Improving Teaching Quality: Promoting a Dynamic Approach to Teacher Professional Development

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Abstract

This presentation draws on teacher effectiveness research to consider implications for teacher professional development. The first part provides a critical review of research on teacher effectiveness. The major findings of this field of research are analyzed. It is argued that teacher factors are presented as being in opposition to one another and that the whole process of searching for teacher factors had no significant impact upon teacher professional development. In this context, the dynamic model of educational effectiveness that attempts to establish stronger links between research and improvement of practice has been developed. Studies investigating the validity of this model and especially its attempt to identify relations among teacher factors reveal that teaching skills can be grouped into stages of effective teaching. These distinct stages move gradually from skills associated with direct teaching to more advanced skills concerned with new teaching approaches and differentiation of teaching. Teachers exercising more advanced types of teacher behavior have better student outcomes. Thus, it is advocated that teacher professional development should be focused on how to address groupings of specific teacher factors associated with student learning and on how to help teachers improve their teaching skills. The second part presents the main characteristics of this *dynamic integrated approach* to teacher professional development. Moreover, experimental studies supporting the use of the *dynamic integrated approach* for improvement purposes are presented. Finally, suggestions for research investigating its impact on promoting quality of education are presented.

Introduction

One of the key findings from decades of Educational Effectiveness Research (EER) is the importance of the classroom level as a predictor of pupil outcomes (Scheerens and Bosker 1997). Research has consistently shown not only that the classroom level can explain more of the variance in pupil outcomes than the school level, but that a large proportion of this classroom level variance can be explained by what teachers do in the classroom (Creemers and Kyriakides 2008). As a result of these findings, classroom practice has become firmly integrated into theoretical and empirical models of educational effectiveness. This presentation aims to summarize key findings and developments in the area of Teacher Effectiveness Research (TER) and to discuss the main methodological and conceptual limitations of TER. We also refer to recent developments in the area which reveal the importance of identifying grouping of teacher factors associated with student achievement and present results of projects conducted in different countries which reveal that teaching skills can be grouped into specific developmental stages. As a consequence, a dynamic approach to teacher professional development has been developed. The main characteristics of this approach and the main findings of experimental studies supporting its use for improvement purposes are presented. Finally, suggestions for research investigating its impact on promoting quality of education are presented.

Major Findings of Teacher Effectiveness Research

During the last 35 years, researchers have turned to teacher behaviors as predictors of student achievement in order to build up a knowledge base on effective teaching. This research has led to the identification of a range of behaviors which are positively related to student achievement (e.g., Brophy and Good 1986; Creemers 1994; Doyle 1986; Galton 1987; Muijs and Reynolds 2000). The most consistently replicated findings of teacher effectiveness studies conducted in different countries link student achievement to the *quantity and pacing of instruction.* Amount learnt is related to opportunity to learn and achievement is maximized

when teachers prioritize academic instruction and allocate available time to curriculum-related activities. Consistent success is another significant factor associated with student achievement. To learn efficiently, students must be engaged in activities that are appropriate in difficulty level and suited to their current achievement levels and needs (Stallings 1985). Effective teachers are also expected to organize and manage the classroom environment as an efficient learning environment and thereby to maximize engagement rates (Creemers and Reezigt 1996; Kyriakides 2008). Doyle (1986) claims that key indicators of effective classroom management include: good preparation of the classroom and installation of rules and procedures at the beginning of the year, smoothness and momentum in lesson pacing, consistent accountability procedures, and clarity about when and how students can get help and about what options are available when they finish.

The findings summarized above deal with factors associated with the quantity of academic activity. The variables presented below concern the *form and quality of teacher's organized lessons* and can be divided into those that involve giving information (structuring), asking questions (soliciting) and providing feedback (reacting). In regard to the structuring factor, Rosenshine and Stevens (1986) point out that achievement is maximized when teachers not only actively present material but also structure it by: a) beginning with overviews and/or review of objectives; b) outlining the content to be covered and signaling 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. These structuring elements not only facilitate memorizing of the information but allow for its apprehension as an integrated whole with recognition of the relationships between parts (Creemers and Kyriakides 2006). 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. Clarity of presentation is also a consistent correlate of student achievement (Scheerens and Bosker 1997; Seidel and Shavelson 2007). Effective teachers are able to communicate clearly and directly with their students without digression, speaking above

students' levels of comprehension or using speech patterns that impair the clarity of what is being taught (Smith and 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. 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 ask more process questions (Askew and William 1995; Kyriakides and Creemers 2008). Effective teachers also use seatwork or small group tasks since they provide needed practice and application opportunities. The effectiveness of seatwork assignments is enhanced when the teacher explains the work that students are expected to do and once the students are released to work independently the teacher circulates to monitor progress and provide help and feedback.

