Combining Different Ways of Learning and Teaching in a Dynamic Model of Educational Effectiveness

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Abstract

In educational effectiveness research evidence is provided for the importance of the learning level. This has resulted in an interest in theory, research and practice for models on effective instruction. In improvement projects these models turn out to be effective. However, the models are criticised for not paying sufficient attention to higher order knowledge and skills and new ways of learning and teaching and more constructivist ways of learning and teaching are advocated, stressing the active involvement and responsibility of the student for his or her own learning processes and outcomes.

In research and improvement projects more active, independent ways of learning and teaching turn out to be successful under specified conditions. In a proposed Dynamic Model of Educational Effectiveness a combination of different ways of learning and teaching related to the context, input and process is proposed. Suggestions will be given for the positive uses of the dynamic model for improving educational practice.

1. The learning level

In educational research there is already a long tradition of research into teacher effects. The major contribution of Gage (1963) was that he stressed the fact that the characteristics of teachers and teaching activities (or teaching behaviour) should be related to the effects on students. Gage's statement was the start of a vast amount of research on the effects of teaching reviewed and

summarised by amongst others Rosenshine (1976) and Brophy and Good (1986). This resulted in a list of teacher behaviours that were positively related consistently over time with student achievement. Brophy and Good (1986) mention the following list of teacher behaviours:

- Quantity and pacing of instruction
- Whole class/small group instruction
- Structuring of information
- Questioning of students
- Reacting to students' responses; and
- Handling seat work and homework assignments

Combining the findings on time, content covered, work groupings, teacher questions, student responses and teacher feedback Rosenshine indicated a general pattern of results that he labelled the Direct Instruction Model, sometimes called a Structured Approach. A slightly different model is called Active Teaching with more emphasis put on involvement of students in the learning and teaching process. There is also in active teaching a great deal of teacher talk, but most of it is academic rather than procedural or managerial and much of it involves 'asking questions' and 'giving feedback' other than extended lecturing (Brophy and Good, 1986:361). In research and teaching there was gradually less interest in teacher behaviour and the effect of teacher and instructional behaviour in favour of teacher cognition and teacher thinking. Within educational effectiveness research initially attention was directed to the effects of schools, however after the introduction of methods for multilevel analysis and a theoretical orientation of educational effectiveness research more emphasis was put on the learning c.q. instructional level.

This is illustrated in the *International Handbook of School Effectiveness Research* (Teddlie and Reynolds, 2000). School effectiveness research was concentrated at the school, definitely at the beginning after the Brookover et al. (1979) and Rutter et al. (1979) studies with all characteristics and factors related to effectiveness located at the school level. Later on these studies were criticised from an empirical, methodological and theoretical point of view. It turned out that more factors, which were originally located at the school level, in fact, were situated at the classroom level where teaching and learning take place.

Theoretically it might be expected that student outcomes i.e. student results in school subjects are related to learning activities which take place mostly at the learning (and instructional) level. This resulted within school effectiveness research in a re-orientation, empirically and theoretically, on the processes taking place at the teaching/learning level. It is advocated that the current research on effectiveness should at least include, next to the student level, a classroom and school level

separately (Creemers & Reezigt, 1996). The variance at the school level might also have been reduced by other levels intermediate between the learning and school level.

Larger schools, for example in secondary and tertiary education, consist of departments or faculties. A major part of the educational organisation is transferred from the school to the departmental level with department heads and other middle managers in charge of the provision of conditions for instruction at the learning (teaching) level. In this case variance in student outcomes originally 'located' at the school level is explained by (effective) factors at the departmental level (Thomas, Sammons & Mortimore, 1994; Harris, Jamieson & Russ, 1997; Leask & Terrell, 1997). To complete the criticism on a school-focussed effectiveness: levels above the school – district, national level – can provide conditions for the effectiveness of schools and classrooms. Therefore it was advocated in several publications (Creemers, 1994; Goldstein & Woodhouse, 2000) to replace the term 'school effectiveness' with 'educational effectiveness'. Even more important than the term in itself, it is important to recognise that within school effectiveness or educational effectiveness, factors at the classroom level or in fact the teaching learning level, related to learning processes and learning outcomes are the prime factors. This brings back in educational effectiveness the research and results of teacher effectiveness.

When a better foundation was sought for educational effectiveness research, this resulted also in an orientation on theories about learning in schools. These theories were seen as a possible bridge between learning outcomes, which are used as criteria for effectiveness, and processes at the classroom and school level. It can be questioned however, whether the models used in educational effectiveness research such as the model developed by Carroll (1963) were empirically valid enough to be used as the foundation for a theory about educational effectiveness or as a point of departure for empirical research, indicating the most important concepts at the process, input and context level.

Walberg (1986) states that although the theories about learning yield some good ideas, they are not sufficiently supported empirically.

A favourite model within educational effectiveness was Carroll's model for learning in schools (Carroll, 1963). It was popular because it related individual student characteristics important for learning to characteristics of education important to instruction. Above that, Carroll indicated as important concepts for learning in schools: time, quantity and quality of instruction. They were also important characteristics for school effectiveness as found in earlier school effectiveness research.

The concepts of time/opportunity, and quality are rather vague and can become more concrete by other characteristics of effective instruction related to effective learning c.q. learning outcomes.

The Carroll model states that the degree of student mastery is a function of the ratio of the amount of time spent on learning tasks to the total amount of time they need. Time actually spent on learning is defined as equal to the smallest of three variables: 1) Opportunity (time allowed for learning), 2) Perseverance (the amount of time in which students are willing to engage actively in learning and 3) Aptitude (the amount of time needed to learn, in the optimal instructional conditions). This last time is possibly increased because of the poor quality of instruction and the lack of ability to understand less than optimal instruction (Carroll, 1963:730). The Carroll model can be criticised for being more an instructional than a teaching model, in fact it does not provide information about how learning itself takes place, only that learning takes time and depends on multiple-level interrelated factors. On the other hand the general framework provides possibilities for elaborating on the different components. The relationship between time, perseverance, aptitude and quality of the instruction was further elaborated by Bloom, using Carroll's model to develop mastery learning. Because of the elaboration Bloom provided within a broadly instructional framework (although some writings of Carroll make clear that he thinks that this is a rather technical and mechanical elaboration of his original intentions) the influence of this learning theory on educational practice was substantial. A consistent line of reasoning was developed in models and theories of educational effectiveness between learning outcomes and learning theories resulting in instructional processes at a classroom level and school and contextual conditions for the quality of the instructional level (see Creemers, 1994; Slavin, 1996; Scheerens, 1993; Slater & Teddlie, 1992).

These conceptual frameworks for educational effectiveness, especially the part relating to instructional and learning processes at the classroom level, received support from the results of empirical research. Factors discerned within the instructional process related to those theories about learning in schools got support from individual studies although the picture was not always the same. Some factors related to structuring were supported by one study but not in the other, however, evaluation and feedback got support in the majority of studies. Also the reviews of research on effectiveness at the classroom level and school/educational effectiveness studies in general support the structural processes related to theories which put emphasis on a mainly reproductive style of learning (see for example Scheerens, 1992; Creemers, 1994; Sammons, 1995; Teddlie & Reynolds, 2000; Fraser et al., 1987).

