

# Key features of effective professional development programmes for teachers

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## Estratto

Studi recenti indicano che lo sviluppo professionale degli insegnanti è fondamentale per migliorare la qualità della scuola. Questa rassegna riassume i risultati di una consistente mole di ricerche e mette in evidenza le caratteristiche fondamentali di un efficace sviluppo professionale per insegnanti. Queste caratteristiche includono un mix di variabili di input, di realizzazione e di output del processo di sviluppo professionale, una focalizzazione sui contenuti formativi, un riferimento ai risultati delle ricerche sull'efficacia educativa, sul feedback ai partecipanti, nonché la creazione di situazioni in cui i partecipanti sperimentano auto-efficacia e partecipano a comunità professionali concentrandosi su l'apprendimento degli studenti.

**Parole chiave:** sviluppo professionale degli insegnanti, formazione in servizio degli insegnanti, efficacia formativa, rassegna bibliografica.

## Abstract

Recent studies indicate that teachers' professional development is crucial to improving the quality of schooling. This review summarises current research results and highlights key features for effective professional development. These features include a combination of the input, application and output variables of the professional development process, a focus on training content, reference to the results of research on educational effectiveness and participant feedback, as well as the creation of situations in which participants experience self-efficacy and participate in professional communities focusing on student learning.

**Key words:** teachers' professional development, in-service teacher training, effectiveness, research review.

## Zusammenfassung

Aktuelle Studien verdeutlichen, dass die Fort- und Weiterbildung von Lehrpersonen einen wichtigen Ansatzpunkt darstellt, um die Qualität von Schule und Unterricht weiterzuentwickeln. Der Beitrag fasst aktuelle Forschungsergebnisse zusammen und identifiziert eine Reihe von Merkmalen, die als Schlüsselmerkmale erfolgreicher Fortbildungen für Lehrpersonen angesehen werden können. Hierzu zählen die

Verschränkung von Input-, Erprobungs- und Anwendungsphasen, der fachliche Fokus der Fortbildung, die Orientierung an Ergebnissen der Unterrichtsforschung, Feedback für die teilnehmenden Lehrpersonen sowie die Schaffung von Situationen, in denen sich Lehrpersonen als wirksam erleben und in denen sie in professionellen Lerngemeinschaften auf das Lernen von Schülern fokussieren.

**Schlüsselwörter:** Lehrerfortbildung, Lehrertraining, Wirksamkeit, Forschungsüberblick.

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## 1. Framework conditions for research on the effectiveness of teachers' professional development

Although many teachers attend professional development programmes throughout their careers, interest in researching the effectiveness of in-service teacher training has increased only over the past few years. The importance of investigating this topic has been underlined by studies in which teachers' motivation, cognition, and instructional practices were proven to be relevant to students' learning (e.g. Kunter, Baumert, Blum, Klusmann, Krauss & Neubrand, 2013; Lipowsky, 2006; Hattie, 2009). While pre-service teachers need to have completed sufficient training to enter the profession, in-service teachers need regular training to maintain and strengthen their professionalism throughout their professional lives. This is particularly important because teachers' content knowledge and pedagogical content knowledge do not expand or deepen automatically with increasing professional experience (e.g., Brunner *et al.*, 2006).

Teacher professional development can be an effective way to enhance and ensure the quality of schooling in general and of classroom instruction in particular. Several meta-analyses and reviews have shown, for example, that professional development programmes can contribute to promoting teachers' knowledge, attitudes, and pedagogical

skills as well as students' learning (Hattie, 2009; Timperley, Wilson, Barrar & Fung, 2007; Yoon, Lee, Scarloss & Shapley, 2007).

### 1.1. The impact of professional development programmes on different outcomes

The effectiveness of professional development programmes for teachers can be assessed in many ways (Kirkpatrick, 1979). First, it can be assessed by measuring the participants' immediate reaction to a programme or to a training<sup>1</sup> in terms of their *satisfaction with and acceptance of it*. However, the link between participants' satisfaction and changes in their knowledge and actions is generally weak (Goldschmidt & Phelps, 2007; Wahl, 2001; for non-teachers, see: Alliger, Tannenbaum, Bennett, Traver & Shotland, 1997). Therefore, the effectiveness of teacher training can only be deduced from participants' acceptance and satisfaction data to a limited extent.

Second, the effectiveness of teacher training can be assessed by measuring the enhancement of the participants' *knowledge* and changes in their *attitudes, beliefs, and levels of motivation*. These teacher characteristics are important predictors for teaching quality and student learning. Third, the effectiveness of teacher training can be measured by observing changes in the *participants' in-class behaviour*, for example, if instruction becomes more cognitively activating or more

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<sup>1</sup> In this paper we use *in-service teacher training* or *professional development programmes* as synonyms. Therefore, the term "training" is not limited to activities focusing on skilled behavior.

strongly encourages students to reflect on their learning processes. Finally, the effectiveness of teacher training can be assessed by measuring the learning outcomes of participants' students. If – after controlling for other relevant variables – those students achieve better learning outcomes (e.g. achievement, motivation etc.) than students of teachers who did not participate or who participated in another programme, the training can be considered effective.

Several meta-analyses have confirmed the numerous effects of teacher trainings. A meta-analysis by Tinoca (2004) included 35 studies with an experimental or quasi-experimental design conducted after 1969 and investigated teacher training in natural sciences. On average, the effect size of the improvement in performance of students whose teachers had taken part in teacher training resulted in  $d = 0.45$  ( $r = 0.22$ ). Blank and de las Alas (2009) analysed 16 studies conducted in the USA between 1986 and 2007 in science ( $n = 4$ ) and mathematics ( $n = 12$ ). The average effect size of the trainings in mathematics on students' learning outcomes was  $ES = 0.21^2$ .