Classroom climate is a significant teacher factor. Effectiveness studies conducted during the last two decades (e.g., Kosir 2005; Rohrbeck, Ginsburg-Block, Fantuzzo, and Miller 2003; Slavin 1983; Slavin and Cooper 1999) reveal the importance of investigating the teacher's contribution in creating a learning environment in his/her classroom by taking into account the following elements of the classroom environment: teacher-student interaction, student-student interaction, students' treatment by the teacher, competition between students, and classroom disorder (Kyriakides and Christoforou 2011). The first two elements are important components of measuring classroom climate, as classroom environment research has shown (Cazden 1986; den Brok, Brekelmans, and Wubbels 2004; Fraser 1991). However, TER is concerned with the type of interactions that exist in a classroom rather than to how students perceive teacher interpersonal behavior (Kyriakides 2008). The other three elements refer to the attempt of teachers to create a businesslike and supportive environment for learning especially since TER reveals that the classroom environment should not be only businesslike but also needs to be supportive for the students (Walberg 1986). Effective teachers expect all students to be able to succeed and their positive expectations are transmitted to their students.

Conceptual and Methodological Limitations of Teacher Effectiveness Research

This section deals with two conceptual problems of TER. The first constraint has to do with the fact that most effectiveness studies are exclusively focused on language or mathematics rather than on the whole school curriculum aims (cognitive, meta-cognitive, and affective). This implies that TER should take into account the new goals of education and related to this their implications for teaching and learning. Moreover, new theories of teaching and learning should be used to specify variables associated with the quality of teaching.

Recent models of teaching and learning characterize learning as a self-regulated and constructive process (Bransford, Brown, and Cocking 2000; Collins, Brown, and Newman 1989). During the last decade, this characterization of teaching stimulated a substantial number of studies which were conducted in different countries around the world and are looking for the impact of new learning approaches to teaching on student outcomes (e.g., Brush 1997; Nolen 2003; Fuchs, Fuchs, Yazdian, and Powell 2002; Ramsden 1997). Although the effects of teaching on student learning which were identified by these studies were diverse and complex, two recent meta-analyses revealed that they were fairly systematic (Seidel and Shavelson 2007; Kyriakides and Christoforou 2011). Instead of treating active and direct teaching approaches as in contrast with the new leaning approaches to teaching, an integrated approach to teaching should be adopted. In this context, the dynamic model of educational effectiveness (Creemers and Kyriakides 2008) has been developed. This model is not based only on traditional views on learning and instruction which emphasize the role of teacher as instructor responsible for providing knowledge and skills. The dynamic model takes into account new ideas on learning and instruction associated with constructivism which give emphasis to independent learning and the construction of knowledge by the learner (Simons, van der Linden, and Duffy 2000). In the latter case, the role of the teacher gradually moves from instructing to coaching and modeling learning. Thus, the dynamic model advocates for the use of an integrated approach in defining quality of teaching and refers to those teacher factors that were found to be

consistently related with student achievement irrespective of whether they are in line with one or the other approach to teaching (Creemers and Kyriakides 2008). This assumption of the dynamic model is in line with those indicating the limitations of using exclusively either the direct teaching approach (Steffe and Gale 1995) or approaches associated with constructivism (Kirschner, Sweller, and Clark 2006) to describe effective teaching. Therefore, suggestions for further research promoting an integrated approach to effective teaching can be drawn, especially since the great majority of effectiveness studies conducted during the last four decades are concerned with factors associated with only a single approach to teaching (Seidel and Shavelson 2007).

A second constraint of the existing approaches to effective teaching is the fact that the process does not contribute significantly to teachers' professional development or to improving teachers' effectiveness. This is partly due to the fact that most studies are based on correlational research findings which look at variations in existing practices and even most of the experiments involved practices previously observed. Even if most of the results of TER are transferable to the classroom and several professional development programs such as the Active Mathematics Teaching (Good, Grouws, and Ebmeier 1983) and the Teacher Effectiveness Enhancement Project (Muijs and Reynolds 2000) have been developed, prescriptions for applications derived from these studies usually remain within the ranges of teacher behavior which were observed (Kyriakides and Christoforou 2011). This implies that we need to establish stronger links between TER and research on teacher professional development and investigate the extent to which teachers and schools can make use of the knowledge base of TER in order to improve their practice.

Establishing Stronger Links between Effectiveness Research and Improvement of Practice

Research on teacher training and research on teacher effectiveness have been conducted apart from and without much reference to one another. Few researchers of teacher training methods rationalize their selection of teaching skills in terms of TER and very few evaluate the

impact of teacher professional development on student learning (Antoniou and Kyriakides, 2011). At the same time, investigators of teacher effectiveness spend little time speculating about the methods that may be used to improve teaching practice. In this context, the dynamic model of educational effectiveness has been developed in order to establish stronger links between effectiveness research and improvement of practice (Creemers and Kyriakides 2006). The essential characteristics of the model are as follows. First, the dynamic model refers to multiple factors of effectiveness which operate at different levels (i.e., student, classroom, school and system). The teaching and learning situation is emphasized and the roles of the two main actors (i.e., teacher and student) are analyzed. Above these two levels, the dynamic model also refers to system-level and school-level factors which have both direct and indirect effects on student achievement since they are able not only to influence directly student achievement but also to influence the teaching and learning situations. Second, the dynamic model is based on the assumption that although there are different effectiveness factors, each factor can be defined and measured using five dimensions: *frequency*, *focus*, *stage*, *quality*, and *differentiation*. These dimensions are supposed to contribute to the effects that a factor may have on student outcome measures (Kyriakides and Creemers 2008). Moreover, they help us describe in better way the functioning of a factor. Specifically, *frequency* is a quantitative way to measure the functioning of each effectiveness factor whereas the other four dimensions examine qualitative characteristics of the functioning of the factors. Thus, the five dimensions are not only important for a measurement perspective but also and even more for a theoretical point of view. Actions of teachers associated with each factor can be understood from different perspectives and not only by giving emphasis to the number of cases the actions occur in teaching. In addition, the use of these dimensions may help us develop strategies for improving teaching since the feedback given to teachers could refer not only to quantitative but also to qualitative characteristics of their teaching practice.