2. ‘New’ learning and teaching

2.1 Beyond language and mathematics

The emphasis in educational effectiveness on mathematics and language as criteria for educational effectiveness resulted in a prime interest in theories about learning which stress the reproduction of knowledge. Although it was mentioned frequently that educational effectiveness could have different criteria for effectiveness such as higher order knowledge and skills, meta-cognition or outcomes in other domains like student well-being and social skills in the end it was mostly about learning an (reproductive) learning results/outcomes in the areas of mathematics and reading. And in fact, as becomes evident from educational policy outcomes, basic skills such as reading, writing, mathematics and science are important as an active citizen in society and to contribute to the socio-economic development.

In society, the importance of these basic competencies is underlined. Next to this knowledge and skills and probably based upon them other competencies are seen as prerequisite for the participation in the society such as moral values and social skills.

Within the cognitive domains higher order knowledge and skills such as the application, evaluation and synthesis of knowledge are expected to be pursued by educative results in problem solving and ‘creative thinking’ skills. Finally it is expected that formal education will ‘create’ life-long learning. For that purpose, learning to learn and self-regulated and self-responsible learning are important.

The final decision about the objectives of education – and thus for the criteria for educational effectiveness (and quality in general) is taken by the educational policy as the result of a political and societal debate (Creemers, 1996). Educational theory and research and the profession in general can contribute to the debate and decision making in addressing questions such as:

- What can be achieved by students and discerned according to their ability
- How much can be done within the limitations of time and other tasks that have to be performed by the school.
- How do learning processes take place in these domains
- How can teaching and instruction be provided for these educational objectives?

Research indicates that for higher order cognitive outcomes and for independent learning and meta-cognition another view is needed on learning and instruction. This approach takes a different point of departure for than is available in the current knowledge base in educational

effectiveness especially at the instructional level. In the following sections, descriptions will be given of new ways of learning and teaching, then we will discuss the possibilities of a combination between the traditional ways of learning and teaching with more constructivist approaches in order to address educational objectives in general, but especially higher order goals and ways of independent learning.

2.2 A 'new' view on learning

With the recognition that behaviourism appealed in providing an adequate explanation of human cognition, cognitive psychology came up in the early sixties. It was based however on the early work of, amongst others, Vigotski, Piaget and the Wurzberger Schule and Gestalt psychology. Contrary to behaviourism, the student reacts to external circumstances with concrete behaviour, these theories were especially interested in cognitive processes and later on in mental representation and knowledge structures. Cognitive psychology paid special attention to these three main issues:

- The complex strategies for processing information. In this field the attention was focused on research in problem solving, especially on the difference between expert and novice problem solvers.
- Meta-cognition, especially the knowledge concerning one's own cognitive processes or products, and the skills to transform this knowledge in skills needed for fine-tuning the cognitive processes.
- Learners have already acquired some knowledge before they start with new tasks and this initial knowledge structure is the foundation for further knowledge and learning. This knowledge basis will expand over a long period of learning and experience.

In the further development of the cognitive psychology new ideas came up, most of them stressing special features of cognitive psychology, such as constructivism which puts emphasis on the fact that human learning is active and constructive, situated cognition in which the emphasis is placed on the contextual character of human cognition. Constructivism and self-regulation of learning processes put emphasis on the responsibility of the learner for his own learning processes (Boekaerts, 1999).

Different terms are used for describing new ideas such as constructivism, self-regulated learning; they have in common the following characteristics with respect to learning (De Corte, 1996; De Corte & Greer, 1996).

In order to learn, which means to change from a novice to an expert in a specific domain, students have to acquire a *learning disposition* that integrates the following elements (Perkins, 1991; Verschaffel & De Corte, 1998):

- A domain specific knowledge base (knowledge about facts, symbols, conventions, definitions, formulas, concepts, rules etc. that constitute the contents of a domain such as math or reading),
- Cognitive strategies, such as heuristics (systematic searching strategies, for example splitting a problem into sub-problems) and learning strategies (such as repeating subject matter, making a summary)
- Meta-cognitive skills (skills that are needed for the self-regulative planning, monitoring and evaluating of learning processes)
- Affective aspects (such as attitude towards a school subject)

2.3 New ways of teaching

According to Verschaffel & De Corte (1998), the first thing that teachers must be aware of when they try to teach along lines of constructivism is the expansion of the *goals of instruction*. Teaching aims at the development of a learning disposition instead of the transfer of knowledge. Knowledge is not the only goal of education, but strategies, meta-cognitive skills and affective aspects are important goals as well.

As a consequence, the *contents of school subjects and the materials that teachers use* must be expanded as well. Curricula for example must enable teachers to achieve the new goals and adequate tests or other diagnostic procedures must enable them to monitor the development of students. They should encompass all four elements of the learning disposition, preferably elaborated in a domain specific as well as in a cross-curricular way in order to achieve transfer of specific skills to a wider area of learning. Constructivism therefore forces teachers not only to expand their goals, but the scope of their subject content and their materials as well.

Teachers who want to practice constructivism must also be aware of changing requirements for the *classroom organisation*. Traditional teaching is often performed by the teacher in front of the class while the students sit in rows next to, and behind each other. This type of organisation is appropriate when all students are supposed to listen to the teacher and when they are not supposed to interact with each other. Constructivism however requires quite different settings, because of the emphasis on student interactions and interactions between the teacher and the students (see also below).

In recent years, constructivist authors have developed a set of *instructional techniques* that are supposed to enhance the learning disposition of students. These techniques include the following (Collins et al., 1989; Choi & Hannafin, 1995; Verschaffel & De Corte, 1998; Bolhuis and Kluvers, 1996; Von Glasersveld, 1998; Savery & Duffy, 1995):

- *Modelling:* modelling occurs when an expert (the teacher) carries out complex tasks and informs students about the processes that are required to accomplish these tasks. Modelling can refer to physical processes and to thought processes that underlie the actual performance.
- *Coaching:* refers to all the supportive actions that a teacher can use to raise the level of students. Coaching is meant to help students to solve problems or find their own ways to accomplish tasks, not to simply provide them with the correct answers or procedures. Examples of coaching are offering help, contingent feedback and modelling closely related to problems the students are dealing with.
- *Scaffolding and Fading:* these techniques refer to the provision of help that students need to carry out parts of tasks that they cannot yet master on their own. Scaffolding creates a match between the cognitive level of the student and the characteristics of instruction in such a way that the student achieves (with the assistance of the teacher or others) what he could not achieve on his own. Fading means that the assistance is gradually withdrawn as the self-regulative skills of students grow. Fading denotes the gradual transition from teacher regulated instruction to student regulated learning.
- *Articulation:* Articulation means that teachers invite students to articulate their ideas, problem solutions, suggestions and thought. In this way, tacit knowledge is made explicit. By means of articulation, teachers can find out what students know, and which skills they possess.
- *Reflection:* Reflection refers to the process of students comparing their solutions to the solutions offered by experts (the teacher or other students). Students are encouraged to test their ideas against alternative views and contexts.
- *Exploration:* By means of exploration, the teacher 'pushes' students in a variety of problem-solving activities.
- *Generalisation:* This technique decontextualises domain-specific knowledge and skills and aims at the transfer of these knowledge and skills to a higher non-specific level.
- *Collaboration:* From the perspective of learning as an interactive and co-operative process, teachers must create ample opportunities for students to interact with each other and with

their teacher. Activities such as classroom conversations and working in co-operative groups are examples of collaboration.

