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**The influence of educational beliefs on the use of ICT
as an educational innovation
in primary education**

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VOORWOORD

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“Is there any knowledge in the world which is so certain that no
reasonable man could doubt it?”

~Bertrand Russell~

The Problems of Philosophy

CHAPTER 1: GENERAL INTRODUCTION

Introduction

Nowadays ICT affects all aspects of our daily lives and the introduction of ICT into the system of education did not come as a surprise. Indeed, the potential of computers in education was recognized by researchers as far back as the nineteen-sixties (Voogt & Knezek, 2008). Before outlining the purpose of this dissertation and the research questions investigated, in this chapter we sketch out the context in which this study is placed; namely, the question as to whether the acceptance and integration of ICT in Flemish primary education is fostered or hindered by teachers' educational beliefs.

First, we give a brief outline of the history of ICT in Flemish primary education. We focus on the recent rise and establishment of ICT in Flemish primary education. However, despite worldwide governmental initiatives that support the introduction of ICT in education, recent studies indicate that the level of integration of ICT in the daily classroom practice is low (see e.g. Kozma & Anderson, 2002). In terms of primary school education in Flanders, recent research shows that the use of computers in classrooms is still rather low (e.g. Tondeur, Hermans, van Braak, & Valcke, 2008). This finding prompts questions concerning the barriers to educational innovations. Numerous researchers have recently emphasized the need to take into account 'teacher beliefs', in order to better understand what impedes and facilitates educational innovations, (e.g. Gess-Newsome, Southerland, Johnston, & Woodbury, 2003; Harris, 2003).

However, while the 'belief' concept has received much attention in educational research (Southerland, Sinatra, & Matthews, 2001), confusion of the concept still exists. In this chapter we aim to delineate the belief construct by concentrating on what we view as the main characteristics of teachers' beliefs.

Theoretical framework

ICT in the Flemish primary curriculum: a state of affairs

One example of an educational innovation is the current integration of Information and Communication Technologies (ICT) in education. The speed of technological development in terms of information technology and information systems in the eighties transformed our society from an industrial society into an information society; a society ‘inundated by information and dominated by information technology’ (Anderson, 2008; Bindé, 2005). Under the influence of (new) media and methods of information dissemination, the first ‘home computers’ appeared in Flemish primary schools in the nineteen-eighties (Delcour, 2008). However, at that time handling computers required technical and program skills. As a consequence, using computers was beyond the skills of most teachers. Therefore, what started as a bottom-up innovation (imported by and for teachers), seemed doomed to fade out. Nevertheless, as the quality of software and hardware developed and the cost of computers decreased, computers became more and more prevalent in educational institutions. This new technology offered an opportunity to widen the range of (educational) purposes and opened up new perspectives for teachers (Delcour, 2008).

Throughout the nineteen-nineties the transformation of the information society into a knowledge society led to questions concerning the role and process of education as well as the role of information and technology in teaching and learning (Pelgrum & Law, 2008). In this interplay between society and education, several governmental measures were taken on behalf of the integration of ICT in Flemish primary education (see Table 1). In June 1998 the Flemish Government introduced the PC/KD® action program. This program was a first step taken by the government to provide (high-quality) ICT-infrastructure to classrooms and to encourage schools to integrate this technology into classroom practice. For a period of four years, schools received an annual incentive for ICT-related costs. Funding was also made available for the purchase of software and in-service training for teachers (Clarebout, Elen, Frederickx, & Vermunicht, 2001). The goal of this initiative was that all Flemish schools should attain a rate of one computer for ten pupils. An evaluation study performed in the school year 1999-2000 indicated that the objectives stated by the government were almost reached. Nevertheless, only half of the

primary schools possessed computers that were connected to the internet (Clarebout et al., 2001).

During this period, the governmental emphasis on using ICT in the classroom was not limited to the investment in hardware and software. In respecting school autonomy, actions were taken by the government to provide demand and supply driven in-service training on technical, organizational, and educational issues. This resulted in the foundation of the Regional Expertise Networks (REN) in 1999.

Table 1
Governmental measures on the promotion of the integration of ICT in primary education.

Period	Governmental measure	Note
1998 – 2002	PC / KD	Improve ICT-infrastructure in schools.
1999	REN	Coordination of in-service training on topic of ICT
2003	ICT-competences for primary education	Basic outline of the general purposes and expectations from the government to primary and first grade secondary schools (non-compulsory).
2007	ICT-attainment targets	Formal, cross-curricular ICT objectives.

In 2003 the Flemish government provided schools with a framework for the expected outcomes with regard to knowledge, skills and attitudes that should be achieved through the use of ICT (Delcour, 2008). Although a concrete list of expected ICT competencies for primary education was put forward to guide this process, these guidelines were non-binding. As a consequence, the policy could not guarantee that all pupils would achieve the ICT competencies (Tondeur, van Braak & Valcke, 2007a).

Although the initial adoption of ICT in Flemish primary education began as a bottom-up movement by and for teachers, it lasted until 2007 when the ICT-guidelines were formalized for primary education and the first grade of secondary education by way of cross-curricular attainment targets for ICT. With the introduction of attainment targets, a two-pronged ICT-policy in education was introduced by the government.