In regard to the use of the model for improvement purposes at teacher level (e.g., initial training and professional development), it is assumed that teaching factors refer to knowledge

and skills associated with different types of teacher behavior in the classroom. Based on the main findings of TER, the dynamic model refers to factors which describe teachers' instructional role and are associated with student outcomes. The eight factors included in the model are as follows: *orientation, structuring, questioning, teaching-modeling, applications, management of time, teacher role in making classroom a learning environment,* and *classroom assessment.* These eight factors do not refer only to one approach of teaching such as structured or direct teaching (Joyce, Weil, and Calhoun 2000) or to approaches associated with constructivism (Schoenfeld 1998). An integrated approach in defining quality of teaching is adopted. Moreover, the model is based on the assumption that teaching factors are not separate entities but some of them are interrelated (Campbell, Kyriakides, Muijs, and Robinson 2003; Johnson 1997). This implies that teachers may demonstrate types of behavior that are based on different combinations of the various teaching approaches which can be related to student outcome measures. The model also attempts to describe the complex nature of effectiveness by pointing out not only the importance of specific factors but also by searching for grouping of factors (i.e., types of teacher behavior). This implies that the model is based on the assumption that improvement of teacher effectiveness can be focused not on the acquisition of isolated skills/competencies (Gilberts and Lignugaris-Kraft 1997) but on helping teachers exercise and/or develop types of teacher behavior that are more effective than others. Two recent studies (Kyriakides, Creemers, and Antoniou 2009; Janosz, Archambault, and Kyriakides 2011) provided support to this assumption. These studies are briefly described below.

1) A Study Searching for Stages - Levels of Effective Teaching

All the grade 5 students (n=2503) from each class (n=108) of 50 primary schools in Cyprus participated in this study. Student achievement in mathematics, Greek language, and religious education were measured, when the students were both at the beginning and end of grade 5. In order to collect data on the eight teacher factors of the dynamic model, 972 observations of the 108 teachers of the student sample were conducted. Two low-inference and

one high-inference observational instruments were used. These instruments were designed to collect data concerned with all the eight teacher factors in relation with the five measurement dimensions which are included in the dynamic model (see Kyriakides and Creemers 2008).

By utilizing the Rasch and Saltus models, the teaching skills included in the dynamic model of educational effectiveness were grouped into 5 stages. These were situated in a developmental order and linked with student outcomes. Taking student outcomes as criteria, teachers who demonstrated competencies in the higher stages were found to be more effective than those situated at the lower stages, and thus students of teachers situated at higher stages showed better outcomes. This association is found for achievement in different subjects and for both cognitive and affective outcomes. The five levels of the model are presented in Table 1.

The first three levels are largely related to the direct and active teaching approach, by moving from the basic requirements concerning quantitative characteristics of teaching routines to the more advanced requirements concerning the appropriate use of these skills as these are measured by the qualitative characteristics of these factors. These skills also gradually move from the use of teacher-centered approaches to the active involvement of students in teaching and learning. The last two levels are more demanding since teachers are expected to differentiate their instruction (level 4) and demonstrate their ability to use the new teaching approach (level 5). Considering these five stages and the properties of the Rasch scale which were developed, one can conclude that some stages are more difficult to accomplish than others. This supports the conclusion that the five stages are not just a grouping of effectiveness factors, but represent equivalent developmental stages of teaching proficiency.

The findings of this study are also in line with theories related to the stage models of professional development (e.g., Dreyfus and Dreyfus 1986; Berliner 1994; Feiman-Nemser and Remillard 1996; Sternberg et al. 2000). The five stages proposed by Kyriakides, Creemers and Antoniou (2009) advance on previous stage models by specifically determining the content of each stage (in terms of teaching skills), whereas previous stage models often lacked clarity on what might constitute each developmental stage.

Table 1. The Five Stages of Teaching Skills Included in the Dynamic Model

Stages	Teaching Skills
1. Basic elements of direct teaching	• Frequency management of time • Stage management of time • Frequency structuring • Frequency application • Frequency assessment • Frequency questioning • Frequency teacher-student relation
2. Putting aspects of quality in direct teaching and touching on active teaching	• Stage structuring • Quality application • Stage questioning • Frequency student relations • Focus application • Stage application • Quality of questions
3. Acquiring quality in active / direct teaching	• Stage student relations • Stage teacher-student relation • Stage assessment • Frequency teaching modelling • Frequency orientation • Focus student relations • Quality: feedback • Focus questioning • Focus teacher-student relation • Quality structuring • Quality assessment
4. Differentiation of teaching	• Differentiation structuring • Differentiation time management • Differentiation questioning • Differentiation application • Focus assessment • Differentiation assessment • Stage teaching modelling • Stage orientation
5. Achieving quality and differentiation in teaching using different approaches	• Quality teacher-student relation • Quality student relations • Differentiation teacher-student relation • Differentiation student relations • Focus orientation • Quality orientation • Differentiation orientation • Quality of teaching modelling • Focus teaching modelling