Timperley *et al.* (2007) analysed 72 studies in which effects of teacher training on student outcomes had been reported. The average effect was  $d = 0.66$ ; however, great deviations from this average effect were found depending on the school subject and the student grade. The effect was greatest ( $d = 0.94$ ) in science while the effects for mathematics ( $d = 0.50$ ) and literacy ( $d = 0.34$ ) were much lower. Furthermore, the effects of the training programmes varied depending on the grade. While the effects of training were greater for students in 1<sup>st</sup> to 6<sup>th</sup> grade ( $d = 0.61$ ) and from 9<sup>th</sup> grade onwards ( $d = 0.60$ ), its effect on students' academic performance was lower in 7<sup>th</sup> and 8<sup>th</sup> grade ( $d = 0.36$ ).

The results of meta-analyses led Hattie

(2009) to conclude that teacher training has a medium-sized effect of  $d = 0.62$  on students' learning, but it is not clear exactly how Hattie calculated this data.

## 1.2. A model of factors influencing the effectiveness of professional development programmes

The success of professional development programmes for teachers can depend on a spectrum of factors which can be systematised within an integrative model (see Fig. 1) derived from offer-and-use models used in research on the effectiveness of teaching. The following groups of factors are supposed to influence the success of a professional development programme: The quality and quantity of learning opportunities during the programme (which are influenced by conceptual and didactic characteristics of the training), the characteristics and competencies of the facilitator, the perception, interpretation, and use of received trainings programmes by participants (which depend on the cognitive, motivational, and volitional characteristics of the individual participants), the general conditions at the schools where the participants teach, as well as interactions among these variables (Lipowsky, 2014).

Considering the characteristics of participants, the knowledge and beliefs of teachers are influenced by their professional experience and constitute their *cognitive characteristics*. However, research findings on the impact of prior knowledge on teacher outcomes are inconsistent. In a case study by Rank, Gebauer, Fölling-Albers, and Hartinger (2011) teachers with more prior knowledge benefitted more from a teacher training programme than teachers with less prior knowledge. Theoretically, this can be explained by the assumption that teachers with a high level of prior knowledge about the subject being trained

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<sup>2</sup> The authors measured the effect size as the mean difference between an experimental and a control group divided by the control group's standard deviation, which can differ from Cohen's  $d$ .

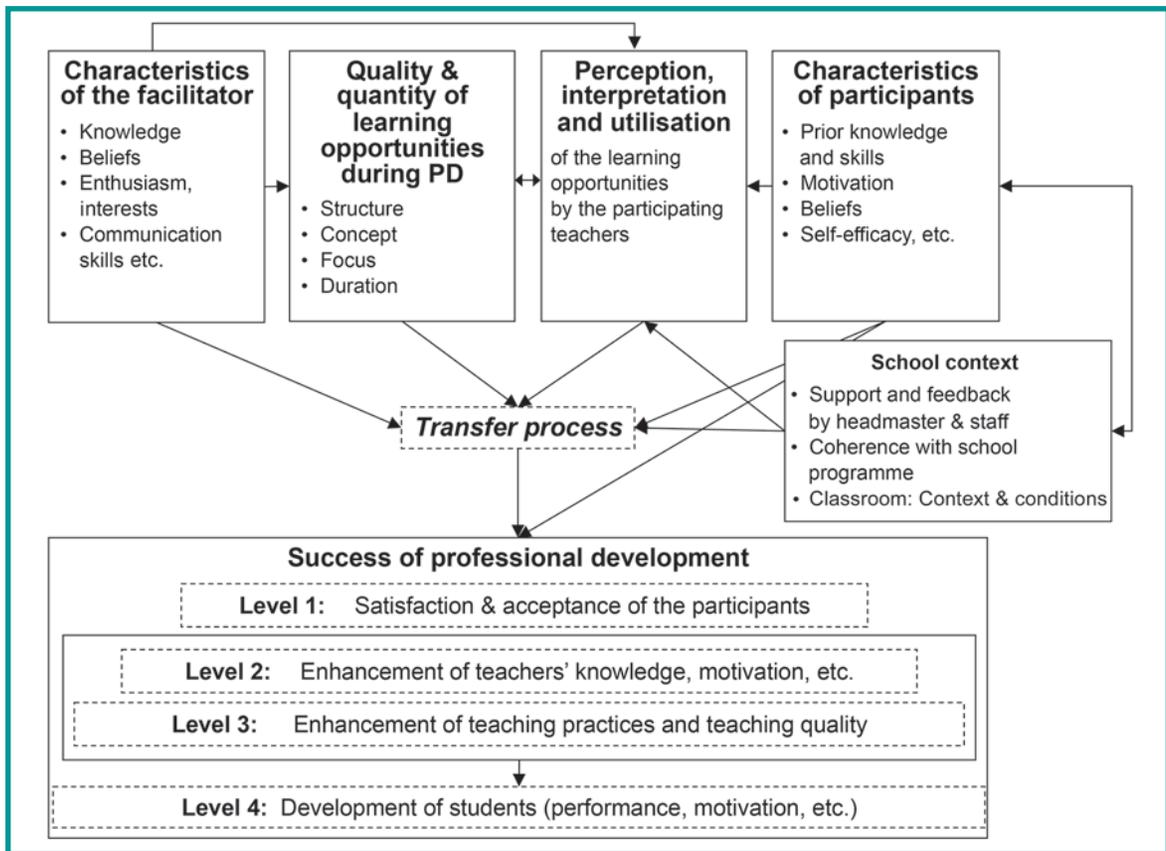


Fig. 1 - Offer-and-use model for research on teachers' professional development (Lipowsky, 2014).

are more likely to establish links between their prior knowledge and the new content presented in the training. However, high prior knowledge and pronounced competencies could hinder learning due to a ceiling effect, which occurs when the training cannot offer any – or only limited – new information to a teacher with extensive prior knowledge and skills. Landry, Anthony, Swank, and Monseque-Bailey (2009) investigated the effects of different kinds of teacher training on teachers' instructional practices and the reading ability of preschoolers in the U.S. (see paragraph 2.6). In their study teachers with less prior knowledge were more successful in their professional development in terms of instructional practices and students' learning than teachers with substantial prior knowledge of the subject and content of the training.