By introducing ICT-attainment targets as cross-curricular and emphasizing ICT as an educational tool, the integrated use of ICT in education is centralized in schools. From this point of view, ICT is understood as a catalyst for educational innovation as it offers opportunities in all subject domains: ICT can promote an increasing flexibility of education by a desynchronization of time, space and pace. Moreover, ICT can be used to enhance learning outcomes, improve motivation and offer teachers more opportunities in terms of variation, differentiation, and remedial approaches (Vandenbroucke, 2007). By emphasizing the integrated use of ICT, less attention is given to the instrumental and procedural skills of ICT and more attention is given to the acquisition of information, expression and communication skills (Delcour, 2008). Central to this learning perspective is the teacher coaching the pupil's learning process.

The second aim of these attainment targets is to manage social polarization, i.e., between the ICT haves and have-nots. These attainment targets are in line with the needs from the knowledge society in which ICT-skills are perceived as a basic skill, both in increasing job opportunities as well as ensuring social participation. By implementing attainment targets, the Flemish Government ensures that all pupils receive as many opportunities as possible to develop in the knowledge society (Vandenbroucke, 2007). As schools have the responsibility to provide all children with equal opportunities to attain ICT related knowledge, skills and attitudes, the government can begin to manage social inequity in schools.

With the formulation of these formal attainment targets ICT has come to a turning-point in Flanders (Vanderlinde, van Braak, & Hermans, 2009). Educational technology is no longer dependent on teachers' individual effort or willingness, but is now considered as a part of the formal curriculum and must be integrated in all subjects of study. As a consequence, schools are confronted with the challenge of reaching the proposed attainment targets (Vanderlinde et al., 2009). One characteristic of this decentralized curriculum approach in Flanders is that the attainment targets outline 'what' targets should be implemented, but 'how' to do so is left up to schools. The main challenge for schools, therefore, is to formulate their own ICT-related policy plan on the basis of the school's own vision and mission statement (Delcour, 2008; Vandenbroucke, 2007).

Research on the implementation of ICT in Flemish primary education.

Numerous studies have been carried out that focus on Flemish primary teachers' use of ICT in their classroom practice. For example, van Braak, Tondeur and Valcke (2004) examined different types of computer use among primary school teachers working in East-Flanders. In that study, two measurement scales were developed and validated to assess how often teachers use computers in their classroom or for support. The results indicated that teachers were more familiar with supportive use of computers than with classroom use of computers. Although computers have found their way into the classroom, the actual use of them over time is rather limited.

In a follow-up study Tondeur et al. (2007b) explored different types of classroom use of computers in Flemish primary education. Three different types of computer use were discerned. The first type concerns the use of computers to teach pupils basic or technical computer skills. The second type refers to the use of computers for researching and processing information and communication. The third type concerns the use of computers as a learning tool, such as practicing knowledge or skills, elaborating learning content, or carrying out research. Using this typology the authors provide insight into the actual usage of computers of Flemish primary school teachers. The results indicate the use of computers as a learning or basic skills tool has more priority than the use of computers as an information tool in the classroom. Furthermore, compared to lower grades, fifth and sixth grade teachers are more likely to use the computer as an information tool. Both studies indicate that the integration of computers into the teaching and learning process in Flemish primary education is still limited.

ICT – integration as an example of educational innovation

We have presented a general outline of the integration of ICT in Flemish schools over the last twenty years and the supportive role of the government in facilitating this process. ICT integration can be considered as one of the major innovations that schools are confronted with both nationally and internationally. With this state of affairs the question can be posed as to why the integration of ICT as a case of educational innovation has not yet produced the results that so many have hoped for. To date, the rate of ICT implementation in schools is lower than expected and has not yet lead to major educational innovation (see e.g. Kozma & Anderson, 2002; Mumtaz, 2001; Niederhauser

& Stoddart, 2001; Tondeur, et al., 2007b; van Braak et al., 2004). To understand in the reasons why ICT as a case of educational innovation has not yet reached its full potential, below we focus on the nature of innovations.

In order to define innovation, it is necessary to emphasize the impact of the innovation in practice. The effect of innovations can be clarified following Cuban's (1988) distinction between changes of the first and second order. Changes of the first order refer to improving the efficiency and effectiveness of existing structures without altering the basic features of the organization (Cuban, 1988). Changes of the second order refer to reforming or renewing the educational system (Cuban, 1988; Lagerweij & Lagerweij-Voogt, 2005). Second order changes are more profound and are directed towards changing the goals and functions of the organization. In order to fundamentally alter the structure and culture of an organization one must redefine existing roles and redistribute responsibility. In this context, Waks (2007) states that educational change is only fundamental when change in educational ideas, norms and the overall organizational structure is realized (Waks, 2007).

Fullan (2001) states that not all educational change can be called fundamental. When a new programme or policy is implemented, three components or dimensions are always at play: (1) the possible use of new or revised materials, (2) the possible use of new teaching approaches, and (3) the possible change of beliefs. From this perspective, all three dimensions must be present for an educational innovation to be goal-directed and fundamental (Fullan, 2001).