2) Using Student Ratings to Test the Validity of the Dynamic Model at Teacher Level

The main aim of the second study was to further test the validity of the dynamic model at the teacher level, by investigating the extent to which the teaching skills of teachers in Canada could be grouped into the same stages as those reported by the first study which was conducted in Cyprus. The eight teacher factors and their dimensions were measured by administering a questionnaire to students. Students were asked to indicate the extent to which their teacher behaved in a certain way in their classroom; a Likert scale was used to collect these data. This questionnaire has been used to collect data from Cypriot students of grades 5 and 6, and a Generalizability study (Creemers and Kyriakides 2008) on the use of students' ratings revealed that data from almost all the questionnaire items could be used for measuring teaching quality. For the development of the French version of the questionnaire, the process of double translation was used and thus both the face and content validity of the instrument were examined. Consequently, 78 items were kept in the final version of the questionnaire.

The sample was taken from seven primary schools in the suburb area of Montreal (Canada), who agreed to participate in the study. All grade 3, 4, 5, and 6 students (n=959) from each class (n=42) of the school sample were asked to complete the questionnaire. The response rate was 73%.

The Generalizability study (G-study) revealed that the data from almost all items (63 out of 65) could be used for measuring the teaching quality of each teacher. It is important to note here that the student questionnaire was administered to far younger students than those participating in the Cyprus study. However, age effects on the results of the G-study were not identified. Since the data were found to be generalizable at the teacher level, the research team calculated a score for each teacher in each of the 63 questionnaire items deemed generalizable. Specifically, for each teacher a score for each item was created by calculating the mean score from the responses of the students of their class. Following this, the Rasch

model was applied to the whole sample of teachers and all 62 measures concerning their teaching skill but five items did not fit the model. By analyzing the data on the other 58 items, a scale with appropriate psychometric properties was established (see Janosz et al. 2011). Subsequently, the procedure for detecting pattern clustering in measurement designs, developed by Marcoulides and Drezner (1999), was used to establish whether teaching skills were grouped into levels of difficulty corresponding to easier or more difficult types of teacher behaviors. This method of clustering teaching skills, on the basis of their difficulties from the Rasch model, showed that they are optimally clustered into four types of teacher behavior (stages of teaching) which were similar to those identified by the study conducted in Cyprus (Janosz et al. 2011).

This study provides some support to the assumption of the dynamic model that teacher level factors are interrelated, and thus should not be treated as isolated. Moreover, the use of specific ways to describe both quantitative and qualitative characteristics of these factors assists in classifying these skills into types of teacher behaviors, which range from relatively easy to the more advanced. The four types of behavior which emerged from this study are similar to the five levels identified by the study conducted in Cyprus. However, skills associated with the differentiation of teaching were not found to belong to a single level. The results of this study also provide support to the dynamic model's attempt to describe effective teaching using an integrated approach. Specifically, skills associated with both direct teaching and the new teaching approaches were found to belong to the same levels. Moreover, the types of teacher behavior identified support the idea of combining teaching skills within each type of behavior, rather than treating each skill in an isolated way.

A Dynamic Integrated Approach to Teacher Professional Development

The groupings of factors identified through the studies testing the validity of the dynamic model reveal the need to establish a Dynamic Integrated Approach (DIA) to teacher professional development. This approach lies between the two dominant approaches (i.e., the Competency-Based Approach and the Holistic Approach). In particular, the dynamic dimension of this approach is attributed to the fact that its content derives from the grouping of teaching skills included in the dynamic model and it is differentiated to meet the needs and priorities of teachers at each developmental stage. The integrated dimension of this approach is also attributable to the fact that although the content of the DIA refers to teaching skills that were found to be positively related to student achievement, the participants are also engaged in systematic and guided critical reflection on their teaching practices. Finally, the DIA is based on the assumption that INSET courses are offered by an Advisory and Research Team (A&RTeam). Each teacher is expected to develop his/her own strategies and action plans for improvement, but support for teachers should be offered by an A&RTeam, which is able to provide technical expertise and the available knowledge-base on improvement of teaching factors. Although a teacher is treated as being responsible for designing and implementing his/her own improvement strategies and action plans, he/she is not left alone to design and implement the strategies and actions, but is encouraged to make use not only of the A&RTeam, but also of other available resources within and outside the school. Therefore a systematic research-based approach to design, implementation and evaluation of teacher improvement programs is promoted. The main steps of the DIA are presented below.

Step 1: Identify Needs and Priorities for Improvement through Empirical Investigation

The first step of the DIA is based on the assumption that teacher improvement efforts should refer to the development of teaching skills found to be related to student outcomes.

Research on teacher effectiveness refers to specific factors concerned with teacher behavior in the classroom that are found to be associated with student outcomes, and thus the DIA refers to the development of INSET courses addressing the teacher factors in the dynamic model. This implies that the DIA is based on the assumption that the ultimate aim of any improvement effort should be to promote student learning and its outcomes. To achieve this, INSET courses are expected to help teachers improve their teaching skills and therefore become more effective.