In contrast to younger learners, adult learners typically rely on a more profound knowledge base and on more developed skills. They have more accumulated experiences and link their learning motivation more to the utility of the learning content and to the anticipated benefit of a programme (Illeris, 2006). Thus when designing and implementing professional development programmes for teachers, the personal needs, interests, experiences, and goals of the participants should be taken into consideration (Diehl, Krüger, Richter & Vigerske, 2010; Lieber *et al.*, 2009). The influence of motivational variables can be explained from various theoretical perspectives (e.g., achievement goal theory, self-determination theory, interest theory, expectancy-value models). However, few studies have been conducted on teachers' motivations to participate in

professional development programmes. Following achievement goal theories Nitsche and colleagues (2013) as well as Runhaar and colleagues (2010) were able to demonstrate that teachers with greater learning goal orientation participated in teacher training more often, questioned their own classroom behaviour more frequently, and were more likely to ask their colleagues for feedback on, for example, the influence of their classroom behaviour on student learning.

Other studies investigate the qualities of motivation leading teachers to take part in professional development (Gorozidis & Papaioannou, 2014; Kao, Wu & Tsai, 2011; Richter, Engelbert, Weirich & Pant, 2013; Rzejak *et al.*, 2014). In these studies the different components of motivation to participate in professional development were obtained by factor analysis revealing conceptual overlaps. In the studies by Kao and colleagues (2011) and Rzejak and colleagues (2014) the highest scores were shown by intrinsic factors reflecting personal interest and need to hone one's skills and enhance one's practices. In both studies the extrinsic motivation for teachers to take part in training stemmed from expectations within the work environment (e.g. colleagues or school administrators) showed the lowest values. It remains largely unclear how motivational components are related to the perception and use of learning opportunities during training, to the processing of the content of the training, and to the success of the training mediated through these variables (Rzejak, Lipowsky & Künsting, 2013).

In addition, little is known about the effect of the *school context* on professional development and transferring processes. The few available findings indicate that the school context can have positive effects on implementing training contents into practice if school administrators give teachers the time required to participate actively, if participation is actively supported and promoted by school administrators, and if the school administrators practise a transformational leadership style (Benke, Kittner & Krainer, 2014; Runhaar

*et al.*, 2010). Furthermore, learning and transfer processes seem to be influenced positively when the focus of the training is congruent with current, ongoing school-related reform processes (Garet, Porter, Desimore, Birman & Yoon, 2001; Penuel, Fishman & Yamaguchi, 2007). From a theoretical point of view, this is understandable because the training may be perceived as more relevant by the teacher and supported within the college. The importance of school support for professional development was found in an Australian study by Ingvarson, Meiers, and Beavis (2005) and in a British study by Watson and Manning (2008).

It can be supposed that the school context is particularly important during phases of trying and applying between training sessions and during the transfer period immediately after the training. Furthermore, it appears plausible to assume that the school context influences the sustainability of training programmes (Zlatkin-Troitschanskaia, 2013).

Regarding the presented groups of variables (see Fig. 1) most available research findings concern the *concept of the training* and indicate that effective training programmes depend heavily on structural and didactic characteristics (see paragraph 2 below).

In addition, it can be assumed that the *trainer's characteristics* affect the quality of learning opportunities during the training programme and ultimately its overall effectiveness. Researchers of the New Zealand Literacy Professional Development Project (McDowall, Cameron, Dingle, Gilmore & MacGibbon, 2007) found that facilitators had a significant impact on the effectiveness of teacher training; therefore, such an effect should be stronger in training programmes in which the content is less standardised.

## 2. Features of effective professional development

In the following paragraphs empirical research findings on features of effective

professional development programmes for teachers will be summarised. To select studies for review, first, existing meta-analyses were drawn upon (Kennedy, 1998; Timperley *et al.*, 2007; Tinoca, 2004; Yoon *et al.*, 2007) and – based on these studies – common characteristics of effective teacher training were identified. At the same time original studies investigating the success of teacher training on at least one of the above-mentioned levels were analysed (see paragraph 1.1). Thereby only studies published in German or English were selected. Most of them were published as papers in peer-reviewed journals or as monographs. Furthermore, individual non-peer-reviewed studies or articles were only included in this review if they illustrated characteristics of effective teacher training in a particularly vivid manner. In summary, despite the multitude of studies included, this review is more a narrative study than a systematic meta-analysis.

### 2.1. Long lasting professional development - great impact?

In-service teacher training that is attended once and for a short amount of time, often referred to as a one-shot training programme, has been criticised strongly (Gräsel, Fussangel & Parchmann, 2006; Smith & Gillespie, 2007): The time spent in these workshops is insufficient to change teaching practices which have been developed over a long period and which are quite stable. However, can thus be assumed that longer professional development programmes have larger effects?

Studies which investigated the link between the length (in hours) of teacher training and students' learning produced inconsistent results; nevertheless, a minimum length seems to be necessary to have an effect on students. In her meta-analysis Kennedy (1998) couldn't confirm a positive correlation between the total contact time (in hours) of in-service trainings for mathematics or science teacher and student learning. In two U.S. studies the effects of the number of

hours teachers participated in professional development programmes were analysed. Harris and Sass (2011) found positive effects on student achievement gains in mathematics at middle and high school levels, but not at primary school level. In the study by Foster and colleagues (2013) the effect could be demonstrated for mathematics at middle school, but not for mathematics at the primary and high school level and not for science at all. For their meta-analysis Yoon and colleagues (2007) identified more than 1300 studies; however, only nine of them met the evidence standards and were analysed. They found that the shortest training sessions (less than 14 hours) had no significant effects on students' performance whereas training sessions of more than 14 hours had a positive effect on students' performance.

Timperley *et al.* (2007) conclude in their meta-analysis that an extended period and a certain amount of time (contact hours) are necessary but not sufficient for learning during professional development programmes. One advantage of training programmes running over a longer period is that participants are not only provided with new content and might gain new knowledge, but they also get the opportunity to reflect on the subject matter and apply in class what they have learned between sessions (Garet *et al.*, 2001). In the end, however, what happens in a training (e.g. the kind of activities, the deepness of processing and the intensity of using the learning opportunities) is more important than how much time the participants spend. Therefore it is not surprising that the relationship between the duration of teacher training and its effectiveness is not considered a simple linear one (Kennedy, 1998; Timperley *et al.*, 2007).