The lack of fundamental change (or second order change) in education has raised questions concerning the approach of large-scale attempts at educational innovation. This has resulted in a shift in emphasis from the content of innovations to the way in which innovations are implemented by the individual teacher or the school. Van den Berg, Vandenberghe and Slegers (1999), among others, point to the intentionality of the innovation concept and note that different views of educational innovations lie behind the different approaches to implementing innovations. The authors distinguish between a structural-functional view of educational innovations and a cultural-individual view of educational innovations (van den Berg et al., 1999). Within the structural-functional

perspective, an orchestrated and strategic approach is proposed. This instrumental interpretation functions according to a central direction, a linear approach via formalized structures and built-in control mechanisms. The importance of initiating the innovation in a systematic and coordinated manner is strongly endorsed by regarding the head teacher as the manager of the innovation process. Within this perspective, the role of the teacher is pushed back to that of an executive professional (van den Berg, 2004; van den Berg et al., 1999). In contrast to this, within the cultural-individual perspective cooperation and active teacher involvement during the innovation process is emphasized. In this process, the potential and the capacity of the individual teacher is endorsed. Central to this perspective of change is the assumption that for an innovation to succeed the school must connect with the practical knowledge, work experience, and personal biography of its teachers. As a consequence, educational change would not be limited to the integration of strong educational environment, but should also take the personal side of change processes into account by paying attention to both collective meaning making and personal meaning making (Geijsel, & Meijers, 2005). Furthermore, innovations can differ strongly depending on the innovation process, organizational culture, and the problems that arise during the innovation process (van den Berg, 2004; van den Berg et al., 1999).

A somewhat different perspective on educational innovation can be found within a school improvement perspective. Here, the school is placed at the centre of the innovation and the optimization of its capacity forms the ultimate lever to significantly influence learning and student performances (e.g. Harris, 2003; Hopkins, 2001). However, Harris (2003) states that despite the plausible arguments proposed within the school improvement perspective, there is limited empirical evidence to suggest that structural change leads to change in educational beliefs, knowledge and comprehension, which underlie pedagogical and didactic practice. The effectiveness of school improvement initiatives is strongly dependent on the extent to which it renders possible a change in teacher practice. Effectiveness also seems to be dependant on the extent to which it can create the capacity for shared learning. This can be problematic because a lack of formal change is often connected to the failure of innovations to change important aspects of teachers' thinking, such as knowledge and beliefs (Gess-Newsome, et al., 2003; Woodbury & Gess-Newsome, 2002). Harris (2003) notes that class changes involve more than providing and assimilating new knowledge and skills. In this sense, changing the

personal approach to teaching, altering attitudes, views and personal theories is indispensable.

Research on beliefs and educational beliefs

To conclude, the teacher plays an important role in the acceptance and integration of innovations into the classroom practice. In order to gain further insight into the role of the teacher in educational innovations, the focus of this dissertation is on teacher beliefs. Below we delineate the main characteristics of the 'belief' concept in general, and the meaning of teachers' educational beliefs in particular. We concentrate on related constructs, such as knowledge and attitudes, but also address the structure of beliefs, the role of beliefs in determining behavior, and the changeability of beliefs.

In educational research, the attention paid to teachers' beliefs is not new. For example, there has been growing interest in the study of pre-service, novice, and experienced teachers' cognitive processes. In the past, studies catalogued as process-product studies examined the relationship between teachers' behaviors and learner performance from a mainly behaviorist paradigm (Brophy & Good, 1986; Meijer, 1999). One characteristic of these studies was the unidirectional focus on 'the process of teaching' and the impact of that process on 'the products of learning' (Fang, 1996). This positivistic research paradigm led to recommendations on how to improve teaching practices in favor of student achievement (Fang, 1996; Shulman, 1986). However, the limited improvement of the teaching practice and the notion that these studies do not quite grasp what is important in education has led to a shift in the last decade from teacher process-product research to teachers' thought processes research (Beijaard & Verloop, 1996; Meijer, 1999). It is notable that, under the influence of cognitive psychology and a diversification of research paradigms, the unidirectional emphasis on (observable) teacher behavior in relation to pupil outcomes is decreasing while research on 'teacher thinking' is gaining ground (Clark & Peterson, 1986; Fang, 1996; Shulman, 1986). In that research paradigm, teachers' beliefs have been put forward as important explanatory components in studies of teacher behavior in educational psychology (Pajares, 1992). In this context, numerous studies have provided conceptual clarification of the 'belief' construct (see e.g. Calderhead, 1996; Fang, 1996; Kagan, 1992; Muijs & Reynolds, 2001; Nespor, 1987; Pajares, 1992; Richardson, 2003; Wyer & Albarri n,

2005). After twenty years, we have moved one and research on the development of beliefs and knowledge and their influence on learning processes have clearly acquired an important place in educational psychology research (Southerland, et al., 2001). However, faulty conceptualizations and misuse of the belief concept are still found in the literature. As Southerland, Sinatra, and Matthews (2001) observe, researchers continue to struggle to (explicitly) define knowledge and beliefs. The confusion is often reduced to the distinction between knowledge and beliefs (Clandinin & Connelly, 1987; Pajares, 1992). Additionally, a strong conceptual overlap can be found between the concepts of beliefs and attitudes. Even though the distinction is often a purely theoretical discussion, description of the relation between beliefs, knowledge and attitudes and the indication of dissimilarities between the different concepts contributes to the further clarification and delimitation of the belief construct.