The DIA goes further in suggesting that evaluation data are needed in order to identify the needs of each teacher participating in the improvement project. In any effort to train teachers, an initial evaluation of their teaching skills should be conducted to investigate the extent to which they possess certain teaching skills, whilst identifying their needs and priorities for improvement. The results of the initial evaluation can provide suggestions for the content of training that is offered to different groups of teachers. The teaching skills of the participants can be evaluated by the A&RTeam in order to group teachers into corresponding developmental stages, according to their teaching skills.

Step 2: Provide Guidelines for Improvement: The Role of the A&RTeam

Having identified teachers' needs and priorities for improvement, the second step of this approach relates to the provision of appropriate material and specific guidelines for designing their improvement action plans. The A&RTeam is expected to support teachers as they design and implement their improvement action plans. Specifically, the team is expected to provide the teachers of each group with supporting literature and research findings related to the teaching skills of their developmental stage, with clear instructions about the area on which each group should concentrate for improvement. The A&RTeam is also expected to provide the teachers in this group with guidelines related to their improvement priorities,

supplemented by research literature material. Subsequently, under the guidance of the A&RTeam each teacher should develop his/her own action plan for improvement. This allows teachers to adopt and customize the provided guidelines in relation to the specific context of their classroom.

Step 3: Establish Formative Evaluation Mechanism

The next step of the DIA comprises the establishment of formative evaluation procedures. Formative evaluation is the method of ongoing and concurrent evaluation which aims to improve the program. The formative evaluation procedures developed for the teacher professional development program can be carried out on a regular basis (e.g., once a month) throughout the program to provide information and feedback for improving: a) the quality of teachers' learning, b) the extent to which they implement the teaching skills in their classrooms and, c) the quality of the program itself.

The formative evaluation procedures should involve: the identification of the learning goals, intentions or outcomes, and criteria for achieving them; the provision of effective, timely feedback to enable teachers to advance their learning; the active involvement of teachers in their own learning, and lastly, improvement in teaching skills as a result of teachers responding to identified learning needs and priorities. These procedures could be accomplished by the A&RTeam and participating teachers.

Step 4: Establish Summative Evaluation Mechanism

The final step is concerned with the summative evaluation of the project. Summative evaluation should help us identify the overall impact of the program on the development of teachers’ skills and its indirect effect on student learning. The results of summative evaluation assist in measuring the effectiveness of the DIA and allow subsequent decisions to

be made regarding the continuity of the program. This implies that at the end of the school year teaching skills and student outcomes could be measured. Specifically, the teaching skills of the participating teachers should again be evaluated. In this way, we will be able to identify the impact of the DIA on improving the skills of teachers who have made use of the DIA. Data on student achievement should also be collected, in order to measure the effectiveness of the DIA in terms of student achievement gains.

The Impact of a Dynamic Approach to Professional Development on Teacher Instruction and Student Learning

Beyond describing the dynamic approach to teacher professional development, this presentation refers to experimental studies supporting the view that the DIA can have an impact on improving teacher effectiveness and student outcomes. The experimental study presented in this section investigates how teachers can develop their skills and move from one stage to the next one by gradually developing more complex skill. The four phases of the study are described and their main findings are presented. The findings of this study refer to the impact of an intervention which is in line with the proposed DIA upon: a) the development of teaching skills, and b) the learning outcomes of their students. Specifically, the study reported here attempts to compare the impact of the DIA to teacher professional development with the impact of the Holistic Approach (HA) upon each of the above two dependent variables

To achieve this aim, all primary teachers in two districts of Cyprus (i.e., Nicosia, n=1488; Larnaca, n=815) were invited to participate in this project. A total of 130 primary teachers volunteered to participate in the professional development program that was offered at the University of Cyprus in after school hours. Data were also collected for all students (n=2356) of the teacher-sample. Collection of data took place both at the beginning and end of the intervention. Students with missing prior attainment or background data comprised less

than 7% of the original sample and were consequently excluded from each analysis. In the teacher sample, only seven teachers left the experimental study and were equally distributed in the two intervention groups. The four phases of the experimental study are elaborated upon below and help readers see how the DIA can be applied in designing and implementing a professional development program.

A) Phases of the Study

Phase 1: Initial evaluation

At the beginning of the school year 2008-2009, the teaching skills of the participants were evaluated by external observers. Data on student achievement were collected using external written forms of assessment designed to assess knowledge and skills in mathematics, which are identified in the Cyprus Curriculum. Observation data were analyzed using the same procedure as in the first study described above in order to classify teachers into developmental stages according to their teaching skills. Using the Rasch and the Saltus models, it was found that teachers could be classified into the same five developmental stages which emerged from the first study presented above.

Phase 2: The formation of the two experimental groups

The teachers at each developmental stage were randomly allocated into two groups of equal size. The first group employed the DIA, while the second group used the HA. For example, the 32 teachers at stage 1 were randomly allocated into the two experimental groups, each one consisting of 16 teachers.

Phase 3: The establishment of the training sessions

In the third phase of the study, the teachers of each experimental group began to work towards improving their teaching skills. This phase sought to initiate changes in educational practices, working with the teachers throughout the whole curriculum. It was also concerned with whether, and to what extent, teachers can develop their teaching skills and can integrate them into a more self-consciously articulated model of classroom pedagogy. The interventions offered to the two experimental groups are described below.