Furthermore, it is plausible that the aims of a training have to be considered. A programme which is supposed to enhance teachers' declarative knowledge only could be less time-consuming than a training which aims to influence teachers' beliefs and classroom practices or students' learning.

## 2.2. Combining and relating phases of input, practice, and reflection

When analysing effective teacher training programmes it becomes apparent that input, practice, and reflection phases are often associated with one another (Browder *et al.*, 2012; Cohen & Hill, 2000; Garet *et al.*, 2001; Gersten, Dimino, Jayanthi, Kim & Santoro, 2010; Hiebert & Morris, 2012; Korthagen, Loughran & Russell, 2006; Piwowar, Thiel & Ophardt, 2013; Saxe, Gearhart & Nasir, 2001; Tschannen-Moran & McMaster, 2009). Some studies will be highlighted as examples in the following.

During a relatively long input phase at the beginning of a teacher training programme conducted in the Netherlands, 16 primary school teachers were made familiar with theories about providing students with feedback during active learning. They also discussed video clips showing teachers who apply these theories. At the end of each input session the teachers wrote down how they plan to implement their newly acquired knowledge in their own classes. Afterwards, the teachers were supposed to apply the content covered and knowledge acquired in their classes, which were recorded on video tape. Finally, selected sequences from the videotaped classes were used as a basis for reflection with colleagues and researchers.

Altogether this circle of input, practice, and reflection was repeated four times during the 4-month teacher training programme. At the end of the programme the teachers felt more confident to, for example, activate their students cognitively through questions and feedback. After the training programme their feedback behaviour was assessed as more goal-orientated than before the training (Van den Bergh, Ros & Beijaard, 2014).

KODEK, a professional development programme for effective classroom management conducted in Germany was also characterised by input, practice, and reflection phases (Piwowar *et al.*, 2013). During the first phase secondary school teachers received input

on the current state of research on and conceptual foundations of effective classroom management. The practice phase consisted of microteaching situations and role-playing. Afterwards, teachers applied their newly acquired knowledge in their classes, which were filmed. In video circles with four other teachers and a coach the teachers' lessons were then analysed and reflected on. A control group of teachers took part in a reduced form of the same training: They only received input on the current state of research and developed strategies for effective classroom management with the aid of videos of other people teaching. At the end of the training teachers from the intervention group and those from the control group showed comparable knowledge acquisition concerning effective classroom management. The teachers' classroom management skills were measured using students' ratings and evaluations of external observers. According to the evaluations of the external observers the classroom management behaviour of the teachers who had taken part in the more complex training had improved more than that of teachers in the control group. Furthermore, the students whose teachers had taken part in the more complex training were assessed by the observers as showing more engagement than the students of the teachers in the control group.

The lesson study approach, a way to improve instructional practices developed in Japan, also combines phases of practice, reflection, and analysis of teaching (Fernandez, 2002; Lewis, 2002). In this kind of professional development teachers plan a lesson or a teaching unit together, sometimes supported by external experts such as researchers. Then, one teacher conducts the lesson while the other teachers observe the course of the lesson documenting it in written form or on video. Immediately afterwards, the teachers reflect on the lesson together. Further analyses are conducted whereby transcripts and videos of the lesson as well as documents of the students are used to enhance the quality of teaching. In this process the lesson study

groups focus on the learning processes and comprehension of the students. In several circles the lessons are revised and enhanced. This approach to professional development for teachers has been adopted in several countries (Hiebert & Morris, 2012). So far, research on the lesson study approach has been mostly qualitative (Lewis, Perry & Hurd, 2004). One exception is the study by Lewis and Perry (2014) in which qualitative and quantitative data on more than 200 mathematics teachers in 39 working groups in the U.S. were analysed. The groups of teachers were randomly assigned to an experimental or a control condition. The experimental group received research-based articles, materials, and suggestions for teaching fractions and for working in lesson study groups. Teachers in the two control group worked on freely chosen topics. In one control group the teachers followed the lesson study approach and in the second control group the teachers chose a form of professional development as usual. The results indicate that the pedagogical content knowledge of the teachers in the experimental group, who were provided with research-based relevant documents, developed better than that of the teachers in both control group.

### 2.3. Taking into account the research on teaching effectiveness

When the goal is to design professional development programmes that promote both teachers' learning and students' outcomes, it makes sense to take the findings of research on teaching quality into consideration.

In one of their studies Antoniou and Kyriakides (2011; 2013) compared two types of teacher training for mathematics teachers. While the dynamic integrated approach (DIA)

was based on results of research on the effectiveness of teaching, the holistic/reflective approach (HA) allowed teachers to choose their focus. Teachers participating in the DIA training programme were supposed to recognise effective and less effective features of their teaching practices based on research results. Furthermore, they were instructed to use research results to enhance their teaching. The following features of effective teaching were stressed: appropriate teacher questions, clarity and structure of instruction, encouragement to students to employ learning strategies, formative assessment, as well as effective classroom management. The teachers received materials according to their level of teaching competence<sup>3</sup> as well as feedback from researchers.

Teachers in the HA training programme reflected on their in-class teaching practices without any specification as to what they should focus on. Thus, the teachers decided which topic to reflect on, and the reflection was not structured according to evidence-based characteristics of effective teaching. The results indicate that teachers who participated in the DIA programme were better able to improve their teaching skills than the teachers in the HA programme. Using multilevel analysis it was shown that students whose teachers took part in the more integrative training programme performed better in mathematics than the students whose teachers participated in the HA programme.

Another relevant characteristic of effective teaching is cognitive activation (Kunter *et al.* 2013; Lipowsky, 2015), which has been the main focus of several professional development programmes for teachers. Caulfield-Sloan and Ruzicka (2005) trained primary school teachers in asking cognitively demand-

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<sup>3</sup> Before the teacher training programme the teaching competence of the 130 mathematics teachers participating in this study were rated by observers. The teachers were divided into four homogeneous groups according to their determined competence levels. The teachers were randomly assigned to either the DIA training or the HA training.

ing questions during lessons. At the end of the programme the teachers in the experimental group asked more cognitively demanding questions than teachers in a control group, who received the training with a delay.