(1) Beliefs and knowledge

In the past, a great deal of the educational-psychological research agenda was based on knowledge acquisition and the possibility of changing knowledge (Alexander, & Dochy, 1995; Southerland, et al., 2001). In this literature, knowledge is often conceptualized as representations of information stored in memory (Southerland, et al., 2001). Southerland and colleagues note that the dominant discourse in western philosophy has managed to leave its mark on the demarcation line drawn between the end of beliefs and the beginning of knowledge, and they point to the distinction made between views and knowledge as a continuation of the Platonic idea of knowledge described as ‘justified true beliefs’ (Southerland, et al., 2001). According to this epistemological model, when a person or knowledge bearer (S) has knowledge of P (a proposition), then (i) P must be true, (ii) S must be convinced of P, and (iii) S must be able to prove the correctness of his belief in P (Gettier, 1963). Thus, within this epistemological model, three conditions that a proposition must fulfil in order to be called knowledge need to be centralized: truth, belief and evidence. In this case, the truth condition provides a criterion for the reality value of the proposition made. The belief condition indicates to which extent the proposition made is held to be true by the person in question. With the burden of evidence is meant the (valid) reasons the person in question has in store to support and thus strengthen the proposition he made is true (Southerland, et al., 2001). In other words, talking about knowledge is talking about a cognizing subject, a knowledge claim and

reasons that ground the claim. Within this realm, Southerland and colleagues (2001) state that a lot of philosophical effort has been expended on the evidence condition; the reasons and warrants that justify the beliefs. Although the Platonic formulation about the relationship between knowledge and beliefs is (in essence) an individualistic stance, the role of social and cultural influences (communal criterion of validity) has submerged the individual in underwriting entering into the knowledge claims (Southerland, et al., 2001). In an early attempt to differentiate knowledge systems from belief systems, Abelson (1979) refers this communal criterion under the denominator of consensuality and nonconsensuality of respectively knowledge and belief systems which meaning is aptly expressed in the next citation:

“If every normal member of a particular culture believes in witches, then as far as they are concerned, it is not a belief system, it is a knowledge system. They know about witches. But the anthropologist who studies this culture is aware of many witchless cultures, and thus uses the label “belief system” without flinching. The other side of this same coin is that scientific knowledge can be viewed as mere belief by those outside the community of shared presuppositions about sciences as a way of knowing.” (Abelson, 1979, p. 357)

Leaning closer towards educational practice, a similar line of reasoning can be found in Fenstermacher’s (1994) theoretical distinction between formal and practical knowledge. Formal knowledge is delivered by conventional (academic) research and meets criteria of significance, reliability and generalisability (Fenstermacher, 1994). In educational research, this form of knowledge is representative of a positivist tradition. Teacher knowledge is seen here as a set of generalisable principles, which must be extracted from practice by research and put into practice by teachers (Calderhead, 1996). In the educational manner of thought of the 80s, this form of education was prominently present in possible taxonomies on the knowledge base of teachers (see e.g. Shulman, 1986). Practical knowledge, on the other hand, is knowledge related to a specific situation or context and is developed by reflection on actions and experiences (Fenstermacher, 1994). In practical knowledge, formal elements of knowledge are merged with beliefs, intuitions and emotions. This creates a subjective frame that provides directions for actions (Uhlenbeck, Verloop, & Beijaard, 2002).

As suggested earlier, in the interpretation of the knowledge concept primacy is often given to relegate knowledge to a communal and public perspective (Southerland, et al., 2001). Thus, knowledge acquires a higher epistemological status as a social consensus can be reached on its content (Fenstermacher, 1994; Hofer & Pintrich, 1997). Murphy and Mason (2006) describe this as follows: *'We use the term knowledge to refer to all that is accepted as true that can be externally verified and can be confirmed by others on repeated interactions with the object (i.e., factual)'* (Murphy & Mason., 2006, p. 306). As a result, the characteristic 'objectivity' is attributed to knowledge and is affiliated to sharply defined areas of knowledge and application (Pajares, 1992). Consequently, referring to 'objective' and verifiable facts, knowledge requires a certain 'truth condition': an epistemic warrant and evidence to back up the claim made (Richardson, 1996).

Compared to knowledge - which cannot disconnect itself from this epistemological guarantee - beliefs are often allocated a lower epistemological status (Richardson, 2003); especially since beliefs are often impossible to verify (Murphy & Mason, 2006). Generally speaking, beliefs can be described as propositions (or claims) the keeper holds or would like to hold to be true (Murphy & Mason, 2006; Richardson, 2003). These are existential presumptions; irrefutable truths that are held (Nespor, 1987; Pajares, 1992). People draw upon their beliefs whenever they are active in the world and have to handle with the unpleasant state of doubt (Cunningham, Schreiber, & Moss, 2005; Owston, 2007). As such, beliefs express the estimate of a subjective probability that a proposition or a subjective experience is true, or, alternatively, that that an event or state of affairs will occur (Wyer & Albarricín, 2005). In this way, beliefs pertain to knowledge as they represent a subjective likelihood that knowledge is correct (Wyer & Albarricín, 2005). Also Alexander and Dochy (1995) point to this probability process as a possible demarcation line between knowledge and beliefs, between what someone knows (knowledge) and what someone holds to be true (belief).

