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Kyriakides, L.; Christoforidou, M.; Panayiotou, A.; Creemers, B.P.M.

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L. Kyriakides, M. Christoforidou, A. Panayiotou & B.P.M. Creemers

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The impact of a three-year teacher professional development course on quality of teaching: strengths and limitations of the dynamic approach

L. Kyriakides^a, M. Christoforidou^b, A. Panayiotou^a and B.P.M. Creemers^c

^aDepartment of Education, University of Cyprus, Nicosia, Cyprus; ^bSchool of Educational Leadership, Cyprus International Institute of Management (CIIM), Nicosia, Cyprus; ^cFaculty of Behavioural and Social Sciences, Department of Pedagogy & Educational Science, University of Groningen, Groningen, the Netherlands

ABSTRACT

The dynamic approach (DA) suggests that professional development should be differentiated to meet teachers' individual needs while engaging participants into systematic and guided critical reflection. Previous experimental studies demonstrated that one-year interventions based on the DA have a positive impact on teacher effectiveness. The study reported here investigates the impact that a long-term programme based on the DA can have on quality of teaching. In-service primary school teachers were randomly allocated into two groups. The first group received a three-year programme based on the DA whereas the second acted as the control group. Pre- and post-measurement of teaching skills was performed each year. Offering the DA for a longer period resulted in bigger effects on improving teaching skills but no change in the skills of the control group was observed. Differential effects for teachers situated at different levels are also reported. Implications of findings are drawn.

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Introduction

Teacher professional development is considered a key component in supporting teachers improve their skills in order to teach to high standards and have a positive impact on student learning and the features of effective professional development have long been investigated (Asanok and Chookhampaeng 2016; Borko 2004; Gosselin et al. 2016; Morales 2016; Wayne et al. 2008). Even though general assumptions are made regarding the relationship of teacher professional development and improvements in student learning (i.e. strong and direct relationship), the exact nature of this relationship has rarely been addressed and/or linked to the main approaches used for designing professional development programmes (Antoniou and Kyriakides 2011; Cochran-Smith and Zeichner 2005; Guskey and Sparks 2004). This can be partly attributed to the fact that research on teacher training and Educational Effectiveness Research (EER) have been conducted apart from and without much reference to one another (Creemers, Kyriakides, and Antoniou 2013). Given that teacher behaviour matters more to student achievement than any other aspect of schooling (Creemers and Kyriakides 2015;

Muijs et al. 2014), this study brings together research findings from EER and research on teacher professional development and emphasises the importance of examining the impact that professional development initiatives may have on the quality of teaching and through that on improving student learning outcomes. In addition, the shortcomings of the dominant professional development approaches employed (Brooks 2002; Last and Chown 1996; Whitty and Willmott 1991; Zeichner 1983) are acknowledged. Competency-based approaches (CBA) that emphasise skill acquisition have been criticised for reinforcing teachers' practices in a reproductive way (Porter et al. 1992), separating practice from content (McDermott 1993) and restricting teachers' critical and creative thinking (Sprinthall, Reiman, and Theis-Sprinthall 1996). On the other hand, holistic approaches (HA) that recognise reflection as the way for teachers to develop effective practice have also been extensively criticised. Whereas reflection is identified as an important element in all aspects of learning (Ottesen 2007); contradictory interpretations of what constitutes reflection (Cornford 2002; Fendler 2003) and how it translates into action (Cornford 2002) can be identified. Most importantly, both prevalent paradigms appear to fall short of providing adequate evidence of their positive effect on teaching and learning.

Taking the above mentioned into consideration, the Dynamic Approach (DA) to teacher professional development was proposed (Creemers, Kyriakides, and Antoniou 2013) in an attempt to link EER with research on teacher professional development and address the shortcomings of professional development approaches employed so far. The next section provides a description of the DA.

Using research findings to develop the DA

The DA is based on the assumption that teacher improvement efforts should aim at the development of teaching skills which relate to positive student learning outcomes. It is argued that teacher training and professional development should be focused on how to address specific groupings of teacher factors in relation to student learning rather than to an isolated teaching factor (as proposed by the CBA) or to the whole range of teacher factors (as implied by the HA), without considering the professional needs of teachers. Therefore, the DA lies between the two dominant approaches (i.e. the CBA and the HA) and aims to overcome their main weaknesses.

Particularly, the dynamic dimension of this approach is attributed to the fact that its content derives from the grouping of teacher factors included in the dynamic model of educational effectiveness (Creemers and Kyriakides 2008). Based on the main findings of EER, the dynamic model refers to eight factors which describe teachers' instructional role and are associated with student outcomes: (1) orientation, (2) structuring, (3) questioning, (4) teaching modelling, (5) application, (6) management of time, (7) teacher role in making classroom a learning environment and (8) classroom assessment. These eight factors do not derive only from one theory of teaching and learning such as the direct teaching approach (Joyce and Weil 2000) or constructivism (Schoenfeld 1998), but rather an integrated approach in defining effective teaching is adopted (Kyriakides, Christoforou, and Charalambous 2013). For example factors such as structuring and questioning that are associated with direct teaching and mastery learning are taken into consideration, as well as, factors such as orientation and teaching modelling which are in line with theories of teaching associated with constructivism (Brekelmans, Slegers, and Fraser 2000). Moreover, the encouragement of

student collaboration is addressed in specifying the main elements of the classroom as a learning environment factor (see Kyriakides and Creemers 2008).