The construct of cognitive activation is very similar to the concept of authentic instruction as described by Louis and Marks (1998). Authentic instruction is characterised by encouraging students to use higher order thinking, to communicate on deeper levels during class discussions, and to address as well as handle relevant concepts of content presented (Newmann, Marks & Gamoran, 1996). These principles of authentic instruction formed the basis of the professional development programme examined by Louis and Marks. The results of this study indicate that the deeper teachers delved into their training programme, using the available learning opportunities, the more cognitively demanding their instruction became and the better their students performed (Louis & Marks, 1998).

Another multidisciplinary characteristic of effective teaching is a constructive feedback culture in class. In a study from the 1980s 18 mathematics teachers in Venezuela were trained to give their students constructive written feedback on their homework. The training spanned 10 weeks. The classes of the participating teachers were divided into two groups: One group received elaborative feedback on their homework, including detailed information on their mistakes, possible reasons for those mistakes, and how to prevent such mistakes in the future; another group only received information on how many tasks they had completed correctly. The students took tests and completed questionnaires before and after the teacher training programme to assess and analyse their progress as well as affective-motivational characteristics (e.g., self-concept and learning enjoyment). The group of students who had received the elaborative feedback exhibited significantly better learning progress than the group of students who had received basic feedback only.

Additionally, there were treatment effects on students' enjoyment, value, and self-concept (Elawar & Corno, 1985).

Formative assessment is another characteristic of effective teaching, which is currently discussed in research and considered to have a positive influence on students' learning (Kingston & Nash, 2011; Maier, 2010). A study with primary school teachers in which the effects of four teacher training programmes combining approaches of individual support (scaffolding, peer-assisted learning, formative assessment, control group) with enquiry-based learning were compared was recently conducted in Germany. After receiving the training, participants taught a lesson unit on floating and sinking in their classes. The results indicate that students whose teachers had taken part in the training programme on formative assessment showed higher achievement gains than the students whose teachers were in the control group and had participated in the basic training programme on enquiry-based learning (Decristan *et al.*, 2015).

#### 2.4. *Focussing on students' domain-specific processes of learning and understanding*

Aside from the instructional characteristics which have been mentioned in the previous paragraph 2.3 and which are rather general and domain-independent, domain-specific characteristics of instruction seem to be of particular importance for student learning (Seidel & Shavelson, 2007). It is thus hardly surprising that research has clearly shown that effective professional development is content-focused and concentrates on domain-specific topics or domain-specific student competencies (science: e.g., Adey, 2004; Fishman, Marx, Best & Tal, 2003; Möller, Hardy, Jonen, Kleickmann & Blumberg, 2006; Penuel *et al.*, 2007; Wackermann, 2008; literacy: e.g., Corte, Verschaffel & Ven, 2001; Guthrie *et al.*, 2004; McCutchen *et al.*, 2002; Souvignier & Mokhlesgerami, 2006; Taylor, Pearson, Peterson & Rodriguez, 2005;

mathematics: e.g., Carpenter, Fennema, Peterson, Chiang & Loef, 1989; Cobb *et al.*, 1991; Collet, 2009; Saxe *et al.*, 2001). Corresponding teacher training programmes aim to enhance pedagogical content knowledge and provide learning opportunities that encourage teachers to perceive and analyse students' subject-related learning and understanding processes. For example, in several trainings teachers should be able to anticipate students' learning strategies and should compare their expectations with real answers of their students. In addition, they should administer tasks and pose questions which have diagnostic potential and which could give information and cues to teachers on their students' concepts, learning progress, and learning processes (Black & William, 2004; Carpenter *et al.*, 1989; Gearhart & Osmundson, 2009; Herman & Choi, 2008; Sato *et al.*, 2008; Timperley *et al.*, 2007).

The "Cognitively Guided Instruction" project in the U.S. (Carpenter *et al.*, 1989) aims to enhance primary school children's problem-solving skills. Forty teachers were assigned randomly to an experimental group or a control group. The teachers in the experimental group dealt with students' mathematical thinking and learning strategies, classified tasks, and analysed students' solution processes and problem-solving strategies. Furthermore, the teachers learned how to obtain information on students' processes of understanding by asking diagnostic questions. The teachers of the control group participated in a two-hour workshop on problem-solving instruction in mathematics only. In this workshop no discussions on how students solve mathematical problems took place. Furthermore, no framework was provided to the teachers on how they could gain information on students' concepts. At the end of the training the teachers in the experimental group were better able to predict the strategies their students would use to solve a problem than the teachers in the control group. In addition, the teachers in the experimental group paid more attention to student responses than the

teachers of the control group. Moreover, the classes of teachers in the experimental group showed greater achievement gains on various measures than the classes of teachers in the control group.

For science, results of studies conducted by Möller *et al.* (2006), Penuel *et al.* (2007), and Fishman *et al.* (2003) also reveal that domain-specific and content-focused teacher training programmes can have an enhancing effect on students' subject-related understanding. Möller and colleagues (2006) investigated the extent to which teacher training on the topic floating and sinking influenced the development of teaching-related beliefs of teachers and students' performance. The results indicate that the teachers of the trained experimental group showed a better understanding of teaching and learning processes in terms of a conceptual change and with regard to the relevance of students' preconceptions than the untrained teachers in the control group and those in a group who dealt with the topic in form of a self-study. Furthermore, the students' achievement gains during the following teaching unit could be predicted by teachers' conceptions of 'teaching and learning as conceptual change' and 'relevance of preconceptions' (Kleickmann, Hardy, Jonen, Blumberg & Möller, 2007).

Studies also have been conducted on the effects of teacher training programmes on students' language competencies. Most of the analyses focused on students' achievement in reading and writing in their first languages; very few focused on the effects of teacher training programmes on students' foreign language learning outcomes.

