could claim that the establishment of theories of effective teaching helped to address the main weaknesses of previous teacher effectiveness studies. First, the dynamic model refers to eight teacher factors that attempt to measure teacher behavior in the classroom: *orientation, structuring, modeling, questioning, application, management of time, assessment,* and *the role of teacher in establishing the classroom as a learning environment*. At least four of these factors (i.e., structuring, questioning, application, management of time) stem from the major findings of process-product studies (see Brophy & Good, 1986; Good & Brophy, 1986). However, both quantitative and qualitative characteristics of these factors are taken into account in defining them. More specifically, the following five dimensions are used in measuring the functioning of effectiveness factors: *frequency, focus, stage, quality* and *differentiation*. The use of different measurement dimensions reveals that looking at just the frequency of an effectiveness factor (i.e., the extent to which an activity associated with an effectiveness factor is present in a system/school/classroom) does not help us identify those aspects of the functioning of a factor which are associated with student achievement.

Considering effectiveness factors as multidimensional constructs not only provides a better picture of what makes teachers and schools effective, but may also help us develop more specific strategies for improving educational practice (Creemers et al., 2013). In order to test this assumption, instruments measuring all five dimensions of each teacher factor have been developed, and evidence supporting the construct validity of the proposed measurement framework has been provided (Kyriakides & Creemers, 2008). The added value of using the five dimensions to measure teacher factors has also been demonstrated, especially since various studies reveal that more variance on student achievement at classroom level can be explained by taking into account the five dimensions of teacher factors (Creemers & Kyriakides, 2012). One could therefore claim that EER did not only make use of the main findings of the process-product studies in establishing its theoretical framework, but also managed to move a step forward by defining the factors emerged from these studies in a more elaborated way. Thus, findings emerged from effectiveness studies may generate a more comprehensive feedback to teachers for improvement purposes.

The second constraint of TER has to do with the fact that process-product studies have presented the factors concerned with teacher behavior in the classroom as being in opposition to one another (Kyriakides, 2008). As a consequence, different teaching approaches, such as the direct and active teaching approach (Joyce, Weil, & Calhoun, 2000) and the new learning approach (Schoenfeld, 1998), have been developed. In this way, a narrowly focused perspective of effective teaching practice has been provided. However, recent meta-analysis of research on teacher behavior reveals that within each approach there are factors which are associated with student achievement (Kyriakides et al., 2013; Seidel & Shavelson, 2007). This implies that an integrated approach to defining quality of teaching should be adopted in developing theoretical models of educational effectiveness. As a consequence, the dynamic model refers not only to factors associated with the direct and active teaching approach, but also to factors such as modelling and orientation that are more in line with the constructivist theory and its impact on learning. It can finally be claimed that the complex nature of effective teaching can be described in a more comprehensive way by taking into account findings of recent effectiveness studies that show that some teacher factors are interrelated. By defining grouping of teacher factors, not only is the complex nature of effective teaching illustrated, but also more comprehensive strategies for teacher improvement may emerge. Again the reader

can see how EER managed to move from investigating the impact of each teacher factor in an isolated way to searching for types of teacher behavior concerned with different factors and dimensions. In this way, the weaknesses of the competency-based approach to teacher professional development are taken into account, and EER may contribute to the achievement of the ultimate aim of Brophy's work: to establish an evidence-based and theory-driven approach to teacher professional development that can promote quality of teaching, and improve learning and student outcomes. ■

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