- *Provision of Anchors:* Anchors refer to the importance of prior knowledge of students. For successful learning, students need to relate new knowledge to anchors in their prior knowledge. Teachers must check whether these anchors are already present and if not, provide them.
- *Goal orientation and Situation:* The goals of learning must be clear for the students. Preferably students are stimulated to formulate their own goals, but if this is not possible, teachers should clarify the goals. In relation with this, tasks and problems that students perform must be authentic and situated in a meaningful context.

3. Research on 'new' learning and teaching

3.1 Introduction

Even after 20 years there is still a debate going on about the advantages and disadvantages of new learning and teaching as described in the previous section (see for example Van der Werf, 2005). The positive results of studies into new learning and teaching are criticised for several reasons such as:

- The intervention is provided by the researcher who is advocating new learning and teaching
- The intervention study is mostly a small scale study with few students
- The implementation of the intervention is not controlled
- The intervention is not compared with other modes of instruction

In recent years however, studies are carried out which meet the standards for research. In the following, two studies will be summarised. The studies indicate that some elements of new learning and teaching promoting active involvement such as problem solving and a self regulated learning (meta-cognition) can contribute to educational outcomes, especially in combination with more traditional evidence based instructional methods. The studies presented implement instruction carefully in schools and classrooms because as becomes clear from studies presented in section 3.4, teachers face problems in the implementation of new ways of teaching with/without a combination with more traditional ways of teaching such as direct or active teaching.

3.2 A comparison between direct (interactive) and constructivist instruction

In the previous sections, two didactic approaches were presented, direct instruction and the constructive approach for teaching. Direct instruction is based on the research evidence related to effective teaching combining components of teacher behaviour, which have shown to be effective with respect to learning outcomes. In direct teaching different teacher activities are placed in a certain logical and didactical order. The approach as such has received quite a lot of empirical support. The constructivist approaches in teaching depart from a different view on how learning takes place. Knowledge and skills are not learned through instruction in which the knowledge and skills are delivered by teachers and mastered by students, but constructed by students themselves during the learning process. The constructive approach to teaching has also received empirical support, although to a lesser extent. It should be mentioned that most of the – small – research studies were carried out in short-term experimental situations where the researchers fairly often act as teachers themselves.

It seems that both approaches stem from different backgrounds, the constructivist approach from research on learning and the direct instruction approach from research on teaching. Perhaps they also have different objectives in mind, namely consolidated knowledge and development of abilities and skills. Therefore, the two are often presented as opposites.

A possible way of research which is productive in finding out the strengths and weaknesses of two approaches is to compare traditional ways of teaching related to student achievement in the basic school subjects and related to, for example, meta-cognitive skills. Secondary analysis of data collected in 1993 came to the conclusion that traditional effectiveness characteristics are important for the development of meta-cognitive skills and this is seen to be even more important for these skills than the characteristics of new instructional models although these were especially designed for the development of meta-cognitive skills (Creemers, Reezigt, Van der Werf & Hoeben, 1997). This created the starting point for experimental study in which two didactic approaches are compared with respect to the implementation by teachers and the achievements of students (De Jager, 2002).

The direct instruction model was chosen as the more traditional model. There is substantial empirical evidence that teachers can use this model in a regular classroom setting. Furthermore, the direct instruction model proved to have a positive effect on achievement in basic skills. The

cognitive apprenticeship model (Collins, Brown & Newman, 1989) was selected as instructional model that takes new ideas new about learning and instruction into account. The cognitive apprenticeship model focuses on the active involvement of pupils and on the development of meta-cognitive skills. This model combines effective elements of instruction-psychological models such as reciprocal teaching, procedural facilitation and modelling. However, this model has hardly been studied in regular classroom settings. In this study, both the direct instruction model and the cognitive apprenticeship model were implemented in regular classroom settings. Furthermore, both models focused on the development of basic skills and meta-cognitive skills. The implementation and effectiveness of the two models were studied and compared. To make a clear comparison, a quasi experiment was developed in which one group of teachers learned to implement the direct instruction model, and another group was trained to apply characteristics of the cognitive apprenticeship model. A control group of teachers was not trained. The implementation of the two models was studied as well as the effects on the achievement of pupils in basic skills and meta-cognition.

The highest effect sizes are found with respect to meta-cognition. With respect to meta-cognitive skills, both experimental groups show a high effect size. The pupils in both experimental groups score about one standard deviation higher than the pupils in the control group. The effect size of meta-cognitive knowledge is in both groups .38. The remaining significant differences between the CA-group and control group show low to moderate effect sizes. The same counts for the effect sizes of the significant differences between the two experimental groups. On these output measures the CA-group scores between .28 and .54 standard deviation higher than the Direct Instruction group (DI-group). In a further study into effectiveness for pupils with different intelligence, cognitive apprenticeship appeared to be more effective for achievement in reading comprehension of high intelligent pupils, whereas direct instruction had more positive effects on the achievement of low intelligent pupils.

Only the effects on meta-cognitive skills could be attributed to specific characteristics of the two instructional models. The general characteristics preparatory discussion and attention for skills showed a positive effect. In addition, the CA-characteristic ‘modelling’ had a negative effect and ‘discovery learning’ a positive effect. We can conclude that in general the CA model is more effective than the DI model especially in the follow-up. The way the models were constructed and implemented is an argument for a well-structured approach to Cognitive Apprenticeship, actually Cognitive Apprenticeship was introduced in classrooms following the procedures of Direct Instruction. In this sense, the results confirm the basic principles of direct instruction as well.

3.3 Effective school improvement in mathematics (MIP)

Houtveen, Van der Grift & Creemers (2004) report about the result of a study to combine educational effectiveness and educational improvement.

We have sought to identify the key elements of a school improvement programme that facilitate effective teaching and to work out how each of these elements should be designed so that they operate effectively and in alignment with each of the other elements (Van Zoelen & Houtveen, 2000). This resulted in what we refer to as the MIP-programme design for effective school improvement. School design models are hardly used in the Netherlands, although they have become highly significant in the USA (Berends, Bodilly & Kirby, 2000; Herman, 1999; Stringfield, Ross & Smith, 1996), as well as in the Australian context (Hill & Crévola, 1999).

Several key elements refer to the quality of teaching. Some are more related to traditional instruction such as

- Giving high quality instruction (in this case: extended direct instruction)
- Optimising instruction time and
- Supporting self-confidence of students.

Key elements that are more related to 'new' learning and teaching are

- Self-regulated learning and
- Explorative learning environment.

The key elements are described as follows:

High quality instruction

The most important aspect of instructional quality is the degree to which the lesson makes sense to the pupils. This includes presenting information in an orderly way (Kallison, 1986), note transitions to new topics (Smith & Cotton, 1980), use clear and simple language (Land, 1987), use many vivid images and examples (Hiebert, Wearne & Taber, 1991; Mayer & Gallini, 1990), and frequently restate essential principles (Maddox & Hoole, 1975). Lessons should be related to pupils' background knowledge, using such devices as advanced organisers (Nunes & Bryant, 1996; Pressley et al., 1992), or simply reminding pupils of previously learned material at relevant points in the lesson. Use of media and other visual representations can also contribute to quality of instruction (Hiebert et al., 1991); Kozma, 1991).

Clear specification of lesson objectives to pupils (Melton, 1978) and a substantial cohesion between what is taught and what is assessed (Cooley & Leinhardt, 1980; Creemers, 1994) contribute to instructional quality, as does frequent formal or informal assessment to see that pupils are mastering what is being taught (Crooks, 1988; Kulik & Kulik, 1988) and immediate feedback to pupils on the correctness of their performances (Barringer & Gholson, 1979).