McCutchen *et al.* (2002) showed that a two-week teacher training programme on phonological awareness as a prerequisite for literacy development had positive effects on the pedagogical content knowledge and instructional practices of teachers in reading lessons. In addition, the programme had a positive effect on the prerequisite competencies and reading performance of preschoolers and first grade students.

The Literacy Professional Development Project from New Zealand aims to promote students' performance in reading and writing and to reduce the gap in achievement between weaker and stronger students. The project is based on effective literacy practice research as well as on teaching quality research. The two-year long programme was designed to develop teachers' content knowledge and pedagogical content knowledge in order to enable them to assess students' learning processes, their concepts, needs, and difficulties in reading and writing. In this respect, the project emphasises the link between teaching practices and the assessment of students' learning processes in reading and writing. For example, the participants were encouraged to interview students and to analyse students' achievement data in order to get information about students' understanding. The findings show that students of the participating schools exhibited significantly better learning progress in reading and writing than students in a norm sample. The weaker students in particular showed high achievement gains (Parr, Timperley, Reddish, Jesson & Adams, 2007).

Timperley and colleagues (2007, xlv) point out that many of the training programmes proven to be effective enhance both knowledge of assessment and pedagogical content knowledge:

All the studies showing substantive outcomes for students systematically developed teachers' pedagogical content knowledge and approximately 50% developed their knowledge of assessment.

The research results presented in this section indicate the importance of subject-related learning opportunities in the context of professionalisation, which is also known from the first phase of teacher education at university (Blömeke, Suhl & Döhrmann, 2012).

## 2.5. *Allowing teachers to experience the impact of their pedagogical actions*

Providing teachers with the opportunity to analyse and interpret students' understanding and learning processes during training, allows them to become more aware of the link between their beliefs, their teaching practices and students' learning. Teachers' professionalism depends on their ability to recognise and evaluate the effects of their instructional and pedagogical actions on students:

My role, as a teacher, is to evaluate the effect I have on my students. It is to 'know thy impact', it is to understand this impact, and it is to act on this knowing and understanding (Hattie, 2012, p. 19).

During a teacher training programme in Hesse, Germany, on how to enhance the narrative writing skills of primary school children, teachers experienced how minor changes to their questioning techniques influenced students' responses. The facilitator presented to the participants a video sequence of students reacting to different questioning techniques of a teacher. When students were encouraged to put themselves in the shoes of children presented in a picture on the blackboard (e.g. "In this picture, who do I want to be? What do I experience? How did it happen?"), they provided more elaborate responses compared to the answers in response to the very general question to tell a story about the picture. The participants of the workshop also received a transcript of the students' responses to corroborate the effects of questioning techniques on students' responses. Following the training session the participants taught the same lesson unit with different questioning techniques in their own classrooms and made similar experiences to the teacher shown in the video. In the next meeting with the facilitator they summarised their experiences: *I was surprised how small changes of impulses or steps can change a lesson completely. This was very interesting*

for me. Another teacher said: *I understand how important a precise plan is and how thus one can enhance the lesson* (Lipowsky, Rzejak & Dorst, 2011). As shown in this example, providing teachers with the opportunity to experience how changes to their instructional actions lead to noticeable differences in students' responses should have positive effects on teachers' experience of competence and efficacy. According to Ryan and Deci's (2002) self-determination theory, experiencing competence and efficacy should result in greater intrinsic motivation to apply knowledge gained from a professional development programme in daily practices and lead to sustainable change in teachers' actions.

While experiencing how changes to their pedagogical practices lead to changes in students' behaviour affects teachers' motivation, it also should influence change in teachers' beliefs and attitudes (Guskey, 1985; Loucks-Horsley, Stiles, Mundry, Love & Hewson, 2010; Lipowsky *et al.*, 2011). Timperley and colleagues suggest that allowing teachers to experience the outcomes of their actions is a key feature of effective professional development programmes:

It is reasonable to expect that new teaching practices will be reinforced when teachers observe that they are having a positive impact on student outcomes. Such reinforcement can only occur, however, when teachers have the assessment tools with which to see these changes in student outcomes, and when they have come to value them (Timperley *et al.*, 2007, p. 81).

Because teachers do not necessarily perceive the impact of their pedagogical actions, they could benefit from trainer support and assessment tools. Therefore teacher training should have a specific and narrow focus and turn teachers' attention to students' subject-related processes of understanding and learning (see paragraph 2.4).

## 2.6. Providing feedback to teachers

Feedback can help teachers perceive changes in their pedagogical actions and in students' learning. Furthermore, it can help teachers become aware that their competencies increase. The feedback can be given by the instructor or facilitator to teachers on their students' learning progress (e.g., by providing student data to the teachers) or on their pedagogical practices. In some professional development programmes proven to be effective a feedback component is provided systematically. In the Literacy Professional Development Project (Parr *et al.*, 2007) (see paragraph 2.4) information was given to teachers on their students' learning progress in reading or writing. This information was analysed and interpreted with experts and action plans for future lessons were developed together.

Data on students' levels of performance were also regularly reported to teachers in an in-school programme to improve the literacy of primary school students conducted by the American Center for the Improvement of Early Reading Achievement (CIERA; Taylor *et al.*, 2005). In addition to receiving and analysing feedback on students' learning progress, this programme included processing and discussing current research results (e.g., on the promotion of reading) and reflecting on one's own and others' videotaped lessons. Grade-based and inter-grade study groups as well as professional learning communities consisting of teachers, the headmaster, and one external moderator were established at the participating schools. In this study the students' learning progress in reading comprehension as well as in reading fluency could be predicted by the work efforts of the teachers and study groups.

Results from qualitative studies by Jinkins (2001), Schorr (2000), and Strahan (2003) support the assumption that collecting and analysing documents from and data on students has a potentially positive effect on teachers' actions and students' learn-

ing. A precondition for positive effects of feedback using data of students seems to be that teachers receive the students data immediately and that they are supported in the analysis and interpretation of the data provided (Groß Ophoff, Koch, Hosenfeld & Kuper, 2006; Schneewind, 2007).