The dynamic model also supports that teacher factors are inter-related and the importance of grouping of factors has been demonstrated (Kyriakides et al. 2014). Specifically, longitudinal studies conducted in different countries revealed that the teacher factors included in the dynamic model can be classified into five stages of effective teaching, structured in a developmental order (e.g. Christoforidou and Xirafidou 2014; Creemers, Kyriakides, and Antoniou 2013; Kyriakides, Archambault, and Janosz 2013). Moreover, it was found out that teachers exercising more advanced types of teaching behaviour had better student learning outcomes (e.g. Antoniou and Kyriakides 2011; Azigwe et al. 2016; Kyriakides, Creemers, and Antoniou 2009). The lowest classification of factors (i.e. stage 1) is related to the basic elements of direct teaching and refers to the quantitative characteristics of factors such as management of time, structuring of lessons, posing questions and assigning students with application tasks. The second group of factors (i.e. stage 2) focuses not only on the quantitative aspects of the functioning of the teacher factors but also incorporates some qualitative features of the three factors associated with the direct teaching approach (i.e. structuring, application, and questioning). Teachers located at this stage are able to ensure not only the sufficient use of these factors but also their appropriate use taking into consideration their qualitative characteristics. Teachers at this stage are also able to promote on task interactions among students during lessons. Skills included in these two lower stages are considered as easier to acquire than skills located at the upper more demanding stages. Moving to stage 3, teachers are not only expected to effectively use skills related to the direct teaching approach, but also to be able to establish and maintain a learning environment in the classroom that encourages different types of on task interactions (i.e. student–student interactions and teacher–student interactions). Focus at this stage is also given to the orientation of students towards the learning goals and to their contribution in identifying the objectives of a lesson or a series of lessons. Stage 4 is mainly concerned with the differentiation dimension of factors associated with direct teaching so as to accommodate lessons to the specific needs of different groups of students, whilst stage 5 also provides emphasis to the differentiation of factors which are in line with the new learning approach such as orientation and modelling (for a more detailed description of the five stages see Creemers, Kyriakides, and Antoniou 2013).

Since the eight teacher factors of the dynamic model were found to be grouped in developmental stages varying in difficulty, the DA suggests that teacher professional development should be differentiated to meet the needs and priorities of teachers at each stage. The integrated dimension of this approach is attributed to the fact that, although the content of the DA refers to teaching skills that were found to be positively related with student achievement, participants are also engaged into systematic and guided critical reflection on their teaching practices. The concept of stages has also been proposed in the past (Beeby 1966) in one of the early attempts to categorise schools and educational systems. Beeby's model has been criticised regarding the concept of having distinct stages and disregarding other aspects of the school context apart from the teacher (Guthrie 1980). However, this early model has provided a basis of theory building with regard to the notion of progression which can be taken into consideration for designing teacher professional development programmes. Early models make a more general reference to stages while more recent theoretical models in education are more specific in terms of defining the progressive stages and

their content (Dall'Alba and Sandberg 2006). Since the stages of teaching skills are progressive, meaning that lower stages include simpler skills for teachers to acquire such as routines and time management skills, as one might expect, teachers with fewer years of teaching experience (i.e. less than five) were found to be mostly located at the first stage. However, teacher allocation in stages 2–5 did not depend on a teacher's experience (Antoniou and Kyriakides 2011).

The main steps of the DA

This section refers to the four main steps of the DA (see Figure 1). The first step is concerned with the identification of the professional development needs of each teacher separately through empirical investigation. 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 while identifying their needs and priorities for improvement (Creemers,

Figure 1. The main steps of the dynamic approach to teacher professional development.

Kyriakides, and Antoniou 2013). The results of the initial evaluation can help us classify teachers into the developmental stages of teaching mentioned above and generate suggestions for the content of training to be offered to different groups of teachers based on the stage at which they were found to be situated.

The second step is concerned with the support that the advisory team (i.e. mentors) will provide to teachers in order to help them establish their own action plans. Specifically, the advisory team is expected to provide teachers of each group with supporting literature and research findings related to the teaching skills of their developmental stage, and with clear instructions about the area on which each group should concentrate for improvement. As a result, each teacher is in a position to develop his/her own action plan. The next step of the DA comprises the establishment of formative evaluation procedures. The formative evaluation procedures should involve the identification of the learning goals, intentions or outcomes and criteria for achieving them; the provision of timely and constructive feedback to enable teachers advance their learning; the active involvement of teachers in their own learning and, lastly, improvement in teaching skills. These procedures could be accomplished by the close collaboration of the advisory team and the participating teachers. The final step of the DA aims to identify the impact of the programme 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 DA and allow subsequent decisions to be made on how to further improve the programme and maximise its effect on educational quality. In the next section, experimental studies investigating the impact of this approach on improving teaching and promoting student learning outcomes are briefly presented.

Research on the impact of the DA on improving teaching and promoting student learning

Recent studies support the effectiveness of the DA in relation to the CBA and the HA. Particularly, a group randomisation study compared the effectiveness of the DA to the HA (Antoniou and Kyriakides 2011). A total number of 130 teachers volunteered to participate in a teacher professional development programme. Their teaching skills and achievement of their students in mathematics ($n = 2356$) were measured at the beginning and at the end of the intervention. Teachers found to be at each developmental stage at the beginning of the intervention were randomly allocated evenly into two groups. The first group employed the DA and the second the HA. Teachers employing the DA managed to improve their teaching skills more than teachers employing the HA. The use of the DA also had a significant impact on student achievement gains in mathematics.

The second study compared the effectiveness of the DA to the CBA in improving teacher assessment skills and promoting student outcomes. Following the same approach as in the first study, teachers were invited to participate in a professional development programme and their skills in conducting assessment as well as the achievement of their students in mathematics ($n = 2358$) were measured at the beginning and at the end of the intervention. Teachers found to be at a certain stage at the beginning of the intervention were again randomly allocated evenly into two groups (see Christoforidou et al. 2014). The first group employed the DA and the second the CBA. The results of the study demonstrated that, for teachers at all stages, the DA was more effective in improving both assessment skills, as well as student outcomes in mathematics (see Creemers, Kyriakides, and Antoniou 2013).