Instructional pace is also partly an issue of quality of instruction. Frequent assessment of pupil learning is critical for teachers to establish the most rapid instructional pace consistent with the preparedness and learning rate of all pupils. Furthermore, having a quick pace will stop pupils becoming disengaged and bored, and thus will help in keeping pupils actively engaged in learning (Muijs & Reynolds, 2000; Pressley, Goodchild, Fleet, Zachowski & Evans, 1989).

So, in short: teachers who explicitly model, scaffold, explain strategies, give corrective feedback and practice mastery, contribute highly to the academic success of their pupils. (See for meta-analyses of the research Carnine, Dixon & Silbert, 1998; Dixon, Carnine & Kameenui, 1992; Dixon, Carnine, Lee & Wallin, 1998; Ellis & Worthington, 1994; Good & Brophy, 1986; Rosenshine & Stevens, 1986; Slavin, 1996; Veenman, 1992).

Although most Dutch schools use methods based on realistic mathematics education, teaching practices did not change accordingly (Gravemeijer, 1990; Harskamp, 1988; Willemsen, 1994). Therefore in the MIP-programme the following domain-specific instruction principles are formulated: sound preparation of formal calculation; context-bound instruction; act; verbalise; use of models; focus on essential understanding and skills; and finally attending automation (especially for struggling learners) (Van de Vijver & Dijkstra, 1999).

Instruction time

In the theoretical models on learning at school (Bloom, 1976; Carroll, 1963; Harnishfeger & Wiley, 1978), instruction and its efficient use are considered important determinants for learning at school. The connection between time spending and results of pupils was established in a large number of empirical research projects (Carnine et al., 1998; Dixon et al., 1998; Scheerens & Bosker, 1997).

In the MIP-programme, optimal use of time in terms of classroom management as well as in terms of time spent on explicit instruction of skills and integration of skills is stressed.

Supporting self-confidence of students

The third aspect of optimising instruction stresses the relationship between learning and emotion. A certain amount of self-confidence turns out to be a prerequisite for learning. Self-

confidence is built upon the base of experienced successes. This implies that teachers have to provide experiences of success for all learners (Ellis & Worthington, 1994). For initially less successful students it is vital to give second chances to demonstrate success after corrective feedback (Guskey, 2003).

Self-regulated learning

Since learning is an active process of knowledge acquisition and construction, teachers should take measures that make it possible for pupils to adopt an active learning attitude and gradually pass on responsibility for the learning process to the pupils (Boekaerts, 2002; Ellis & Worthington, 1994).

Explorative learning environment

Heterogeneous grouping is not enough to help pupils at risk of school failure. Extended learning and instruction time for these pupils is necessary. In all cases, extension of instruction time for struggling learners demands a classroom organisation in which the remainder of the pupils are able to manage their own learning process. In the MIP-programme this classroom organisation is referred to as an explorative learning environment. Apart from organisational reasons, and explorative learning environment has a value in itself because it contributes to school success and the intrinsic motivation of pupils (Carver & Scheier, 2000; Ryan & Deci, 2000).

In the improvement project the elements are implemented in the experimental schools. This implementation was especially successful for the elements ‘direct instruction’ and ‘instruction time’.

Table 1 shows the differences between the experimental and comparison group school for the implementation features related to instruction.

Table 1 Implementation features for optimising instruction and supporting active learning in the experimental and comparison group schools in the school year the effect measures on the pupils took place

Number of teachers	Experimental group 14	Comparison group 15	St. dev.	Effect size
Optimising instruction				
Giving direct instruction	66.38	45.30	14.37	1.47
Optimising instruction time	71.05	54.75	12.92	1.26
Supporting self-confidence of pupils	77.55	74.49	10.69	0.27
Supporting active learning				
Supporting self-regulated learning	50.01	44.62	10.76	0.50
Creating an explorative learning environment	67.68	62.06	11.00	0.51

In the further analysis of the positive results of the project with respect to student outcomes it turned out that direct instruction, supporting self-confidence and creating an explorative learning environment contributed significantly to the explanation of the learning outcomes.
The results underline the importance of both elements from 'traditional' instructional approaches as well as 'new' ways of learning and teaching.

3.4. The implementation of 'new' teaching

The ultimate value of 'new' teaching for educational practice depends on the possibilities for actual implementation and the effects on different groups of students. Teachers must be able to succeed in the *implementation* of this type of teaching and the desired effects on students must be achieved, i.e. the development of a learning disposition (Sleegers, 2000). Because of the strong focus of constructivists on learning processes, as yet there is not much empirical evidence on implementation and effects in regular educational settings. A survey in Dutch secondary education (Bolhuis & Kluvers, 1996; Bolhuis, 1997) however shows that teachers find it hard to transfer responsibilities to students and to promote self-regulative learning. They also find it hard to tolerate mistakes and errors of students and to interpret these as starting points for further learning. They are persistently inclined to provide correct answers instead of stimulating students to find their own answers and solutions. In the content of their lessons they tend to focus strongly on knowledge and to forget the importance of strategies, skills and

affective aspects in the processes of learning. Moreover, they offer isolated knowledge instead of situated knowledge. Teachers do not provide ample opportunities for student co-operation. In general math teachers practice more elements of constructivist teaching than language teachers do or teachers of subjects like geography and history. Unfortunately, this survey did not study the actual effects of teaching practices on students.

Literature on the implementation of innovations consistently shows that teachers in general do not easily implement major innovations that expect a change in vision, materials and behaviour (Fullan, 1991). The implementation of constructivist teaching certainly can be considered a major innovation. Teachers have to change their vision about the goals that they try to achieve and the techniques they use to achieve these. Teachers will need new materials in order to cover the full range of goals united in the concept of a learning disposition. Finally and most importantly, teachers will have to change their regular teaching behaviour.

The implementation of innovations such as constructivism are likely to be influenced by the *culture of teaching* in a country. This culture is for example reflected in the initial teacher training and later professional training. Most of all, the culture will be reflected in the ideas that teachers form about their professions and the activities that they are required to perform from day to day. When the culture of teaching holds notions that strongly oppose the basic concepts of constructivism, it will be much harder for teachers to implement this new way of teaching.

Another concept that will strongly influence the implementation of constructivist teaching is the feeling of *efficacy* of teachers (Rosenholtz, 1989). Teachers with high self-efficacy will be more confident in the implementation of innovations, that are basically characterised by uncertainty. Rosenholtz (1998) found that receiving positive feedback on performance and collaborating with other teachers are among the most important sources of teacher efficacy. In general, mastery experiences are the most important determinant, but social persuasion (pep talk and general feedback) and vicarious experiences (i.e. modelling by peers) are important as well (Tschannen-Moran et al., 1998). Huberman and Miles (1984) have stressed the importance of support in the implementation process because of its vital importance for teachers' feelings of practice mastery. A close relationship between teacher efficacy and school improvement has been demonstrated empirically (Lander, 2000).

Finally, the implementation of new ways of teaching and learning will be influenced by the *training and support* offered to teachers. When teachers are enabled to get specific training for their new practices, in-service or otherwise, implementation will be enhanced. The same holds for support in the form of collegial coaching or feedback from external agents such as school counsellors or specialists from national resource centres (Reezigt, 2000). Training and support

in general should include the concepts described by Joyce and Showers (1980): theory, demonstration, practice, feedback and coaching. Also the *perception of teachers of the school conditions* will influence the implementation.