(2) Beliefs, attitudes and teacher behaviour

In the realm of the social and behavioral sciences much research focusing on attitudes has been generated. Due to the centrality of the belief construct in explaining attitudes,

the belief concept is not only contrasted with the concept of knowledge, but also with the behavioral concept of attitude.

In general, attitudes can be described as behavioral predispositions that lead to approach and avoidance behavior (Krosnick, Judd, & Wittenbrink, 2005). They express a preference for an object based on an attribute dimension like favorite-undesirable, good-bad, harmful-beneficial, pleasant-unpleasant. Therefore, attitudes represent ‘a summary evaluation of a psychological held object’ captured in an attribute dimension (Ajzen, 2001). This implies not that one and only one attitude matches with any given object. In contrary, empirical evidence is found that, for example, depending on an illusory correlation between the observation of a target behavior and the context in which the behavior is observed, people can form context dependent attitudes (Ajzen, 2001). Further, attitudes can alter over time and new attitudes are supposed to override the old attitude (Ajzen, 2001).

The blurry distinction between beliefs and attitudes can be founded in the premise that in everyday life a person’s actions are determined or at least influenced by their beliefs and values (Walley, 1991). However, the relation between beliefs and attitudes is more a question of an empirical and theoretical nature and two main theoretical formulations of the relationship among beliefs and attitudes appear to be prominent. In a tri-partite concept of attitudes, attitudes are divided in an affective (i.e. sentiments towards an object), a cognitive (i.e. beliefs and opinions towards an object) and a conative component (i.e. the behavioral part). In this definition, beliefs are seen as part of an attitude, since they are classified under the cognitive component (Richardson, 1996; Wyer & Albarricín, 2005). Another distinction can be found in definitions where attitudes refer to an affective component and beliefs refer to a cognitive component.

In such conceptualizations, beliefs are indicated as determinants to attitudes (Wyer & Albarricín, 2005). In search for a psychological explanation for human actions, adherents of the expectancy-value model – one of the most widely accepted conceptualization on attitude formation – ascribe the determination of people’s evaluations of, or attitudes toward, an object to the salient beliefs about the object (Ajzen, 2001; Ajzen, & Sexton, 1999). From this theoretical stance, beliefs can be defined as the subjective probability

that a certain attribute is associated with a given object (Ajzen, & Sexton, 1999; Fishbein & Ajzen, 1975). As such, the formation of a concept's connotative meaning is inextricable bound up with the formation of beliefs about the object (Ajzen, 2001). Then, the person's overall attitude is determined by 'the subjective values of the object's attributes in interaction with the strength of the associations'¹ (Ajzen, & Sexton, 1999). For example, a teacher's attitudes towards education are based upon his beliefs about education. If the teacher associates education with favorable attributes, his or her attitude towards education will tend to be positive. To postulate that beliefs influence behavior does not mean that they are the only determinant of behavior (Walley, 1991). People possess more beliefs about the same object, yet those beliefs readily accessible in memory influence on attitude at a certain moment (Ajzen, & Sexton, 1999). In a critical review of the expectancy-value model, Ajzen (1999) indicates that beliefs judged to be more important seem to be more accessible in memory.

Bound up with the importancy aspect, also values are indicated as having influence on the formation of attitudes. Beliefs influence behavior through their relation with values (Walley, 1991). As a consequence, beliefs and values are behavioral dispositions (Walley, 1991). They are latent tendencies, which can not be inferred directly from behavior, but 'to have certain beliefs and values is to be disposed to behave in certain ways' (Walley, 1991). A clear example of this intertwinement of beliefs and values as behavioral dispositions is provided by Krathwohl, Bloom, and Masia (1964) in their description of the internalization process. Krathwohl and colleagues use the concept of internalization to describe the ongoing process of the organisation of a person's values. In this process, the authors recognize a number of stages placed on a continuum. In an early level on the internalization process a person complies with expectations without commitment to them. In this early stage, the individual actually does not believe in the behavior, but acts on it because the behavior is expected. The more a person moves up to the middle stages of the continuum, the more the individual responds with the expected behavior, gaining some

¹ Often, this is algebraic represented as follows: $A_o = \sum_{i=1}^n b_i e_i$, with:

A_o : the attitude toward the object (o);

e_i : the evaluation of the attribute i

b_i : the subjective probability that o is associated with the attribute i

n: number of salient attributes

satisfaction from this response and accepting the values in the behavior. In this stage on the continuum, the person believes that the response which he adopts through identification will establish or maintain a satisfying relationship to another person or group. Beliefs and values do not exist in isolation from one another as the subjective probability (what is true?) and the desirability (what is desirable?) are clearly intertwined. Finally, when the person has accepted values, attitudes, interests ... into his system, the behavior becomes completely internalized and routine. This process of internalization makes it plausible that more internalized beliefs and values are harder to change.