The third experimental study attempted to investigate not only the impact, but also the one-year sustainability of the effects of the DA to teacher professional development (see Antoniou and Kyriakides 2013). Teaching skills of the participating teachers ($n = 130$) and their students' achievement in mathematics were measured at the beginning and at the end of the intervention. The DA had an impact on improving teaching skills and student achievement. However, a follow-up measurement of teaching skills, one year after the end of the interventions, revealed no further improvement or decline. This may be partly explained by the fact that teaching experience alone without any form of teacher professional development does not contribute to the improvement of teaching skills (Çakir and Bichelmeyer 2016; Huang and Moon 2009; Lopez 2012). Previous research has shown that teacher experience plays an important role in determining student achievement in the first years of teaching when teachers are still attempting to master simpler skills such as routines and time management (Kyriakides, Creemers, and Antoniou 2009; Sandoval-Hernandez et al. 2015). However, teachers' allocation in higher stages (i.e. stages 2–5) was not found to depend on their experience (Antoniou and Kyriakides 2011), which demonstrates the need for teacher participation in professional development courses despite how long their teaching experience is. These studies seem to reveal that teachers can benefit more in terms of their teaching and assessment skills when involved in the DA instead of the other two dominant approaches. However, all teacher professional development programmes in the studies presented were offered for only one school year. In addition, the study measuring the sustainability of the DA revealed that during the year that no intervention was offered, the teaching skills of teachers who were offered the DA had neither improved nor declined. Similarly, most recent studies on teacher professional development examine the short terms effects of providing teachers with professional development and even if positive effects are observed the sustainability of these effects is not determined (Derri, Vasiliadou, and Kioumourtzoglou 2015).

In a meta-analysis by Rose and Church (1998), only 20 studies measuring the sustainability of the results of teacher professional development programmes were found. This meta-analysis also revealed that in most of these studies, the period from post-test to follow-up tended to be very short and only 8 of these 20 studies were categorised as complete maintenance, indicating that performance of the target skills was sustained at or above levels attained during training. This finding implies that changes due to teacher professional development programmes may revert to baseline after the intervention stimulus ends. In the study mentioned above, the follow-up measure took place one year after the intervention and at least no decline in the teaching skills of participating teachers was observed. However, one could raise the question of whether teachers can further improve their teaching skills, when they participate in a teacher professional development programme based on the DA that is offered for a longer period than a single school year. In this paper, the duration of teacher professional development is being addressed since it is expected that the development of teaching skills is a rather long-term process demanding acquisition of both simple and more complex in-class teaching behaviours (Garet et al. 2001; Villegas-Reimers 2003). Taking in mind the argument that it is easier for a teacher to improve than to maintain a standard of excellence (Creemers and Kyriakides 2010), the study reported here moves a step forward and attempts to investigate the impact of the DA when the teacher professional development programme is offered for a longer period of time.

Research aims

An important element of effective professional development programmes is their duration. Research has shown that on–off professional development workshops are not typically aligned with the participants' existing practices, needs and priorities for improvement and do not reliably lead to changes in classroom teaching (Creemers, Kyriakides, and Antoniou 2013; Loucks-Horsley et al. 1998). In addition, a number of studies have suggested that the duration of professional development is related to the depth of teacher change (e.g. Shields, Marsh, and Adelman 1998; Weiss et al. 1998; Yoon et al. 2007). Desimone (2009) supports the view that 'research shows that intellectual and pedagogical change requires professional development activities to be of sufficient duration, including both span of time over which the activity is spread and the number of hours spent in the activity' (184). Therefore, identifying the optimum point in determining a programme's duration is crucial, since research also indicates that too many hours of professional development could be ineffective (Telese 2008).

In this context, this experimental study has two main aims. First, the study aims to examine the added value of offering a professional development programme based on the DA for more than one year. Second, it aims to investigate whether the intervention has the same effect each year or if the effect is gradually reduced or expanded. Specifically, participating teachers were offered a three-year professional development programme based on the DA so as to examine possible changes/stability in their teaching skills during these three years. In this way, suggestions about the duration of teacher professional development programmes based on the DA could be drawn.

Methods

Participants

In order to examine the added value of the duration of the DA, a three-year school-based professional development programme was offered to in-service primary education teachers in Cyprus, who chose to participate on a voluntarily basis. A total number of 106 teachers coming from different public schools volunteered to participate in this programme. Teachers' professional experience ranged from 1 to 28 years. Although the sample was not randomly selected, it was representative to the teacher population of Cyprus in terms of gender ($\chi^2 = 0.98$, $df = 1$, $p = 0.32$) and years of experience ($t = 0.87$, $df = 965$, $p = 0.385$). During the period that teachers attended this programme, almost all of them had to teach to different classes (i.e. student population) and some of them (17.9%) had to move from one primary school to another. For this reason, we did not collect data from the different groups of students which were taught by this group of teachers during the three school years that the intervention took place.

Phases of the study

The phases of the experimental study are elaborated below and their correspondence with the main steps of the DA is explained.

Phase 1: initial evaluation through classroom observations

At the beginning of the school year 2010–2011, the teaching skills of the participants were evaluated by external observers so as to identify teachers' needs and priorities for improvement (first step of the DA). Two low-inference and one high-inference observational instruments were used. These instruments were designed to collect data concerned with the eight teacher factors of the dynamic model and previous studies provided empirical support to their construct validity (e.g. Antoniou and Kyriakides 2011; Azkiyah, Creemers, and van der Werf 2014; Kyriakides and Creemers 2008).

Specifically, the first of the low-inference observation instruments is based on Flanders' system of interaction analysis (Flanders 1970). However, a classification system of teacher behaviour which is based on the way each factor of the dynamic model is measured was developed. The first low-inference observation instrument provides information on aspects of teacher in-class behaviour using the five measurement dimensions proposed by the dynamic model (i.e. frequency, focus, quality, stage and differentiation) as well as, information on student behaviour. The use of this instrument also enables generating data about teacher–student and student–student interaction. The second low-inference observation instrument refers to five factors of the model (i.e. orientation, structuring, teaching modelling, questioning techniques and application). This instrument also collects information in relation to the five measurement dimensions. The high-inference observation instrument covers the five dimensions of all eight factors of the model, and observers are expected to complete a Likert scale to indicate how often each teacher-behaviour was observed. For example, an item concerned with the frequency dimension of orientation is asking observers to indicate how much time the teacher spent to explain the objectives of the lesson. In order to measure the quality dimension of this factor, one of the items of the high-inference observation instrument is asking observers to indicate the extent to which the orientation activities that were organised during the lesson helped students understand the new content (for more information about the instruments see Creemers and Kyriakides 2012).