Constructivist theories in general do not pay very much attention to the consequences for teaching, but the consequences for the school organisation are even more absent. In an attempt to define some of the changes that constructivist teaching bring about in the school organisation, several authors (Scheerens, 1994; Scheerens & Bosker, 1997; Bolhuis & Kluvers, 1996) mention practical as well as more conceptual changes.

The practical changes include the following:

- Changes in the *time schedule*. So far, schools are used to a uniform time schedule that allocates a certain amount of time (measured in number of lessons, approximately one hour per lesson) to each school subject. When teaching procedures change, the schedule must be more flexible to allow for other formats than the one-hour lesson, for example when students need time for independent learning or problem solving activities.
- Changes in the *physical environment* of schools. So far, most schools provide a number of classrooms, a canteen, a library and so on. Most educational activities during the school day take place in the classroom setting. When teaching changes, the environment will have to change too. Students for example will need small quiet rooms for independent studying or group work.

The conceptual changes come about when main concepts of constructivism are extrapolated from the student to the teacher level. When teachers are seen as learning professionals and their learning processes are defined in a similar way as students' learning processes, the following changes are needed in the school:

- Changes in the *co-operation* between teachers. Constructivists should consider learning as a social and interactive process. For teachers to learn, they should co-operate and interact more than they are used to do now (see for example Finnish Board of Education, 1994). Joint reflection and discussions about the strengths and weaknesses of the current educational practice seem essential, also from the perspective of teacher efficacy. So far however, teaching in most schools is a rather isolated effort. Even within subject departments, co-operation and reflection cannot be taken for granted.
- Changes in the relation between teachers and the school direction. Constructivists focus on the teacher as a facilitator of learning processes and a coach. When teachers are seen

as learning professionals, the higher levels in the school such as the school directorate, is supposed to provide *facilitative leadership*. The school directorate for example should promote teacher training and development and peer coaching procedures. Strict hierarchical relations between the school level and the teachers do not seem to fit the main notions of constructivism.

Major innovations such as the introduction of constructivist teaching in schools will not succeed when the school organisation does not fit the new way of teaching. In general for innovations to succeed, the school should provide favourable conditions for the implementation and incorporation of new ways of teaching. When the school conditions hinder the innovation efforts of teachers, implementation will either not occur at all or fade out quickly. In addition, research in the field of school improvement has abundantly made clear that innovations will fail to yield any sustaining effects on students when they are not incorporated in the school organisation in some way or another (Teddlie & Reynolds, 2000). An essential condition, in addition to the conditions mentioned above is a *school culture* that favours change and that fits the basic idea of constructivism. In schools with such a culture, teachers will implement constructivism more easily. Another essential condition is the capacity of a school to *plan and manage* a process of change. High capacity schools for example have been shown to have cohesive staff and to use professional networks. Low-capacity schools lack a critical mass of teachers willing to or used to work like this.
In a survey of Dutch schools, Bolhuis & Kluvers (1996) found that schools do not easily change their time schedule, even when the innovations at hand in fact demand this. Teachers who try to implement constructivist ideas report that co-operation with colleagues is not obvious. Peer coaching and intercollegiate observations are still very rare. Also, teachers generally experience little support and facilitation from the school level.

4. The combination of different approaches to learning and teaching

4.1 Merging

In educational practice combinations of the two approaches can be found, as was the case in the experiment described in the previous section. In fact a more interactive learning (and instruction) in which students play an important role in the acquisition of knowledge and skills replace the original direct instruction approach with less attention for learners. Students are

actively involved in the learning and teaching processes. Also the social aspects of learning have received more attention by developing ways of co-operation between students and teachers within direct instruction. In the constructivist approach, elements of direct instruction are included for parts where knowledge and skills are required before more constructivist ways of learning can start and also in the way procedures for knowledge construction are presented. For example, modelling should take place in a well-structured way by the teachers.

Effective instruction can combine direct instruction elements especially those that are most directed towards active learning, as well as elements of constructivist instruction, especially where elements that foster the effectiveness of the constructivist approach are included. Although the two approaches remain different from one another, they are not opposites. The choice between the two approaches depends especially on the objectives pursued in education. For knowledge and skills, it seems that direct, active learning/teaching approaches can provide an effective and efficient way to achieve these objectives. With respect to higher order knowledge and skills with learning processes in which students are directly involved, and especially for meta-cognitive objectives more constructivist approaches seem most suitable.

The choice between the two approaches depends also on the characteristics of the learner, such as the age, the development of students and their abilities. More structured ways of teaching as included in direct and active instruction are more suitable for younger students in the earlier stages of learning and for more disadvantaged students who benefit from more structured ways of teaching. Self-regulation of learning, including the more constructivist approaches, is more appropriate for students with high abilities and in the later stages of learning (see for example Tynjälä, 1999). Finally the choice between the two approaches depends on the conditions and context of learning. A more constructivist learning environment requires teachers who can organise this ‘open’ learning situation and who are able to guide students’ learning. Furthermore, constructive ways of learning require a context-rich learning environment, with appropriate learning material available for students, which is not often the case (Hyerle, 1996). Materials and tools in the classroom but especially of textbooks are often not designed to elicit constructive ways of learning (De Jager, Reezigt & Creemers, forthcoming). In a programme of research concerning ‘structured independence’ (Scheerens & Creemers, 1999) these issues are pursued in more depth. The two traditions of educational effectiveness and constructivism are compared in order to determine the strengths and weaknesses of the two traditions.

One aspect of the attempt to integrate the traditions is a multilevel comprehensive mapping of the research domain, distinguishing levels of individual learners, groups of learners, teachers and school context (see figure 1, *Degree of structure in instructional technology conditional upon entrance conditions and goals*). Figure 1 uses the basic context-input –process-output framework common in educational effectiveness research to depict this comprehensive view. The basic framework consists of several continua reflecting technology and throughput. Pupil entrance conditions and teachers roles are input, while school organisation and management is seen as a contextual condition.

Figure 1 Degree of structure in instructional technology conditional upon conditions and goals (Scheerens & Creemers, 1999)

Context	**Input 'given' entrance conditions**	**Teacher repertoires (skills, attitudes, roles)**	**Technology** **Throughput**				**Aims (types of outcomes)**
School as professional Bureaucracy Instructional leadership	Low aptitudes	Teacher 'structurer'	*Instruction* direct	*Learning* reactive receptive	*Classroom organisation* whole class individual	*Tasks* highly structured	basic skills academic
School as adhocracy, learning organisation Facilitative leadership	High aptitudes	Facilitator	open	active productive discovery learning	groups	real life problem	Higher order processes 'real life' knowledge and social skills

This careful analysis of the two traditions related to input, context and output may result in guidelines for the choice between the two traditions based on the conditions for learning and expected outcomes. It might be that one of the two traditions is more appropriate for certain kinds of outcomes, given a particular set of conditions (with respect to the input and the context). There exist examples of this delineation between the two traditions as presented by Veenman (1992), Marzano, Pickering & Polk (2001), and Sharpe and Gopinatan (2001). Based on experience in educational practice and research results with examples of merging reflect the original position of the designers in Singapore (Sharpe & Gopinatan, 2001) the

more technical approach to this higher order outcomes and independent learning is designed (making use of elements of constructivist ways of teaching). It might be that constructivist ways of teaching and elements of it as described in earlier sections are more effective for higher order outcomes than a technical, structured approach to higher order cognitive processes. That means that also in merging the original questions with respect to the original strengths and weaknesses of the two approaches is still open an has to be answered.