In another kind of professional development programmes, feedback from a coach or mentor was given to teachers. In a study conducted in Switzerland, science teachers acquired knowledge of theories, models, and definitions of adaptive teacher competence during a two-day training programme (Beck *et al.*, 2008). Afterwards, the teachers were observed by a coach during approximately nine lessons and received a domain-specific pedagogical coaching. The teachers in the control group participated in self-chosen teacher training programmes during the intervention period. The results indicate that there was a greater effect of the intervention on the adaptive planning competence of the trained teachers than on that of the control group teachers; however, there was no effect on their adaptive implementation competence (Vogt & Rogalla, 2009). Additionally the progress of students' performance was investigated in science. Only secondary school students whose teachers took part in the intervention exhibited a significant improvement in their performance. However, in primary school there was no difference in progress between the students whose teachers were in the intervention group and those whose teachers were in the control group (Beck *et al.*, 2008). Even though this study had a couple of limitations (e.g. not all the relevant preconditions of teachers were controlled for and the effects on student outcomes were not examined in multilevel analyses), the majority of studies focusing on feedback by coaches indicate positive effects of coaching on teachers' knowledge and actions in the classroom (Domitrovich *et al.*, 2009; Garet *et al.*, 2008; Neuman & Cunningham, 2009).

Tschannen-Moran and McMaster (2009) compared four types of teacher training

programmes on how to implement a new teaching strategy for beginning readers. The first type, training A, provided input only. The second type, training B, combined input with a demonstration phase. The third type, training C, included in addition to input and demonstration a 90-minute practice phase that focused on how to plan corresponding actions in class. The fourth type, training D, included a coaching component in which teachers were joined by a coach in class and received feedback as well as concrete suggestions for improvement. The teachers who participated in training D developed higher self-efficacy expectations with regard to reading instruction than teachers in training B or C. Although training D was the only one that included a coaching component, the positive effects of the training could not be attributed solely to the coaching because features other than coaching differed among all the training types.

Using a 2x2 design Landry *et al.* (2009) conducted an experimental study in which they investigated the effects of *mentoring* (yes vs. no) and *giving feedback to teachers on students' progress* (detailed information vs. limited information) during a one-year professional development programme. One group of teachers received in-class mentoring as well as detailed feedback on their students' learning progress. A second group of teachers received detailed information on their students' learning progress only. A third group of teachers received mentoring and limited feedback on their students' learning progress. A fourth group of teachers received limited feedback on their students' learning progress only. All four intervention groups participated in an online seminar on reading skills that provided evidence-based information on the promotion of literacy and language skills. A fifth group received no intervention and served as control group. The sample included 262 teachers from four different American states who were assigned randomly to the five groups. The teachers' classroom behaviour and pre-schoolers' language abilities were

analysed as dependent variables. The results indicated that the teachers in the first group who had been coached *and* had received detailed feedback on students' learning progress improved their teaching practices more than the teachers in the other groups. Similar results were found for students' progress: The students of teachers who had received a combination of mentoring *and* detailed feedback on students' learning progress developed better language comprehension skills, more advanced phonological awareness, and more letter knowledge than preschoolers in the control group (Landry *et al.*, 2009).

## 2.7. Cooperation within professional learning communities

A rather limited amount of research has been conducted on the effects of professional learning communities (Lomos, Hofman & Bosker, 2011; Vescio, Ross & Adams, 2008). Professional learning communities are teams of teachers who continuously and intensively discuss and reflect on teaching practices, the curriculum, and learning processes of students. Members of such communities do not consider teaching a private matter; they appreciate their colleagues' visiting their classrooms and providing feedback through which they hope to enhance their teaching skills. Furthermore, members share a fundamental understanding of issues related to teaching and learning and their cooperation efforts place students' learning at the fore (DuFour, 2004; Kruse, Louis & Bryk, 1995; Stoll, Bolam, McMahon, Wallace & Thomas, 2006).

In theoretical approaches to situated learning (Lave & Wenger, 1991) co-constructive exchange is paramount to acquiring action-related competences, coping with problems, and reflecting on everyday teaching practices (Berkemeyer, Järvinen, Otto & Bos, 2011; Bonsen & Rolff, 2006; Fussangel, 2008). For example, in the Japanese lesson studies (see paragraph 2.2) teachers apply a particularly intensive form of collaboration. Large transfer programmes conducted in

Germany and in Austria (e.g., SINUS-Transfer, Chemie im Kontext, Biologie im Kontext, IMST) count beside other methods specifically on working in professional learning communities. In these programmes teachers exhibited somewhat deeper reflection processes and some changes in their instructional practices and students' motivation increased and their performance improved (Demuth *et al.*, 2005; Gräsel *et al.*, 2006; Krainer, Hanfstingl & Zehetmeier, 2009; Lücken & Elster, 2010; Prenzel, Carstensen, Senkbeil, Ostermeier & Seidel, 2005). However, due to the heterogeneity of the programmes, these effects cannot be attributed clearly to the work of professional learning communities.

In a study conducted in the United Kingdom by Bolam, McMahon, Stoll, Thomas, and Wallace (2005) evidence of the positive effects of professional learning communities on student achievement was found. This study was one of five of professional learning communities in the United States of America, the United Kingdom and the Netherlands which was analysed in a meta-analysis by Lomos, Hofman, and Bosker (2011). In all of these five studies Lomos and colleagues (2011) found a weak positive effect of  $d = 0.25$  of professional learning communities on student learning in secondary school. Thereby the effect sizes in these five studies were distributed quite widely (from  $d = 0.22$  to  $d = 0.56$ ).

Timperley (2008) points out an apparent contradiction between the theoretical relevance on participating in such communities and the research findings revealing often weak effects of professional learning communities on student outcomes.

The resolution of this apparent contradiction appears to be that if teachers are to change, they need to participate in a professional learning community *that is focused on becoming responsive to students*, because such a community gives teachers opportunities to process new information while helping them keep their eyes on the goal (Timperley, 2008, p. 19).