Prior to conducting the observations, in order for the instruments to be used effectively, it was necessary to train observers in their use. For training the observers, the following steps were followed: (a) explanation of all eight factors and their dimensions, (b) presentation of each instrument separately and explanation of how it can be used, (c) practice in using the instruments to code video-lessons as well as live lessons and (d) use the data collected above to calculate the inter-observer reliability. In this study, the same three observers were used for conducting the lesson observations each year without knowing the stage at which a teacher was found to be situated or the group at which he/she used to belong, to avoid bias during the observations. Each year the three observers and their trainer coded a video-taped lesson so as to ensure reliability between observers and observations. Teachers were informed of the observation in advance for practicality reasons and they were informed that they could teach any topic they liked in math (based on the curriculum). Since the system in Cyprus is centralised and a national textbook is used for teaching mathematics, teachers of the same age group were teaching more or less similar topics. The observations took place during the first three periods of the day and full lessons were observed (i.e. 40 min). Before the observations took place the observers held a short discussion with the teachers to find out the topic of the lesson to be observed as well as the topics covered in the previous lessons. This discussion aimed at helping observers in coding more accurately the activities of the lesson. For example, it helps them realise whether an application activity is related to

other lessons of a unit or in terms of quality, whether students are using the same type of activity to find a specific result as the ones used in previous lessons or requested to apply the new knowledge to find something new and/or more complex.

For each scale of the three observation instruments, the alpha reliability coefficient was found to be higher than 0.87. Since more than 8% of the lessons were observed by pairs of observers, the inter-rater reliability coefficient was estimated. For each measurement period, the coefficient was found to be higher than 0.84. It is also important to note that each measurement period teachers were observed three times. Thus, a generalisability study (Shavelson, Webb, and Rowley 1989) on the use of observation data was conducted and was found that the data emerged from almost all scales of the three observation instruments could be used for measuring the teaching skills of each teacher in each measurement period separately. Thus, for each measurement period, the score for each teacher in each scale of the observation instruments found to be generalisable was the mean score emerged from using the instrument in observing him/her teaching mathematics three times.

Observation data were then analysed with the use of the Rasch and Saltus models in order to classify teachers into developmental stages. By utilising the Rasch and Saltus models, the teaching skills included in the dynamic model were grouped into the same five stages that emerged from earlier studies conducted in Cyprus (see Antoniou and Kyriakides 2011; Kyriakides, Creemers, and Antoniou 2009).

Phase 2: the formation of the two experimental groups

In the second phase of the study, participating teachers were randomly assigned into two groups; one experimental group which received a professional development programme for three consecutive school years based on the DA ($n = 53$) and one control group which received no training ($n = 53$) for the same period. For example, the 32 teachers that were found to be situated at stage 2 were randomly allocated into the 2 groups, each one consisting of 16 stage 2 teachers.

Phase 3: establishment of training sessions

In Phase 3, teachers of the experimental group had to attend a series of training sessions. These sessions aimed at providing support to teachers in order to help them establish their own action plans, implement and revise them throughout the course of the programme. Table 1 presents briefly the structure of the training sessions offered to teachers of this group during the three years which helps readers see the sequence of the sessions offered to teachers and how this programme is related to the main steps of the DA. The first session (see Table 1) took place before the initial evaluation (Phase 1) aiming to introduce participants to the programme. In this session, the main phases of the professional development programme were analysed. Teachers were explained the significance of evaluating the impact of this professional development programme and they were ensured that the evaluation results would remain both anonymous, as well as, confidential. Finally, training on how to develop an action plan was provided.

At the second session, teachers employing the DA were allocated into four smaller groups, each group consisting of teachers of the same developmental stage. The focus area of each group was made clear and teachers were encouraged to concentrate their efforts for the improvement of the specific skills which corresponded to their stage. To aid these efforts, supporting literature and research findings specifically related to the skills under

Table 1. Focus and main activities of the DA training sessions.

	Year 1	Year 2	Year 3
Session 1	<ul style="list-style-type: none"> • Presentation of the theoretical framework and timeframe of the study • Administration issues • Training on action plan development 	<ul style="list-style-type: none"> • Administration issues • Allocation of teachers into groups based on year 1 final evaluation results 	<ul style="list-style-type: none"> • Administration issues • Allocation of teachers into groups based on year 2 final evaluation results
Initial evaluation Session 2	Classroom observations <ul style="list-style-type: none"> • Allocation of teachers into groups based on initial evaluation results • Presentation of focus area for each group • Presentation of handbook of activities and how it can be used • Development of 1st action plan draft 	----- <ul style="list-style-type: none"> • Application activities/ training in working groups related to the 1st action plan • Critical reflection, development of action plan 2 • Extra supporting material • Formative evaluation so as to plan next sessions 	----- <ul style="list-style-type: none"> • Application activities/ training in working groups related to the 2nd action plan • Optional classroom observations between teachers • Exchange of classroom experiences • Extra supporting material related to the new actions taken • Development of action plan 3
Sessions 3–7	<ul style="list-style-type: none"> • Application activities/ training in working groups based on the area of focus • Critical reflection on the implementation of the 1st action plan • Extra supporting material • Revision of action plan 1 • On-site visits/ Additional classroom observations when requested • Formative evaluation and constructive feedback from the advisory team 	<ul style="list-style-type: none"> • Application activities/ training in working groups • Exchange of classroom experiences regarding the implementation of action plan 2 • Extra supporting material • Revision of action plan 2 • On-site visits/ Additional classroom observations when requested • Feedback from the advisory team regarding the actions taken to achieve the aims set 	<ul style="list-style-type: none"> • Application activities/ training in working groups • Exchange of classroom experiences regarding the implementation of action plan 3 • Extra supporting material • Revision of action plan 3 • On-site visits/ Additional classroom observations when requested • Feedback from the advisory team and support for implementing new activities
Final evaluation End of year reports	Classroom observations <ul style="list-style-type: none"> • Detailed feedback reports based on 1st year final evaluation results • Identification of new area for improvement 	Classroom observations <ul style="list-style-type: none"> • Detailed feedback reports based on 2nd year final evaluation results • Identification of new area for improvement • Overview of year1–2 progress 	Classroom observations <ul style="list-style-type: none"> • Formative evaluation of the teacher professional development programme based on participants' views • Detailed individual feedback reports based on observation data collected from years 1–3

development were given to teachers of each group. Finally, the exchange of ideas among the research team and members of each teacher's group led to the development of individual action plans for improvement (second step of the DA). These action plans consisted of two to three individual goals for each teacher, which were based on the priorities set for improvement through the initial teaching skill evaluation. Apart from these goals, the action plans also included practical actions/activities for achieving them. A handbook with suggestions regarding alternative activities that could be used so as to develop their action plans was provided to teachers. [Appendix A](#) presents the cases of two teachers situated at different

stages and an example of actions taken to achieve the individual goals set. The action plans also included a timeline for implementing these activities and a section for teacher self-evaluation during the implementation phase, so as to report difficulties faced and ways of overcoming them.