A step further than making a choice between different didactical approaches according to criteria concerning the objectives students' background and the conditions within the classroom and the school, might be the combination of approaches within one comprehensive framework of effective instruction. Evidently this cannot be a definite blueprint for instruction that will always remain the same and should be followed by teachers and students in the same way all the time. Many instructional tools for teaching and learning can be used according to the objectives, input and the conditions/contexts of teaching and learning. The combination of approaches consists of process characteristics for instruction which turn out to be effective in relation to the ultimate goal of education, that is to make students independent learners and participants in society. This implies that elements of structuring are combined with the final goal of independent learning.

A special issue that has to be addressed in educational practice and research on new ways of learning and teaching is the changing role of the teacher. Instead of an instructor, he is a coach of learning processes because students themselves are also supposed to take responsibility for their own learning processes. This means that they are also in charge of implementing effective learning (and teaching in collaborative group work) characteristics in their learning and instructional processes. It might be that teachers become more the coach or mentor of new learning processes providing the students' characteristics of effective ways of learning and teaching. At the same time however, teachers become, more than in the past, managers of learning processes and organisers. Responsibilities of this kind belonged, in the past, to school and departmental management and leadership. Teachers were supposed to take care of the evaluation, the monitoring of students' learning and the facilities like books, library material, computer, courseware and so on, for independent learning, and maybe even keeping records of absenteeism becomes a part of the teacher's duties. This implies that also the traditional division of labour within schools and the responsibilities will change. On top of that the collaboration between teachers and between teachers and school management will be different

in the future because independent learning probably will not happen according to the traditional barriers, such as between school subjects and grade levels.

4.2 The dynamic model combining different ways of teaching

4.2.1 Critical analysis of educational effectiveness research (EER)

The design of the dynamic model was stimulated by an analysis of the weaknesses of educational effectiveness research. A significant weakness of studies on educational effectiveness arises from the fact that almost all of them are exclusively focused on language or mathematics. Researchers have not been able to monitor pupils' progress in the full range of the school curriculum and did not examine educational effectiveness in relation to the new goals of education such as the development of meta-cognitive skills (Campbell et al., 2003). Thus, EER threw itself under the suspicion of being solely interested in the cognitive domain and restricting itself further by focusing on basic knowledge and skills. As a consequence, EER has been criticised by opponents for a narrow scope, reducing school learning to discrete, assessable and comparable fragments of academic knowledge (Slee & Weiner, 1998, p. 2). For example, Lingard, Ladwig, and Luke (1998) state that educational effectiveness departs from an impoverished idea of what counts as achievement since it seems to assume that outcomes of schooling can be measured in conventional terms of skills, behaviour, knowledge and competences. The arguments used by the critiques of EER can be countered by referring to numerous studies that used multiple measures of schooling outcomes (e.g., Bosker, 1990; Knuver & Brandsma, 1993; Kyriakides, 2005; Opdenakker & Van Damme, 2000). It becomes evident from these studies that it is possible to measure a broad range of outcomes in a valid and reliable way using traditional methods of assessment.

A critical review of the current models of educational effectiveness research shows some further criticisms on the models itself. During the last two decades several effectiveness studies conducted in different countries provided support for the main assumption of the multilevel integrated models of EER (Teddlie & Reynolds, 2000). It has been found that influences on student achievement are multilevel. Although the findings of these studies provide support to the argument that models of EER should be multi-level in nature, it can also be argued that next to the multi-level nature of effectiveness the relationship between factors at different levels might be more complex than assumed in the integrated models (Creemers & Kyriakides, 2005). This is especially true for interaction effects among factors

operating at classroom and student level which reveal the importance of investigating differentiated effectiveness (Campbell et al., 2004). Therefore, a dynamic model of EER, which is not only multi-level in nature but also demonstrates the complexity of improving educational effectiveness by taking into account the major findings of research into differentiated effectiveness, is presented below. Specifically, the dynamic model incorporates four dimensions of differentiation which could refer to differences in: a) teaching objectives and curriculum content, b) teaching processes, c) assessment, and d) cultural and organisational contexts. In order to achieve this purpose, the following three major criticisms of current models of EER are taken into account.

First, meta-analyses of the effect of some effectiveness factors upon student achievement revealed that although they have been perceived as factors affecting teacher or school effectiveness, the research evidence is problematic. For example, teacher subject knowledge is widely perceived as a factor affecting teacher effectiveness (Scriven, 1994), but teachers' subject knowledge, regardless of how it is measured, has rarely correlated strongly with student achievement (Borich, 1992; Darling-Hammond, 2000). The explanation may be, as Monk (1994) reported, that the relationship is curvilinear: a minimal level of knowledge is necessary for teachers to be effective, but beyond a certain point a negative relation occurs. Similar findings have been reported for the impact of classroom emotional climate and teacher management upon effectiveness. A negative emotional climate usually shows negative correlations but a neutral climate is at least as supportive as a warm climate. Beyond an optimal level teacher direction, drill or recitation becomes dysfunctional (Soar & Soar, 1979). Rosenshine (1971) suggests inverted-U curvilinear relationships with student learning for verbal praise, difficulty level of instruction, teacher questions and amount of student talk.

Moreover, the possibility of interaction of effectiveness factors with student individual differences should be taken into account. For example, cross level interactions between student thinking styles (Sternberg, 1994) and quality of teaching have been identified (Kyriakides, 2005b). Therefore, the dynamic model of EER should be based on the assumption that the relation of some effectiveness factors with achievement may be curvilinear and that their effects may vary according to student personal and background characteristics, the cultural and organisational context and the objectives and content of the curriculum.

Second, there is a need to carefully examine the relationships between the various effectiveness factors in order to incorporate differentiated effectiveness in educational effectiveness modelling. It should be acknowledged that one model of EER illustrates such

relationships. Specifically, Walberg (1984) formulated an encompassing model of educational productivity which is based on the main factors of the Carroll's (1963) model and included an additional category of environmental variables. Aptitude, instruction and the psychological environment are seen as major direct causes of learning. They also influence one another and are in turn influenced by feedback on the amount of learning that takes place. The Walberg's model was tested as a structural equation model on science achievement, indicating more complex, indirect relationships (Raynolds & Walberg, 1990). This finding seems to provide support to our argument that there is a need to develop a dynamic model of effectiveness revealing the relationships between the factors of effectiveness which operate at the same level. Such approach to modelling educational effectiveness might reveal optimal combinations of factors that make teachers and schools effective which could also contribute in establishing strategies of improving effectiveness.

Finally, the current models of EER do not explicitly refer to the measurement of each factor of effectiveness. On the contrary, it is often assumed that these factors represent unidimensional constructs. For example, the comprehensive model of educational effectiveness states that there should be control at school level, meaning that goal attainment and the school climate should be evaluated (Creemers, 1994). In line with this assumption studies investigating the validity of the model revealed that schools with an assessment policy focused on the formative purposes of assessment are more effective (e.g., Kyriakides et al, 2000; Kyriakides, 2004) However, assessment policy at school level can be examined not only in terms of its focus on the formative purpose but also in terms of many other aspects of the functioning of assessment such as the procedures used to design assessment instruments, the forms of record keeping, and the policy on reporting results to parents and pupils. This implies that the dynamic model of EER should not only refer to the various factors of effectiveness but also explain the various dimensions upon which each factor can be measured. Considering effectiveness factors as multidimensional constructs does not only provide a better picture of what makes teachers and schools effective but also help us develop more specific strategies for improving educational practice.