Experimental group A: Intervention based on the DIA. Teachers participating in the experimental group A (employing the DIA) were engaged with activities which corresponded solely to skills appropriate to their developmental stage. The teachers in both groups were required to attend eight sessions. The content and purpose of each session is described below.

First session: The first session could be perceived as equivalent to the first step of the DIA, since it aims to build consensus in relation to the main aims of the improvement initiative. Particularly, in the first session the rationale of the professional development program, as well as the main characteristics and value assumptions of the DIA, were analyzed. In addition, the main aims of the program were illustrated (i.e. the improvement of teaching practices and student outcomes) as well as the program procedures and other administrative issues. The importance of evaluating the impact of the program on teacher behavior and student outcomes was also emphasized, and the relevant procedures for the classroom observations, questionnaires and test administrations at both time points were explained. It was also made clear to the participants that provisions had been taken to ensure the anonymity and confidentiality of the results of the evaluation.

Second Session: In the second session, the teachers employing the DIA were assigned to four groups according to their own development stage, based on the results of their

teaching skills evaluation. Following this, the A&RTeam provided supporting literature to the teachers of each group, which was related to teaching skills appropriate to their developmental stage, and identified specific areas for improvement.

Third – Seventh Sessions: After the second session and the development of teachers' initial action plans, one session was scheduled each month until the end of the school year. This provided the teachers with sufficient time to implement the activities in their action plans into their teaching, whilst reflecting on the effectiveness of these activities. The monthly sessions also provided teachers with the opportunity to revise and further develop their action plans on a systematic basis with the assistance of the A&RTeam. This was based upon their own and others' experiences, as well as on research concerning the effectiveness factors of their developmental stage. In each monthly session, teachers' training was based on "active teaching" and was not restricted solely to lecturing. Thus, the participating teachers had the opportunity to report teaching practices and comment on them, to identify effective and non-effective teaching practices, to understand the significance of the teacher level factors in their stage of the dynamic model, and to comprehend how these factors could be linked to effective teaching and learning.

At the same time, the teachers received systematic feedback and suggestions from the A&RTeam with additional reading materials and tasks concerning how teaching skills could be used for teaching specific content. To achieve this, guidelines were developed and distributed to teachers. Finally, members of the A&RTeam visited teachers at their schools to discuss issues regarding the implementation of their action plans into their everyday teaching, and also to provide support and feedback.

Experimental Group B: Intervention based on the HA. Teachers who participated in the experimental group employing the HA were engaged in activities involving the whole

spectrum of teaching elements, attitudes and perceptions; these were not specific to their initial competences or development stage. This intervention was based on reflection. It involves thoughtfully considering one's own experiences and beliefs in applying knowledge to practice, while being coached by professionals in the discipline. As Wilhelm, Coward, and Hume (1996) report, the curriculum of this professional development program was based on providing teacher interns with an opportunity to explore attitudes and reflect on the ethical implications of practice in classrooms whilst also focusing on their previous experiences. Given its nature, this method of professional development causes teachers to step back and critically reflect not only on how they teach, but also on why they teach in a particular way. Teachers participating in the HA were required to attend eight sessions, in the same way as the teachers employing the DIA in group A. The content of the *first session* was the same for both groups.

Second Session: In the second session, the teachers employing the HA (experimental group B) were assigned to groups based on their own preferences. The elements of an action plan were described to teachers in all four groups, who then created their own action plan under the supervision of the A&RTeam. Through discussion the teachers identified problems they considered important, which led to the formulation of action plans to tackle them.

Third – Seventh Sessions: After this second session, one session was scheduled each month until the end of the school year. The primary aim of reflective practice was for teachers to gain a deeper understanding of their own teaching style. Specifically, teachers were encouraged to make use of journals, observation notes, transcribed conversations and self-report. The aim was to enable individuals to critically evaluate their own beliefs and practice and help them to transform their experiences from a past event into an ongoing learning process. Moreover, the intervention was designed to engage participating teachers in

writing narrative stories of experiences, and participate in guided reflective questioning as a process of teacher inquiry and professional development.

The monthly sessions also provided the teachers of each stage with the opportunity to revise and further develop their action plans. The participating teachers could report and comment on their own teaching practices, and identify both effective and non-effective teaching practices, attitudes and beliefs. For example, the teachers were asked to reflect on what they perceived to be successes and failures in terms of effective teaching and learning. They were then encouraged to focus on and write down their story of one critical incident, whether positive or negative, which occurred in their classrooms. They were asked to describe the incident in detail (e.g. situation, people involved, feelings, and reasoning), what they had learned about teaching as a result, how their perspectives changed and the resulting changes in how they taught. In each monthly meeting the A&RTeam encouraged teachers within the same group to co-operate and share both ideas and teaching materials, to exchange and discuss their experiences and generally to share the results of their exploration (see Antoniou and Kyriakides 2011). Finally, as with the teachers of experimental group A, the A&RTeam visited teachers at their schools during this period to discuss emerging issues related to the implementation of their action plans into their everyday teaching. They provided consistent support and feedback to all teachers.