After the second session, formative evaluation procedures were established to monitor the implementation of each teacher's action plan, discuss emerging challenges during the implementation phase and identify alternative actions for resolving the issues emerged, by revising the action plans (third step of the DA). As part of these formative evaluation procedures constructive feedback was provided to teachers to enable them advance their learning and improve their teaching skills. Thus, one two-hour session per month was scheduled until the end of the first year of the intervention (see Table 1). Teachers' distribution in groups was sustained throughout the monthly sessions in order to encourage teachers' cooperation, sharing of ideas and materials, and critical reflection. During these sessions each group of teachers was working separately. With the support of the research team, teachers of each group were asked to reflect on their experiences and identify effective or non-effective practices, share comments on the activities implemented and receive and provide feedback. Group discussions also helped teachers identify the significance of the factors at the teacher level of the dynamic model which correspond to their developmental stage, and comprehend how these factors could be linked with effective teaching and learning. Additional material was also provided in each session. Furthermore, teachers were asked to complete application activities related with their focus area. These activities had as a purpose to provide practical examples of new knowledge and skill application, as well as, to encourage collaboration within the team. For example, as already mentioned stage 2 teachers were expected to address not only qualitative but also qualitative characteristics of the factors which are in line with the direct and active teaching approach. Therefore, at one session they were given a lesson plan in order to improve it so that the stage dimension of the structuring factors was satisfied. Teachers were thus expected to collaborate in order to introduce and distribute well-targeted structuring activities not only at one stage of the given lesson (e.g. at the beginning) but throughout the lesson.

During each session, teachers were also encouraged to revise their action plans, based on the material provided; this was done always under the support and guidance of the advisory team. The duration of the programme provided teachers with sufficient time to put their action plans into practice so as to reflect on the effectiveness of the implemented activities and further develop their action plans. Apart of the monthly sessions, the advisory team regularly visited teachers at their schools to discuss emergent issues related with the implementation of their action plans into their everyday teaching and to provide them with support and constructive feedback. Based on the implementation of the action plans the advisory team was able to monitor the progress made by teachers through the three-year implementation of the study.

At the end of the first implementation year, teaching skills of participants were measured using the same procedure as in the first phase of the study. Each teacher received a report on her/his results indicating the progress that she/he managed to make. Those teachers who managed to move from one stage to the next more demanding were provided suggestions on developing a new action plan addressing the teaching skills included in this more demanding stage. All other teachers were encouraged to further develop their initial action plans addressing the same improvement area as during the first year of the

intervention. Table 1 shows that at the beginning of the second year a session was organised that had similar structure and aims like the second session offered during the first year of the programme. During this session, teachers were supported to develop a new action plan addressing the new improvement areas identified through the observations that took place at the end of the first year. They were then asked to implement their new action plans and the advisory team organised sessions to support teachers in implementing, evaluating and adapting the action plans developed during the second year following the same procedure as in the first year of the programme (see Table 1). Since by the end of the second year all participants were observed, data on the new improvement priorities of each teacher emerged and were used to help them develop the action plans of the third year of the study. Table 1 shows that the same procedure was followed each year and the sessions offered aimed to support teachers develop, implement and adapt their action plans every year.

Since a similar procedure in offering the sessions was followed during the second and third year, one could expect teachers to be less committed in participating in this optional programme for three consecutive school years. However, since this professional development programme was offered on a school-basis it was easier for teachers to stay committed to the programme throughout the three years. Most teacher professional programmes offered in Cyprus usually take place at the University of Cyprus or at the Cyprus Pedagogical Institute during afternoon time, making it more difficult for teachers to participate for a long time. Of course the cost for offering school-based professional development is higher, but the cost-effectiveness of the project is not examined in this study. In addition, each teacher had to develop a different action plan each year and as a consequence, the sessions offered during each year were concerned with different topics and addressed their own improvement needs by taking into account the context of their classrooms/schools (which were not the same each year). Teachers also acknowledged that the area of improvement identified each time was referring to a whole range of skills. Thus, to achieve mastery in each skill was not an easy task and required continuous efforts to improve different aspects of each skill. Moreover, from the first year on, the teachers found out that the advisory team kept their promises and its members were available to support them in their teaching, therefore trust was built among participating teachers and the advisory team. During the on-site visits not only trust between the advisory team and teachers was built, but teachers also realised that the team was available to provide concrete, practical suggestions, exchange ideas with them and discuss any difficulties faced during the implementation of their action plans. In particular, since on-site visits were taking place, it was easier for the advisory team to observe the lessons of teachers that wanted to, before or after the training and provide individual feedback. In some cases, the training was enriched with examples and suggestions based on the lessons observed during the on-site visit. For example, during a school visit we were asked by a teacher located in stage 3 to observe her lesson based on problem-solving activities aiming to promote student-student interactions. During this lesson, students were divided in groups and the activities planned could not be completed unless students undertook roles and collaborated. In another case, a teacher located at stage 4 that aimed at promoting differentiation, invited us to observe a lesson where he attempted to differentiate the application tasks offered to students, both in terms of their type as well as in terms of the feedback provided to students. At the end of the lesson, the advisory team discussed with the teacher ways of improving the handouts that had been given to students and suggestions were made that could be used in subsequent lessons.