4.2.2. A proposed dynamic model of EER

One of the integrated models of EER seems to be in line with at least two of the starting points upon which the dynamic model is based. The comprehensive model of educational effectiveness (Creemers, 1994) refers to factors at different levels (i.e., student, classroom,

school, system) and at the same time it is based on the assumption that there are direct and indirect relations between the levels and the outcomes. Based on the critical review of EER presented above, the dynamic model also assumes that these relations may not be necessarily linear and that factors at the same level may also be related to each other. Finally, in principle each factor which refers to the classroom, school and system can be measured by taking into account the following five dimensions.

A) Dimensions of measuring effectiveness factors

First, the *frequency* refers to the quantity that an activity associated with an effectiveness factor is present in a system, school or classroom. This is probably the easiest way to measure the effect of a factor on student achievement and most effectiveness studies used this dimension to define effectiveness factors. However, this dimension may not always be related in a linear way with student outcomes. For example, personal monitoring at school level can be measured by taking into account how often the principles use a monitoring system to supervise their teachers. EER could attempt to identify whether this dimension of measuring personal monitoring is related not only directly to student outcomes but also indirectly through teacher behaviour in the classroom. Further, it is questionable that there is a linear relation between frequency of personal monitoring and both type of outcomes. It can be assumed that after an optimal value of using a monitoring system it may not have an additional effect on outcomes but even can lead to negative effect in teacher behaviour and ultimately in student outcomes.

Second, the factors are measured by taking into account the *focus* of the activities which reveals the function of the factor at classroom, school and system level. Two aspects of focus of each factor can be measured. The first one refers to the specificity of the activities which can range from specific to general. For example, in the case of school policy on parental involvement, the policy could either be more specific in terms of concrete activities that are expected to take place (e.g., it refers to specific hours that parents can visit the school) or more general (e.g., it informs parents that they are welcome to the school but without giving them specific information about what, how and when). The second one addresses the purpose for which an activity takes place. An activity may be expected to achieve a single or multiple purposes. In the case of policy on parental involvement, the activities might be restricted to a single purpose (e.g., parents visit schools to get information about student progress) or addressed more than one purpose (e.g., parents visit the school to exchange information about

children progress and to assist teachers in and outside the classroom). It is expected that the measurement of the focus of an activity either in terms of its specificity or in terms of the number of purposes that is expected to achieve may be related in a curvilinear way with student outcomes. For example, the guidelines on parental involvement which are very general may not be helpful at all either for parents or teachers in establishing good relations which can result in supporting student learning. On the other hand, a school policy which is very specific in defining activities may restrict the productive involvement of teachers and parents in creating their own ways for implementing the school policy. Similarly, if all the activities are expected to achieve a single purpose then the chance to achieve the purpose are high but the effect of the factor might be small due to the fact that other purposes are not achieved and/or synergy may not exist since the activities are isolated. On the other hand, if all the activities are expected to achieve multiple purposes there is a danger that specific purposes are not addressed in such a way that they can be implemented successfully. The above example help also to identify the importance of investigating whether for some effectiveness factors an interaction between these two aspects of their focus dimension may exist.

Third, the activities associated with a factor can be measured by taking into account the *stage* at which they take place. It is expected that the factors need to take place over a long period of time to ensure that they have a continuous direct or indirect effect on student learning. For example, school policy on opportunity to learn which refers to policy on cancellation of lessons and absenteeism is expected to be implemented throughout the year and not only through specific regulations announced at a specific point of time (e.g., only at the beginning of the school year). It is also expected that the continuity will be achieved when the school is flexible in redefining its own policy and adapting the activities related to the factor by taking into account the results of its own self-evaluation mechanism. Measuring the stage dimension gives information about the continuity of the existence of a factor but the activities associated with the factor may not necessarily be the same.

Fourth, the dimension *quality* can be discerned in two different ways. The first one refers to the properties of the specific factor itself, as these are discussed in the literature. For instance, school policy on assessment can be measured by looking at the mechanisms which have been developed in order to establish instruments which meet psychometric standards (i.e., valid, reliable, representative to the content taught, making use of different techniques). At the same time, it can be examined whether this policy makes clear and guarantees that teachers are expected to make use of assessment information for formative rather than summative reasons (Black & Wiliam, 1998; Harlen & James, 1997; Kyriakides et al., 2000). This refers to the

second aspect of measuring quality which has to do with the impact a factor has on the subjects which are addressed by the factor. In the case of school policy on assessment, the subjects are the teachers who are expected to implement the policy whereas when we measure the effect of the factor within the EER framework the impact that the factor has on student learning outcomes is examined.

Finally, the dimension *differentiation* refers to the extent to which activities associated with a factor are implemented in the same way for all the subjects involved with it (e.g., all the students, teachers, schools). It is expected that adaptation to specific needs of each subject or group of subjects will increase the successful implementation of a factor and ultimately maximise its effect on student learning outcomes. Although differentiation could be considered as a property of an effectiveness factor, it was decided to treat differentiation as a separate dimension of measuring each effectiveness factor. In this way, the importance of taking into account the special needs of each subject or group of subjects is recognised. The dynamic model is therefore based on the assumption that it is difficult to deny that persons of all ages, learn, think and process information differently. Thus, effective teachers are expected to acknowledge, honour, cultivate individuality, support the concept of differentiated instruction and build on the premise that learners differ in important ways (Tomlinson, 1999). One way to differentiate instruction is for teachers to teach according to individual student learning needs as these are defined by their background and personal characteristics such as gender, socio-economic status, ability, thinking style and personality type. A similar argument can be made in relation to the way teachers should be treated by their school leaders. For example, instructional leadership should not be seen as equally important for all the teachers of a school. Effective principles are, therefore, expected to adopt their leadership to the specific needs of the teachers by taking into account the extent to which they are ready to implement a task. Similarly, policy makers are expected to adopt their general policy into the specific needs of groups of schools. As it has been argued above, research into differentiated effectiveness reveals that teachers' objectives as well as organisational and cultural factors should also be taken into account when the dimension of differentiation is measured (Dowson & McInerney, 2002; Hayes & Deyhle, 2001). However, the differentiation dimension does not necessarily imply that the subjects are not expected to achieve the same purposes. On the contrary, adopting the policy on the special needs of each group of schools / teachers / pupils may ensure that all of them will become able to achieve the same purposes. This argument is partly supported by research into adaptive teaching and evaluation projects of innovations

concerning with the use of adaptive teaching in classrooms (e.g., Houtveen et al., 2004; Noble, 2004; Reusser, 2000)

Above we have described in a more general way the five dimensions which can be used to measure each effectiveness factor. The examples which are given refer to factors at school and system levels. This was deliberately done in order to acknowledge the importance of establishing a comprehensive dynamic model which refers to effectiveness factors at all levels. However, in order to explain better how these five dimensions can be used to establish such a model, the following section refers to the specific measurement of two of the eight factors concerning teacher behaviour in classroom which according to the dynamic model are related to student achievement gains. The choice made for the classroom level is based on the fact that studies on EER show that this level is more significant than the school and the system level (e.g., Hextall & Mahony, 1998; Kyriakides et al., 2000; Yair, 1997) and defining factors at the classroom level can be seen as a prerequisite for defining the school and the system level (Creemers, 1994).