Besides, also non-attitudinal related research on the relation between beliefs and teacher actions has proven that educational beliefs guide and influence teachers' actions in practice, just like beliefs direct daily life (e.g. Clark & Peterson, 1986; Fang, 1996; Nespor, 1987; Pajares, 1992; Richardson, 1996; Shulman, 1986). The goals of this research tradition are often to promote insight in, on the one hand, the complexity of the context of teaching and, on the other hand, the thought processes of the teachers in this context. Teaching, seen as interplay between teacher, pupil, content and context, is inherently complex. Seeing that it aims to promote learning, it is a goal-directed activity. This goal-directedness is hindered by the individual characteristics and needs of pupils in combination with group size. On top of this, different goals are often pursued simultaneously (Uhlenbeck et al., 2002). Consequently, a unique context is constantly created, where laws to access this complexity are difficult to prescribe (Kagan, 1992). As there is little time for (extended) reflection while they are teaching, teachers call upon their personal knowledge and fall back on different alternative solutions and models. The grounds on which these decisions are made are not just founded on specific contextual features such as class size, pupil characteristics and available learning material, but also on earlier experiences and beliefs spawning from them (Kagan, 1992). As a consequence, it cannot simply be concluded that educational beliefs completely determine the actions of teachers. Whereas the literature used to assume a consistency between actions and beliefs, this is not entirely supported anymore in valid research. The use of triangulation (e.g. observations, interviews and written sources) has led to the insight that the complexity that is inherent to teaching limits the teachers' possibilities to teach congruent to their beliefs. This indicates that contextual factors can exert a considerable influence on teachers' beliefs and, in fact, their class practice (Fang, 1996). Yet, Thompson (1992)

points out that there are contextual limitations to the realization of beliefs in practice. A limiting influence can be exerted by the values, beliefs and expectations of others involved, by the curriculum that is used, and by the assessment practices, values and philosophical influence of the overarching educational system (Thompson, 1992).

Additionally, research shows that – besides context-related factors – there can also be discrepancies between the reported ideal typical beliefs and actual class behavior. Bolhuis and Voeten (2004), among others, note in a study on Dutch secondary teachers' conceptions related to student learning and their own learning that teachers have process-directed beliefs on education, but that they do not necessarily put them into practice. Schuh (2004) arrives at a similar finding and seeks an explanation in the overgeneralization of underlying theoretical principles. They conclude that stereotypes can be created as a direct result of focusing too much on the superficial characteristics of instruction. For example, traditional lesson practices are often equalled to the image of the teacher standing in front of the classroom explaining something. Another common image is that of the students performing collaborative group work, which is seen as the main or even only representative of a pupil-centered approach. This leads to a one-sided focus, creating a discrepancy between reported beliefs and actual behavior. Schuh (2004), however, notes that pupil-centred principles can just as well appear in a strong teacher-directed approach. Wideen, Mayer-Smith and Moon (1998) make a similar remark in a critical review of research on learning to teach. Beginning teachers keep a rather humanistic view on education, emphasizing social aspects of teaching, affective and relational teacher characteristics and a strong desire for social change. This contrasts sharply with their image of teaching practice, which is seen more as a simple and rather mechanical transfer of information (Wideen et al., 1998). In conclusion, when asked about their behavior, teachers tend to give their espoused theory rather than their theory-in-use (Argyris & Schon, 1978).

(3) Belief systems

Rokeach (1976) defines a belief system as the whole of beliefs about oneself and the surrounding world. Within this system, beliefs cluster around partial aspects of the self and of the social and physical reality in different dimensions. Within the system as well as within the different dimensions, mutual relations between beliefs are important

(Rokeach, 1976). The more a belief is functionally connected to or in communication with other beliefs, the more central the position of the belief within the system and the more important the belief will be (Rokeach, 1976). Here, beliefs of existential questions and personal identity will stand a better chance of centrally nestling in the system. Equally, non-derived beliefs, originating from experience and personal involvement, are more important than derived beliefs. Random beliefs, such as beliefs of taste, are less central and have less functional connections.

The belief system plays an important part in the reduction of confusion and in the attribution of meaning to the world around us and helps individuals to define and understand the world and themselves (Pajares, 1992). Furthermore, a general belief structure or system can vary in strength. The more a belief is interrelated with others in this structure, the more difficult it is to alter the belief in question (Pajares, 1992)

For teachers, educational beliefs can be understood as constituting one of their main belief subsystems and can further be specified as the premises and propositions held about education (Denessen, 1999). It states the obvious that this subsystem further can be analysed in terms of several dimensions (or clusters) of interrelated beliefs, and in the literature, several distinctions are made in the description of educational beliefs. Often, these involve a cluster of ideal typical descriptions that can be divided into contrasting quotes or opinions on the goals and design on the one hand, or professional identity and the position of the teacher in education on the other hand (Denessen, Michels, & Felling, 2000).

Beliefs of educational goals can be split into ideal typical beliefs pertaining to ‘emancipatory’ goals directed to formation and ‘traditional’ goals directed to the profession (Denessen et al., 2000). On the one hand, the goals directed to formation emphasize the pedagogical task of the school (social formation and personality development) (Denessen et al., 2000). From a holistic view on man, nature and society, a harmonic development and the promotion of creativity are sought (Brooks & Brooks, 1999; Denessen et al., 2000; Minor, Onwuegbuzie, Witcher, & James, 2002). Furthermore, it is assumed that pupils need to be socially prepared for later life (Denessen et al., 2000). On the other hand, within the goals directed to the profession, the emphasis

is put on the qualification function of education (Denessen et al., 2000). From an economic-technical view on education, it is presupposed that pupils need to have certain knowledge and skills at hand in order to be able to act competently (Eisner, 2001; Standaert, 2001). Maintaining social, political and economic order and stability is put to the front (Su, 1992).