Results

The observational data of the initial measurement (September 2008), and of the three measurements at the end of each implementation year were analysed separately using the extended logistic model of Rasch (Andrich 1988) in order to identify the extent to which the five dimensions of the teacher factors included in the dynamic model could be reducible to a common unidimensional scale. The model does not test only the unidimensionality of the scale, but it is also able to find out whether the tasks can be ordered according to the degree of their difficulty. At the same time people performing these tasks can be ordered according to their performance in the construct under investigation. When the extended logistic model of Rasch was applied to the data for each one of the four measurements separately, it was found that all teaching skills included in the dynamic model were well targeted against the persons' measures. Moreover, the reliability of persons (i.e. teachers) and items (i.e. teaching skills) was calculated through the Rasch analysis, indicating how well the scale discriminates among teachers based on their estimated teaching skills and how well each teaching skill can be discriminated from one another on the basis of their difficulty. For each measurement period, the separability of each scale (person and items) was satisfactory (i.e. higher than 0.93). Finally, the fitting of the Rasch model to the data was tested against alternative item response theory models and was found to be statistically preferable.

In order to measure the impact of the DA upon teaching skills, we compare the person estimates emerged from Rasch analysis of the data collected at the beginning of the intervention and at the end of each school year that the programme was offered. The mean and standard deviation of the person estimates measuring teacher behaviour in the classroom for each group and in each measurement period are shown in Table 2. The following observations arise from this table.

First, at the beginning of the intervention, the mean scores of the two groups were almost the same and the *t*-test for two independent samples did not reveal a statistically significant difference at .05 level between these two groups in relation to the quality of their teaching skills ($t = 0.06$, $df = 104$, $p = 0.96$). At the end of the third year of the intervention, the *t*-test for two independent samples revealed statistically significant differences at .05 level between the skills of the two groups ($t = 2.01$, $df = 104$, $p = 0.04$). By looking at the figures of the second column, we can see that the teaching skills of the group employing the DA gradually improved from the beginning of the intervention till the end of the third implementation year. On the other hand, the figures of column 4 (i.e. means) seem to reveal that the skills of teachers of the control group remained the same. Moreover, the paired *t*-test reveals that teachers of the control group did not manage to improve their teaching skills during these three years whereas statistically significant improvement in the skills of the DA group during

Table 2. Means and standard deviations of teacher scores measuring quality of teaching of the DA and HA group at the beginning of the intervention and at the end of each year of implementation.

Occasion	DA group		HA group	
	Mean	SD	Mean	SD
Baseline	−0.88	0.93	−0.89	0.92
End of year 1	−0.72	0.92	−0.87	0.91
End of year 2	−0.58	0.90	−0.85	0.94
End of year 3	−0.49	0.92	−0.85	0.93

Note: Using the Rasch model, it was possible to measure the skills of each teacher in logits.

each year can be identified (from the beginning till the end of year 1: $t = 2.12$, $df = 52$, $p = 0.04$, from the end of year 1 till the end of year 2: $t = 2.04$, $df = 52$, $p = 0.05$ from the end of year 2 till the end of year 3: $t = 2.01$, $df = 52$, $p = 0.05$). Finally, by calculating the effect sizes on teaching skills of offering the DA for only one year ($d = 0.17$), two years ($d = 0.30$) or three years ($d = 0.39$), it could be claimed that the duration of the programme plays an important role in improving teaching skills. Although the intervention had a relatively stronger effect during the first year of implementation, the intervention was almost equally beneficial to the DA group during the second and the third year of the intervention.

During these three school years, none of the teachers of the control group managed to move from one stage of effective teaching to another. Teacher allocation into stages and per year movement in the next more demanding stages for the three-year period of the experimental group is shown in Table 3. Although the number of teachers participating in the teacher professional development course is relatively small, one could draw some conclusions from this table about the type of progression that was observed among the teachers of the experimental group.

First, 21 out of 53 teachers of the DA group managed to move from the stage they were found to be situated at the beginning of the intervention to the next more demanding stage. Specifically, nine teachers managed to move from one stage to the next during the first school year, seven managed to move to a higher stage during the second year and five moved from one stage to the next during the third year. Second, the great majority of teachers (i.e. 8 out of 9) who managed to move from one stage to the other during the first year were situated at either the first or the second stage. Third improvement of teachers who were at stage 4 to the next more demanding stage was only observed during the third year. These findings seem to imply that it takes more time for the DA to help teachers move from the first three stages to the last two stages which are more demanding since teachers are expected to differentiate instruction (level 4) and demonstrate their ability to use factors such as orientation and teaching modelling which are in line with the new teaching approach (level 5). Further research is however needed to test the generalisability of these findings especially since the number of participants is relatively small. Further research can also examine the reasons for which some teachers did not manage to progress to the next stage of teaching skills through case studies examining in more depth the barriers faced in implementing the DA based on individual differences (e.g. teaching experience, motivation etc.). It is finally important to note that all progress was done in a stepwise manner since in the cases where change occurred; this change was towards the next demanding level. Namely, there were no cases of teachers which progressed to the extent that would allow them to skip a stage and move to the next more demanding one. Similarly, even though some

Table 3. Experimental group teacher improvement for each of the three years of intervention.

	Beginning of the intervention (<i>n</i>)	Number of teachers improved per year			
		Year 1	Year 2	Year 3	Stable through the 3 years
Stage 1	12	5	1	0	6
Stage 2	16	3	3	1	9
Stage 3	14	1	3	2	8
Stage 4	8	0	0	2	6
Stage 5	3	–	–	–	3
Total	53	9	7	5	32

Note: No teacher of the experimental group had a leap of more than one stage per year.

teachers did not manage to move to the next stage, there were no cases of teachers that moved back to the previous stage.

Finally, a multilevel analysis (occasion/time within teachers) was conducted in order to examine the changes in the teaching skills of the DA group. Table 4 presents the parameter estimates and the standard errors of the models used to analyse the progress of their teaching skills. The empty model reveals that almost 50% of variance can be found at the first level meaning that significant changes in the skills of this group from the beginning of the intervention till the end of the third year can be identified. A linear relation with time can also be observed since time had a statistically significant effect and model 1 was found to fit better than the empty model. Moreover, the parameter estimate of the time in square was not statistically significant at 0.05 level. This reveals that there is linear rather than curvilinear relation with time. Finally model 2 was found to fit better than model 1. This model takes into account the two teacher background variables (i.e. gender and length of experience) that were available. The figures of the fourth column reveal that length of teaching experience (measured at the beginning of the intervention) had an effect on the skills of teachers but gender did not have any effect. It is finally important to note that we tested for any interaction effects but none of them was found to be statistically significant.