B) Specification for the teacher behaviour at the classroom level

Based on the main findings of Teacher Effectiveness Research (TER), our dynamic model refers to the following eight effectiveness factors which describe teacher's instructional role: orientation, structuring, questioning, teaching modelling, applications, management of time, teacher role in making classroom a learning environment, and teacher evaluation. Space limitations allow only a brief

summary of two factors which are related to different ways of teaching: structuring and teaching modelling.

Structuring

Rosenshine & Stevens (1986) point out that achievement is maximised when teachers not only actively present materials but structure it by: a) beginning with overviews and/or review of objectives; b) outlining the content to be covered and signalling transitions between lesson parts; c) calling attention to main ideas; and d) reviewing main ideas at the end. Summary reviews are also important since they integrate and reinforce the learning of major points (Brophy & Good, 1986). It can be claimed that these structuring elements not only facilitate memorising of the information but allow for its apprehension as an integrated whole with recognition of the relationships between parts. Moreover, achievement is higher when

information is presented with a degree of redundancy, particularly in the form of repeating and reviewing general views and key concepts. Therefore, structuring is measured as follows.

First, the dimension frequency is measured in a similar way as in the case of orientations. The two indicators that can be used are the number of tasks that take place in a typical lesson as well as how long each task takes place (e.g., the percentage of teaching time spent on structuring). Second, the focus dimension is measured in a similar way as in the case of orientation since it is possible that a structuring task may either refer to a part of a lesson or to the whole lesson or even to a series of lessons (e.g., a lesson unit). As far as the second aspect of focus is concerned, a structuring task may refer to the achievement of a single objective or to the relation of the elements of the lesson in relation to multiple objectives. It is expected that the structuring tasks which have an impact on student behaviour are those which refer to the achievement of multiple objectives since the tasks which refer to a single objective may increase the fragmentation of learning process. The third dimension of measuring structuring which refers to the stage at which an activity takes place is also measured in the same way as orientation. Structuring tasks may take place in different parts of a lesson or series of lessons (e.g., introduction, core, ending of the lesson). Fourth, the dimension of quality is measured by examining the impact that a task has on student learning. It is expected that structuring tasks are not only clear for the students but also help them understand the structure of the lesson. For this reason, we don't measure clarity as a property of structuring nor as an independent factor of teacher effectiveness but clarity is seen as a condition for helping students to understand the structure and the content of a lesson/series of lessons. On the contrary, the aspect of quality which refers to the properties of a structuring task has to do with the extent to which teachers organise their lessons/series of lessons in a way to move from easier tasks to more complicated. Finally, in the case of structuring, differentiation is measured by investigating the extent to which teachers provide different types of structuring tasks to students according to their learning needs.

Teaching Modelling

Although there is a long tradition in research on teaching higher order thinking skills and especially problem solving, these teaching and learning activities have taken more attention during the last decade due to the emphasis given in policy on the achievement of new goals of education. Thus, TER has shown that effective teachers are expected to help pupils to use strategies and/or develop their own strategies which can help them solve different types of problems. As a result of this, it is more likely that students will develop skills that help them

organise their own learning (e.g., self-regulation, active learning). Thus, the frequency dimension of teaching modelling can be measured by looking at the number of teaching modelling tasks that take place in a lesson and the teaching time devoted to them. As far as the focus is concerned, teaching modelling tasks can be examined in relation to the extent to which they refer to strategies which can be used to solve problems under various conditions (e.g., problems of different subjects). This measure refers to the specificity aspect of this dimension. Moreover, focus can be seen in relation to the extent to which teachers provide opportunities to students to use/develop more than one strategies to solve specific problems/types of problems. Third, the stage dimension is concerned with the sequence under which a teaching modelling is used in the classroom. It is possible that initially students are faced with a problem and then are expected to use/develop a particular strategy to solve it. On the other hand, teachers may teach a strategy or different strategies to students and then students are asked to use these strategies in order to solve a problem. Fourth, the measure of the quality deals with the properties of teaching-modelling tasks and especially with the role that the teacher is expected to play in order to help students use a strategy to solve their problems. Teachers may either present a strategy with clarity or they may invite students to explain how they solve a problem and use that information for promoting the idea of modelling. The later may encourage students not only to use but also to develop their own strategies for solving problems. Quality is also measured by looking at the impact that an activity has on student behaviour. Students may either become able to use a strategy in an effective way (i.e., finding the solution of the problem) or the use of the strategy may become an obstacle in dealing with a problem (e.g., causes more confusion about the problem). Finally, differentiation can be seen in terms of adopting teaching modelling to specific needs of group of students. These might result in more emphasis on applying a single strategy for a group of students to solve problems or more emphasis on using multiple strategies or even develop new strategies for other groups of students.

4.2.3 Suggestions for possible uses of the dynamic model

In the current phase, the emphasis is on developing and testing the model rather than on investigating the impact that the use of the dynamic model may have on improving effectiveness. However, it is expected that the dynamic model of EER will help us establish links between EER and improvement practices. In order to support our argument two possible uses of the dynamic model at the classroom level presented above are discussed. First, since

the proposed part of the model refers to the instructional role of teacher and especially to specific dimensions of eight significant aspects of teaching, it can be a useful tool for teacher self-evaluation, which is considered as the key to improvement (Macbeath, 1999). At the heart of self-evaluation is the establishment of a set of criteria measuring effectiveness (Kyriakides & Campbell, 2004). Teachers could, therefore, be encouraged to draw their own meanings of what makes a teacher effective by considering the knowledge-base of effective teaching practice provided by the model. Second, based on the various dimensions of each effectiveness factor presented in the model, different teaching profiles, which affect in different ways student achievement, can be produced. Teachers may, therefore, identify the extent to which their classroom behaviour is similar to any of these profiles and whether specific changes to their practice are needed in order to adopt a more effective profile. For example, a teacher may find out that his/her effectiveness is limited due to the fact that: a) s/he does not use enough teaching modelling activities that can help students use or develop strategies for solving problems and b) the great majority of the orientation tasks he/she offers are at the introduction of the lesson. The identification of more than one weaknesses is not helpful for identifying how you can develop professionally in a better way. However, due to the dynamic nature of the model, different priorities for professional development for each teacher can be identified. These will be based on the fact that the effects of the improvement of a factor on student outcomes depend on the stage at which each individual teacher is at the moment. Thus, one teacher who attempts to improve his/her orientation skills may result in improving student outcomes more than attempting to improve his/her skills in teaching modelling. A completely different interpretation can be drawn for another teacher by looking at the situation at which he/she is at the moment.

Using the proposed model, policy-makers could conduct large-scale evaluation studies. Since some of the effectiveness factors are expected to have a curvilinear relation with student achievement, the impact of an intervention program attempting to improve a specific aspect of teaching practice (e.g., questioning techniques, teacher evaluation) will depend on what the current situation is. Therefore, data collected through these studies may help policy-makers identify those dimensions that constitute the major weaknesses of the system and therefore design relevant intervention programs for improving its effectiveness. Research is, however, needed to investigate the impact that the use of the model may have on improving teaching practice at teacher-level through building self-evaluation mechanisms and at national level through establishing an “evidence-based” approach on introducing educational policy (Fitz-Gibbon, 1996).

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