Phase 4: Final evaluation and 8th session - measurement of teaching skills and student outcomes

This was the last phase of the teacher professional development program, which corresponds to the last step of the DIA. By the end of the school year, the teaching skills, and student achievement in mathematics were measured using the same procedures and instruments as in Phase 1. Following the data analyses, a common final meeting was held

with participating teachers in the two experimental groups. During this meeting, the teachers were first invited to express their views and comments about the developmental program in which they participated. This enabled the collection of data concerning the formative evaluation of the project. The overall results of the summative evaluation were then presented to the teachers, and they were asked to reflect on these results.

C) Main Results

The results of the analysis evidenced the impact of the two approaches to teacher professional development on the improvement of teaching skills, and student academic outcomes. These are presented in this section.

Impact on teaching skills

The observational data of each time period were analyzed separately following the procedure described by Kyriakides et al. (2009). On both occasions the results validated the five developmental stages of teaching skills proposed by previous research findings (Kyriakides et al. 2009). Since the teachers were grouped into the same five stages of teaching competencies, a decision was made to compare the initial and final stages of each teacher. This could identify the extent to which some teachers improved their teaching skills and progressed to the next stage of teaching skills. By comparing the classification of teachers into stages at the beginning and end of the intervention, the analysis found that none of the teachers of the group employing the HA moved from one stage to another. On the other hand, 21 out of 65 teachers employing the DIA progressed to the next stage.

In order to measure the impact of the two professional development programs upon teaching skills, the Rasch person estimates were also compared. This comparison revealed that the final scores of teachers employing the DIA (Mean=0.36, SD=1.05) were higher than

initial scores (Mean=-0.28, SD=1.01) and this difference was statistically significant (t=4.14, df=64, p<.001). On the other hand, the final scores of teachers employing the HA (Mean=-0.25, SD=1.04) were not higher than their initial scores (Mean=-0.26, SD=1.05) and paired samples t-test did not reveal any statistically significant differences in progress (t=0.87, df=64, p=0.38).

Impact on student achievement

The results of the multilevel analysis to measure the impact of each of the two approaches to teacher professional development on student achievement are presented in this section. In particular, this analysis aimed to identify the extent to which student achievement gains were significantly different for teachers participating in the DIA as compared to those employing the HA. It is also important to note that other explanatory variables, such as teacher qualification and student socioeconomic status (SES), were taken into consideration in the multilevel analysis. Although the teachers were randomly assigned to the experimental groups, this procedure was still conducted to identify the net impact of each approach on students' academic progress (see Creemers, Kyriakides, and Sammons 2010).

In the data analysis presented below, the variables related to the interventions were added at the last stage of the multilevel modeling analysis. This procedure enabled the authors to supplement the analysis with data for teachers' personal characteristics and perceptions, in order to investigate for possible variation both within groups and between groups. The models presented in Table 2 were estimated without the variables that did not have a statistically significant effect at .05 level.

In model 1, the variables related to the student context were added into the empty model (model 0). All of the student context variables (i.e. *prior achievement in maths, gender, SES, Cultural capital*) had statistically significant effects upon student achievement.

Nevertheless, *prior knowledge* was the strongest predictor of student achievement at the end of the school year. In addition, *prior achievement* was the only contextual variable which had a consistent effect upon achievement when aggregated either at the classroom or the school level.

In model 2 the explanatory variables of the student level, related to the opportunity to learn, were added to the previous model. The amount of time students spent doing their homework showed a statistically significant effect on student achievement. In the third model, all variables related to teachers' background factors, perceptions and attitudes were added to model 2. The y*ears of teaching experience* had a statistically significant effect on student achievement.

In model 4 the variable related to the quality of teaching was added to model 3. Quality of teaching was measured through classroom observations, with each teacher then assigned to a single developmental stage according to his/her teaching skills. In order to measure the effect of each developmental stage on student outcomes, teachers at stage 3 were treated as the reference group (i.e. stage 3 = 0) and three dummy variables were entered into model 4. The results revealed that the developmental stage in which a teacher is situated had a reasonably large and significant effect on student achievement. In particular, we can observe that the students of teachers at stage 1 showed the lowest achievement, whereas students of teachers at stage 4 had higher achievement levels than students within the first three stages. This finding provides support for the developmental nature of the four stages, since students of teachers situated at higher stages performed better than students of teachers at lower stages. Similar results were found at the beginning of the intervention and also in previous research (e.g., Kyriakides et al. 2009).

Table 2. Parameter Estimates and (Standard Errors) for the analysis of student achievement in maths (Students within classes, within schools)