Implications

In the last part of the paper, implications of findings are drawn and suggestions for further research (based on the limitations of this study) are provided. First, the results of this study reveal that the DA had a significant impact on improving teaching skills during each year that the programme was offered. On the other hand, no improvement of the skills of teachers of the control group (for a period of three years) was observed. The findings of this study are in line with the findings of previous experimental studies investigating the impact of the DA and provide further support to the argument that professional development programmes employing the DA can have a positive impact on teachers' skills (see Creemers and Kyriakides 2015). Therefore the study suggests 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 programmes (Creemers, Kyriakides,

Table 4. Parameter estimates and (standard errors) for the multilevel analysis of the skills that the teachers of the experimental group had during the intervention.

Factors	Model 0	Model 1	Model 2
<i>Fixed part</i>			
Intercept	1.23 (.23)	0.69 (.20)	0.45 (.21)
Time (linear)		0.31 (.14)	0.32 (.15)
Gender (male=0)			0.09 (.06)
Length of experience			0.15 (.07)
<i>Variance components</i>			
Teacher	50.6%	37.9%	30.5%
Time	49.4%	34.1%	33.9%
Explained		28.0%	35.6%
Significance test			
χ^2	1114.3	924.9	893.7
Reduction		189.4	31.2
Degrees of freedom		1	1
p-Value		0.001	0.001

and Antoniou 2013). This argument is supported by the fact that teachers of the control group did not manage to improve their teaching skills, while all of them remained at the same stage that they were found to be situated at the beginning of the intervention. On the other hand, teachers employing the DA managed to improve their skills. Apart from the development of teaching skills, improvement in student learning outcomes has also been demonstrated in previous professional development programmes where the DA was used for teacher training (Antoniou and Kyriakides 2011; Christoforidou et al. 2014). In this study, results on student outcomes at the beginning and the end of the three-year intervention could not be measured since the participating teachers had a new set of students each year they participated in the project. Moreover, there is no national assessment system for Cypriot primary students in mathematics. We could collect data using our own battery of written tests in mathematics, but this could only help us measure the impact of offering the DA on student achievement gains during a single year; a question already examined through the previous studies and revealing positive results. Thus, further studies in other countries with different educational contexts, in which teachers have the same set of students for more than one year, may examine the impact of the long-term intervention, based on the DA, on student achievement gains for a longer than a school year period.

Second, the results of this study on the effectiveness of the DA appear to provide further support to the approach's main assumptions. The DA recognises that professional development opportunities should be structured to correspond to the professional needs of teachers. Therefore, in any professional development initiative, evaluation mechanisms of teachers' skills need to be established in order to offer appropriate professional development, as well as, to examine the effectiveness of the programme offered, based on the changes identified in relation to teachers' skills. Moreover, teachers employing the DA were asked to make use of the knowledge-base of EER in developing and implementing their action plans. Although thinking and critical analysis are important (Ottesen 2007) complimenting reflection with the knowledge-base of EER, which addresses the needs of specific groups of teachers, could help us establish effective approaches to teacher professional development which will have an impact on improving learning outcomes.

Third, implications of the results of this study for the duration of teacher professional development programmes based on the DA can be drawn. The effect sizes measuring the impact of offering the DA for one year (0.17), two years (0.30) or three years (0.39) reveal that the duration of a programme based on the DA plays an important role in improving teaching skills. During the first year of the implementation of the project a small effect of the DA on improving teaching skills was identified. This result is similar to those reported in previous studies investigating the impact of offering the DA for only one year (see Creemers, Kyriakides, and Antoniou 2013). However, by offering the DA for a period of three years a bigger effect on improving teaching was identified. This implies that this intervention does not reach an optimal point where it can have no further effect when offered for a long period. On the contrary, by offering the intervention for a period of three years, a medium effect of the intervention can be identified which reveals the value of the DA especially since most interventions in education have relatively small effects (Scheerens 2013; Slavin et al. 2011). By calculating the extra impact of the DA on improving teaching during the second year (0.13) and during the third year (0.09), one can see that even two years after the implementation of the project, teachers employing this approach get almost equal benefits as during the first year. The results of the multilevel analysis of the skills of teachers employing the DA

revealed a linear rather than a curvilinear relation with time and this implies that the effect of this intervention does not vanish after a period of three years; especially since teachers are expected each year to further develop their action plans and address new improvement areas in cases that a leap from one stage to the next most demanding is observed.

Fourth, this study seems to reveal that there are different optimal points of duration for teacher professional development programmes based on the DA for teachers situated at different stages. This argument is based on the fact that the great majority of teachers who managed to move from one stage to the next most demanding during the first year were situated at the first or second stage, whereas none of the teachers situated at stage 4 managed to move to stage 5 during the first year. This implies that for teachers situated at the lower stages a programme of just one year might be sufficient but this is not the case for teachers situated at stages 3 and 4 especially since the great majority of teachers who moved from one stage to the next more demanding during the third year were teachers situated at the higher stages. Therefore, this study suggests that it takes more time for the DA to help teachers move from the third to the fourth stage or from the fourth to the fifth, rather than to move from the first two stages to the next more demanding. The relatively small number of participants should, however, be acknowledged and suggestions for further research to test the generalisability of the findings of this study is needed. Such studies may further examine the argument made in this paper that offering teacher professional development programmes based on the DA for a long period may have a long lasting effect and substantially improve the quality of teaching. Even if significant effects can be observed during the first year of the programme, one should also bear in mind that programmes that are offered for a longer period better address the needs of teachers situated at higher stages, helping them to become even more effective.