A frequent criticism of professional learning communities and site-based professional development programmes is the lack of external expertise and perspectives. The view of an external expert can encourage schools and their staff members to focus on relevant determinants of learning and prevent them from adhering to previous ineffective perspectives on teaching and learning (Corcoran, Fuhrman & Belcher, 2001; Guskey, 2003; Guskey & Yoon, 2009; Little, 2002, 2003). External expertise and support can also be relevant because sustainable changes of school and teaching practices are often exhausting and sometimes full of conflicts. A review of the effectiveness of teacher collaboration by Cordingley, Bell, Evans, and Firth (2005) revealed that involving external experts in site-based professional development programmes had a positive effect on the attitudes, beliefs, and classroom behaviour of the teachers and on students' learning.

### 3. Conclusion and outlook

The key features of effective professional development for teachers presented in this paper point to the importance of including external expertise and considering current international research results for designing professional development programmes. Although the results of this literature review give reasons to be optimistic about the outcomes of teacher training, many questions need to be addressed and aspects clarified in future research.

- Most of the teacher training programmes mentioned in this review are complex and consist of several components. Thus it is often not possible to identify the single features responsible for the effectiveness of a positively evaluated training programme. Therefore studies are needed in which single components are varied systematically and their impact tested.
- In some of the studies reviewed it was unclear whether the concept of a profes-

sional development programme had been implemented in the intended way because treatment checks, which are complex and not very common in this field of research, had not been conducted.

- In several of the teacher training programmes reviewed, lessons had been video recorded and used as reflection tools. Using video sequences is considered an effective way to examine and reflect on teaching practices and to aid in changing teaching-related beliefs and attitudes (Borko, Jacobs, Eiteljorg & Pittman, 2008; Krammer & Reusser, 2005; van Es & Sherin, 2008). However, investigation into various methods of using videos of teaching practices and into their effects on teachers' perceptions, analytic abilities, pedagogical content knowledge, and teaching behaviour is just emerging (Blomberg, Renkl, Gamoran Sherin, Borko & Seidel, 2013).
- The depth and quality of teachers' processing operations and content-related examination also seems to be important for teachers' development of competencies. Evidence of this is provided in a study of prospective teachers during teacher induction classes which showed that a change in teachers' beliefs could be predicted by the depth of content-related processing (Decker, Kunter & Voss, 2015).
- Two questions that are closely related and have not yet been answered on the basis of empirical research are whether it is more effective to include whole colleges in professional development programmes or instead individual teachers and whether the participation should be compulsory or voluntary. With reference to the first question it should be noted that the target group of professional development programs is not necessarily the whole college of the school but subgroups of teachers teaching the same subject. From this point of view it could be more promising to bring teachers of the same subject from different schools together.

With reference to the second question it can be assumed that teachers participating voluntarily in training, initially might be more motivated and satisfied. However there is (still) no evidence that optional participation leads to greater change in teachers' professional knowledge or instructional quality.

- Moreover, teachers' motivation *during* the professional development – e.g. to acquire and apply newly gained knowledge, their openness to try new approaches, and perception of the relevance of the training – may be more important for implementing new approaches into classrooms than teachers' motivation *at the beginning* of the training (Timperley *et al.*, 2007). Different studies show a positive relationship between the intensive utilisation of learning opportunities by the teachers within professional development and the effectiveness of teacher trainings (e.g. Bolam *et al.*, 2005; Bömer, Kunter & Hertel, 2011; Collet, 2009; Gräsel *et al.*, 2006; McCutchen *et al.*, 2002; Taylor *et al.*, 2005; Wackermann, 2008).
- It can be assumed that cognition, volition, and motivation of teachers participating in professional development programmes influence the extent to which teachers benefit from the training (see paragraph 1.2). The research on the influence of participants' individual characteristics on their learning outcomes is still in its early stages. In particular, studies are needed in which the interplay of participants' individual characteristics, their use of learning opportunities, their school context and features of the training on the four levels mentioned above (see paragraph 1.1) is investigated (Opfer, Pedder & Lavicza, 2011). However, in order to investigate this interplay the requirements on sample size and study design are demanding.
- Although the presented research results highlight that the trainers and facilitators must meet great demands, their role in the effectiveness of professional development has been studied insufficiently. Results of the few available studies indicate that

facilitators can have great influence on the success of training (McDowall *et al.*, 2007).

In future studies the extent to which facilitators' knowledge, skills, attitudes, and beliefs, as well as their ability to motivate influence teachers' learning should be investigated. For example it can be assumed that facilitators' knowledge and communication skills play an important role for making the content of professional development meaningful and relevant to the teachers' practice (Timperley *et al.*, 2007).

Research gaps can also be identified with regard to the criteria of effectiveness:

- The effects of teacher training programmes on the affective-motivational development of students of participating teachers are investigated far less than the effects of teacher training on students' achievement. The few results of these studies suggest that the effects of teacher training programmes on students' motivation are rather small (Fischer, 2006; Kiemer, Gröschner, Pehmer & Seidel, 2015; Otto, 2007; Stipek, Givvin, Salmon & MacGyvers, 1998). This could be due to the fact that variables such as teacher competence or teaching practices have a potentially high impact on the learners' cognitive variables, but only a weaker impact on their affective-motivational development.
- Theoretically, the effectiveness of teacher training programmes could be measured by organisational development of participating schools. However, there is little empirical evidence of the effects of professional development on the whole teaching staff and the whole student body of one school. Studies in which the impact of professional learning communities (see paragraph 2.7) can be drawn upon to address this question. Results from these few studies indicate small effects but the pathways of effects should be indirect and complex.

In summary, results from several international evidence-based studies have indicated that training for in-service teachers can have positive effects on the development of teachers' professionalisation and on students' learning outcomes. Despite increasing research efforts over the past several years many questions still need to be addressed to be able to offer teachers a wide selection of high-quality professional development programmes that will meet their individual interests, needs, and goals.

In future reviews and meta-analyses it appears worthwhile to make further differentiations. For instance, studies on teacher trainings for different subjects and domains (e.g. mathematics, reading, writing, science) should be analysed separately. Furthermore a differentiation according to dependent variables and thus to different levels of a training success (level 2: Learning of teachers: attitudes, beliefs, knowledge and motivation of teachers; level 3: teaching actions; level 4: learning of students) could be useful.

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