Factors	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Fixed part (Intercept)	5.19 (0.80)	4.10 (0.78)	3.80 (0.80)	3.70 (0.90)	2.90 (0.80)	2.10 (0.80)
Student level						
Context						
Prior achievement in maths		0.80 (.12)	0.79 (.12)	0.81 (.12)	0.80 (.11)	0.80 (.12)
Grade 3		-1.20 (.40)	-1.09 (.40)	-1.08 (.40)	-1.10 (.40)	-1.07 (.40)
Grade 4		-0.72 (.30)	-0.66 (.30)	-0.62 (.30)	-0.63 (.30)	-0.62 (.30)
Grade 6		0.65 (.30)	0.64 (.30)	0.64 (.30)	0.65 (.30)	0.66 (.30)
Sex (0=Girls, 1=Boys)		0.10 (.04)	0.10 (.04)	0.11 (.04)	0.10 (.04)	0.09 (.04)
SES		0.40 (.14)	0.41 (.14)	0.40 (.14)	0.41 (.14)	0.40 (.14)
Cultural capital		0.19 (.08)	0.19 (.09)	0.20 (.08)	0.18 (.08)	0.18 (.08)
Opportunity to learn						
Homework			0.12 (.04)	0.12 (.04)	0.12 (.04)	0.12 (.04)
Private tuition (0 =no, 1=yes)			N.S.S.	N.S.S.	N.S.S.	N.S.S.
Classroom level						
Context						
Average achievement in maths		0.40 (.10)	0.40 (.10)	0.40 (.10)	0.40 (.10)	0.40 (.10)
Average SES		N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.
Average cultural capital		N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.
Percentage of girls		N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.
Teacher background						
Gender (0=male, 1=female)				N.S.S.	N.S.S.	N.S.S.
Years of experience				0.08 (.03)	N.S.S.	N.S.S.
Position				N.S.S.	N.S.S.	N.S.S.
Quality of teaching						
Level 1					-0.52 (.09)	-0.51 (.09)
Level 2					-0.24 (.09)	-0.25 (.09)
Level 4					0.32 (.10)	0.32 (.10)
Experimental group (0=only reflection, 1=competence based)						0.24 (.08)
School Level						
Context						
Average achievement in maths		0.09 (.04)	0.10 (.04)	0.08 (.04)	0.10 (.04)	0.09 (.04)
Average SES		N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.
Average cultural capital		N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.

Percentage of girls		N.S.S.	N.S.S,	N.S.S,	N.S.S,	N.S.S,
Variance components						
School	10.2%	10.0%	9.8%	9.5%	9.1%	8.5%
Class	18.5%	17.6%	17.2%	16.0%	11.0%	9.0%
Student	72.3%	49.0%	45.0%	44.3%	44.1%	44.0%
Explained		23.4%	28.0%	30.2%	35.8%	38.5%
Significance test						
X^2	1213.4	687.3	650.1	590.1	520.0	480.5
Reduction		526.1	37.2	60.0	70.1	39.5
Degrees of freedom		9	1	2	2	1
p-value		.001	.001	.001	.001	.001

N.S.S. = No statistically significant effect at level .05.

In model 5, the effect of each approach to teacher professional development was investigated. A dummy variable representing the approach (0 = HA) was entered into the analysis. The DIA showed a statistically significant effect on student achievement, compared to the HA which did not have a significant effect. The effect of this DIA variable was 0.24 (0.08), indicating that the students of teachers employing this approach had better results than those whose teachers employed the HA.

Implications

The final part of this presentation attempts to draw implications for research, policy and practice. The above findings seem to support that teachers can improve and ultimately progress to the next developmental stage of teaching skills, by undertaking appropriate interventions and participating in effective professional development programs. As this study demonstrated, teachers employing the DIA improved their teaching skills, whereas those employing the HA did not. In addition, the use of the DIA had a significant impact upon student achievement gains in mathematics. A similar argument was made by King and Kitchener (1994). They argued that stage growth was most apparent for teachers who continued their informal education and participated in effective professional development

programs. This is an important reminder that teacher improvement and stage growth do not unilaterally unfold, but also require a stimulating and supportive environment.

The issue concerning the content of teacher professional development programs has been addressed in this study, by drawing from a validated theoretical model of EER. In particular the dynamic model of educational effectiveness emphasizes not only the importance of specific factors, but also the grouping of factors, when addressing the complex nature of effectiveness. This implies that improvement of teacher effectiveness cannot be focused solely on the acquisition of isolated skills or competencies (Gilberts and Lignugaris-Kraft 1997), nor on reflection across the whole teaching process to help teachers get “greater fulfillment as a practitioner of the art” (of teaching) (Clarke and Hollingsworth 2002, 948).

At the same time, the results of this study indicate that reflection is more effective when teachers' priorities for improvement are taken into account, and when they are encouraged to develop action plans which address their professional needs; these were identified through a relevant empirical investigation. Although both interventions encouraged and utilized teachers' critical reflections of their teaching practices, teachers employing the DIA were asked to reflect on those aspects which related to their priorities for improvement based on their developmental stage. These stages were defined by taking into account the knowledge-base of EER, especially teacher factors found to be associated with student achievement. On the other hand, teachers employing the HA adopted a less focused reflection strategy, which allowed teachers to reflect on any aspect of their teaching practice irrespective of the stage on which they were situated. For example, some teachers at stage 1 employing the HA developed action plans aiming to differentiate their instruction; yet their attempts to incorporate this into their teaching were not successful. This may be attributed to the fact that they did not possess basic skills corresponding to their stage which could be considered pre-requisites for the differentiation of teaching. It must be emphasized that the

importance of thinking and critical analysis are important, and thus those aspects of the HA were utilized in the development of the DIA. However, complimenting reflection with the knowledge-base of EER, which addresses the needs of specific groups of teachers, could help us establish more effective approaches to teacher professional development. Although further resarch is needed to test the generalizability of the findings of this study, one could claim that the DIA can have at least significant impact on improving teaching skills and on promoting quality in education.

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