Fifth, this study provides some further support to results of studies searching for stages of effective teaching based on the grouping of teacher factors included in the dynamic model (e.g. Antoniou and Kyriakides 2013; Kyriakides, Creemers, and Antoniou 2009; Kyriakides, Archambault et al., 2013). Previous studies searching for stages of effective teaching were either cross-sectional (e.g. Christoforidou and Xirafidou 2014; Kyriakides, Creemers, and Antoniou 2009; Kyriakides et al., 2013) or collected data on the teaching skills of participating teachers at only two time points (Antoniou and Kyriakides 2011). Until now it was not possible to find out whether progression occurs in a stepwise manner from one stage to the next and thereby whether the Rasch scale which was developed could be interpreted as a scale measuring stages of effective teaching (Dall'Alba and Sandberg 1996). Cross-sectional studies are very likely to give rise to a stage notion of development because they focus on measuring skills at different levels of experience. However, finding differences among teachers in their teaching skills does not necessarily imply that transition from one level to the other can occur in a stepwise manner. Problems are likely to arise when cross-sectional studies which do not explore the development of teaching skills over time are used in making assumptions about how development occurs (Kyriakides, Creemers, and Antoniou 2009). Nevertheless, the study reported here addressed this weakness since it had measures of teaching skills at the beginning of the intervention and at the end of three consecutive school years. Participating teachers were found to either remain at the same stage during the four measurement occasions or move from the stage that they were situated to the next more demanding. A stepwise progression was therefore observed but this happened only for 21 out of 53 teachers participating in the DA group. On the other hand, no progression

or decline was observed among teachers of the control group which implies that progression is not only a matter of how long the programme is offered but it depends also on the appropriateness of the approach employed. Further research collecting both quantitative and qualitative data may help us not only test the assumption that progression is stepwise but also identify extra challenges faced by those teachers who did not manage to improve their skills and explore ways to expand the scope of the DA in order to have stronger impact on improving quality of teaching.

By providing further empirical support to the assumption that teaching skills can be grouped into stages of effective teaching, this study has also some important policy implications. Since teachers can be classified into stages based on their teaching skills, policy actions can be undertaken to direct teacher training in a way that responds to these diverse needs. In addition, the findings of this study seem to provide support to the assumption that teachers need sufficient time so as to gradually move from one stage to the next especially since some teachers managed to move to the next more demanding stage during the third year of implementation (Desimone et al. 2002). Therefore, the findings of this study provide further empirical support to the argument that teachers should first acquire simpler routines such as teaching skills related to direct teaching approach (i.e. stages 1 and 2) and then move to the higher stages involving the use of “new learning” approaches and differentiation (i.e. stages 4 and 5). However, all five stages are seen as significant steps in teacher professional development efforts, and trainers must be capable of providing teachers with support and guidance irrespective of the stage at which they are found so as to help them move to the next more demanding one. For achieving this aim, teacher professional development programmes addressing teachers’ needs should be offered for sufficient time; especially since this study reveals that when the intervention is offered for a longer period its impact on improving teaching is substantially increased.

Finally, some further limitations of this study are discussed. First, in the results section it has been acknowledged that due to the educational context in Cyprus this study was not in a position to measure the effect of the long-term programme based on the DA on student achievement gains. Even though previous professional development programmes based on the DA that were offered for one school year were able to demonstrate positive effects, not only on teaching skills, but also on student achievement (Antoniou and Kyriakides 2011; Christoforidou et al. 2014), studies are also needed to examine the impact of the long-term intervention, based on the DA, on student achievement gains for a period longer than a school year. Second, the professional development programme that was offered to teachers as part of this study focused only on generic teaching skills and did not include training of domain specific teaching skills, which are also considered essential for maximising student outcomes (Johnson 2013). Third, more research is needed to examine the role of the advisory and research team in relation to the effectiveness of the programme. Namely, the characteristics, qualifications and skills of the research team should be examined as they may provide information as to why some teachers manage to progress and move from one stage to the next, and others do not. In this respect, mixed methods studies can also explore the extent to which the impact of the DA on improving teaching skills depends on the commitment of participating teachers in the programme and the effort they had put in implementing their action plans. Fourth, even though this study was able to collect information on teacher gender and professional experience, more background factors should be examined to identify their association with changes in their teaching skills. Fifth, due to the fact that

only a restricted number of teachers participated in this study it is important not only to test the generalisability of the findings of this study but also to design studies where networks of teachers employing the DA will be established and in this way the added value of teacher collaboration and exchange of ideas through the teacher networks could also be examined (McDonald and Klein 2003; Rhodes and Beneicke 2002). Concluding, it should be acknowledged that all participants in this professional development programme were volunteers, suggesting that even though participating teachers were able to progress in terms of their teaching skills, similar progression may not be observed when the professional development programme is not offered on a voluntary basis.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Leonidas Kyriakides is a professor of Educational Research and Evaluation at the University of Cyprus. His main research interests are in the area of educational effectiveness and especially in modeling effectiveness and using research for improving quality in education.

Margarita Christoforidou is an assistant professor in Educational Leadership and Evaluation at the Cyprus International Institute of Management. Her main research interests are in the areas of educational assessment, educational effectiveness and teacher professional development.

Anastasia Panayiotou is a post-doctoral researcher at the Department of Education of the University of Cyprus. She has participated in several international projects and her main research interests are in the area of educational effectiveness research and teacher professional development.

Bert (Hubertus Peter Maria) Creemers is Professor Emeritus in educational sciences at the University of Groningen, the Netherlands. His main interest is educational quality in terms of students learning outcomes at classroom, school and system level.

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Appendix A. Examples of activities included in participants action plans

TEACHER A

Teacher A was situated at stage 1. Therefore he was encouraged amongst others to increase students' time on task. One of the individual goals set was to reduce time lost for off-task activities. In order to achieve this goal, a number of actions to be taken were set based on the recommendations of the advisory team and of the other members of his working group. One of the actions set was the establishment of clearly defined starting and ending routines for each lesson.

TEACHER B

Teacher B was found to be situated at stage 3. She was encouraged to improve interactions during her lessons. Thus, one of the individual goals set was to provide more opportunities for student–student interactions in each lesson. One of the actions set in order to achieve this goal was that during questioning the teacher could ask students to comment on their classmates' responses to questions before providing their own answer.