Within beliefs on the educational design, Denessen (1999; Denessen et al., 2000) distinguishes between beliefs on the pedagogical relation and the educational organization (content and shape of education). These are, for instance, the beliefs of teachers about their pupils and their learning processes and the way in which these beliefs shape the educational organization and interaction between teacher and pupil (Calderhead, 1996). Beliefs on the organization of education can be explained in transmissive beliefs that are directed to transfer and beliefs directed to pupils or development. Central in transmissive beliefs is the transfer of curriculum. The pedagogical relation is conducted from an approach which is directed to teachers and oriented to control, emphasizing the maintenance of order and discipline (Calderhead, 1996). Pupil-directed approaches are supported by a social-constructivist view on learning and education.

Lastly, it is important to stress that educational beliefs are related to teachers' professional identity and the position of the teacher in educational practice. Professional identity can be described as an ongoing process of interpretation and re-interpretation of experiences. It implies both the individual teacher as well as internalized influences derived from the context of the classroom and school culture (Beijaard, Verloop, & Vermunt, 2000; Beijaard, Meijer, & Verloop, 2004; Krathwohl, Bloom, Masia, 1964). As such, teachers' professional identity comprises a professional and a personal dimension. The professional dimension refers to the way teachers see themselves as subject matter experts, pedagogical experts and didactical experts. However, this professional dimension cannot be separated from a highly personal dimension of personal beliefs, values, and personal life experiences (Beijaard et al., 2000, 2004). Teaching requires a large amount of personal involvement. Therefore, teachers often fall back on their own personality and their ability to engage in personal relationships in function of their educational task (Calderhead, 1996). From a biographical perspective it can be emphasized that the

adaptation of personal understandings and ideals to institutional realities and the decision about how to express oneself in the classroom are core elements in the ongoing process of identity transformation (Beijaard et al., 2000).

(4) Beliefs and changeability

A common issue in the literature on teacher beliefs is that the changeability of beliefs is a complex and difficult matter. At first, there is the importance of experiences for the creation of beliefs. Literature on the origin of educational beliefs points to the contribution of different life experiences to robust and lasting beliefs on teaching and instruction (Murphy, Delli, & Edwards, 2004; Richardson, 1996). Richardson (1996) distinguishes three modes of experiences that each manifests themselves at a different point in life: personal experiences, experiences with education and instruction and experiences with personal knowledge. A general source of beliefs are personal experiences that contribute to the formation of a particular world view (Richardson, 1996). Domestic, religious, political and cultural experiences leak through the personal belief system to educational beliefs (Zeichner & Gore, 1990). In accordance with Rokeach (1976), it is also true in this case that beliefs formed at early age fit in more centrally in the belief system and are therefore less prone to change. Research on antecedents of educational beliefs indicates personal childhood experiences as an influential variable (Entwistle, Skinner, Entwistle, & Orr, 2000; Su, 1992). Nevertheless, research indicates that mainly own experiences of one's (early) school career are at play in the formation of beliefs on education and instruction (Entwistle et al., 2000; Richardson, 1996; Su, 1992). Formed by the many hours spent behind by school desks, ideas about the role of the teacher, the position of the teacher in class, methods of teaching internalized, etc. (Lortie, 1975). This does not only lead to a preference for specific goals and approaches in education. Equally, these experiences lead to the formation of beliefs about positive and negative teacher characteristics (Fajet, Bello, Leftwich, Mesler, & Shaver, 2005; Zeichner & Gore, 1990). An accumulation of beliefs creates a robust and safe interpretative frame, which is often formed when aspiring teachers enter teacher education (Pajares, 1992). Further, during teacher education and further professional formation (professional practice) beliefs are sharpened. Teacher education directs its curriculum to teaching norms, values and skills important to the teacher profession. Within this educational programme, aspiring teachers get in touch

with subject-specific knowledge as well as formal knowledge on classroom management, models of teaching, and classroom environment (Richardson, 1996). Nevertheless, it is assumed that experiences with formal knowledge exert a rather limited influence on teacher beliefs (Richardson, 1996). In contrast, teachers are inclined to add new information to their interpretative frame if this information provides practical relevance to one's personal educational practice (Richardson, 1996).

A central aspect in the formation of educational beliefs is the coding of acquired experiences through images (Richardson, 1996). Throughout personal biography, images are formed on the basis of experiences involving events or persons. As certain images are more enduring, they distinguish themselves from other images and from time to time assume an anecdotic form with an exemplary-illustrative function (Kelchtermans, 1994). These critical phases and people play a crucial part in teacher development (Kelchtermans, 1994). From the Gestalt-belief, Korthagen and Lagerwerf (1996) note that this does not solely involve visual images and cognitive aspects, but also unconsciously recalled emotions and sentiments from the past. A Gestalt reflects the unity of perception, internal processes and a tendency to behave oneself in a certain (Korthagen & Lagerwerf, 1996). We must bear in mind that the creation of beliefs is not purely an idiosyncratic process, but is just as much seen as the result of a process of enculturation. Enculturation is seen here as the incidental learning process which adopts cultural aspects in the personal sphere through assimilation (Pajares, 1992).

To sum up, people grow up comfortably with their beliefs and these beliefs become a part of their 'self.' Thus, beliefs form interpretation frames that face the surrounding world and make sense of it. They structure and diminish confusion and dissonance, even when this dissonance is caused by someone's inconsistent beliefs (Pajares, 1992). They allow us "to proceed as if the world makes perfectly good sense" (Cunningham et al., 2005, p. 179).

However, this steadfastness is somewhat questioned from the perspective of teacher education. Teacher education institutes create expectations towards students and the role they will assume in their later professional lives as teachers (Von Wright, 1997). Due to the underlying assumption that a change in the beliefs of aspiring teachers will lead to a change in their behavior, teacher beliefs have become high up on the agenda of many

teacher education institutes (Wideen et al., 1998). As it is assumed that beliefs play a part in the construction of knowledge and the interpretation of experiences, teacher education focuses on an orientation towards and reflection on personal (initial) beliefs and expectations (Von Wright, 1997). It is assumed that these beliefs are changed, rather than strengthened, when the aspiring teachers acquire genuine experiences and reflections on actions (Richardson, 1996).

As mentioned above, many beliefs that students have when they enter teacher education are, however, deeply rooted and difficult to change (Ashton & 2003). Many teachers still keep the same (initial) beliefs for years (Pajares, 1992). It should be noted that many models and theories of change focus one-sidedly on cognitive, rational aspects of learning (Ashton & 2003). By focusing one-sidedly on cognitive aspects to accomplish change, for example by providing counter examples, a change in the periphery of the belief will occur. Thus, more centrally positioned beliefs will remain untouched (Ashton & 2003). What is missing here is an emphasis on the role of emotions to motivate a change in beliefs. That is, many beliefs legitimize themselves by the sentiment that something is 'correct' or 'true.' This is often paired with cognitive and motivational biases, making it hard for new information to penetrate the existing knowledge system. When new information shows similarities with existing beliefs, this often leads to superficial information assimilation. If there is an inconsistency between the new and the old information, the former will quickly be abandoned before it is thoroughly studied (i.e. cognitive bias). Motivational factors can also obstruct the information assimilation process (i.e. motivational bias). However, it is only when a sentiment of displeasure with current attitudes arises that a first step towards a change in beliefs is taken (Ashton & 2003). It is this feeling of displeasure with the current belief that makes it possible for cognitive and motivational factors to be expressed. Yet – until the impact of more robust programs of teacher education has brought closure – the fixed nature of aspiring teachers' beliefs will remain an open question rather than an accepted assumption (Wideen et al., 1998).

Beliefs function as interpretative lenses through which beginning teachers attribute meaning to their experiences and frame and solve problems that are connected to teaching (Uhlenbeck et al., 2002). Consequently, the wording and critical questioning of these

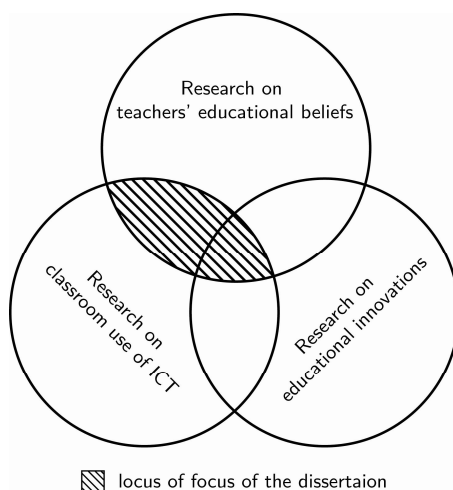
beliefs is important when the personal knowledge base is supported and expanded in the further career (Uhlenbeck et al., 2002; Wideen et al., 1998). From a development-directed approach to teaching and educating (i.e. constructivism), knowledge development is seen as the process of reorganizing, structuring and restructuring (Uhlenbeck et al., 2002). Furthermore, Uhlenbeck and her colleagues (2002) plead to expand this reflection on the personal practice and this consideration of personal beliefs to learning how to engage in professional discourse with colleagues. Learning how to put into words knowledge, beliefs and actions, of both oneself and others, makes it possible to create an enriching dialogue. This view can be supported by pointing out that the formation of educational beliefs can never be a purely idiosyncratic process (Kelchtermans, 1994). Although the individual teacher plays an important part in the personal organization and construction of his beliefs, they are formed by a transactional process between man and environment (Pajares, 1992).

Purpose, research questions and research design

Purpose of the dissertation

The purpose and of this dissertation is to explore three research areas: (1) research on teacher beliefs, (2) research on classroom use of ICT, (3) and research on educational innovations (see Figure 1).

Figure 1
Locus of focus of research.



(1) The purpose of research on teachers' educational beliefs.

Previous research on primary teachers' educational beliefs has largely focused on prospective teachers (e.g. Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003; Stuart & Thurlow, 2000). When in-service primary teachers' beliefs were subject of research, most of the instruments used (e.g. Smith, 1993; Woolley, Benjamin, & Woolley, 2004) focused only on teachers' beliefs about the practice of teaching and classroom processes. While this research helps clarify of the belief construct, it is arguable that primary teachers' beliefs are not only influenced by the immediate contexts of the classroom (Alexander, 2000; Woolfolk Hoy, Davis, & Pape, 2006). As mentioned above, government policies and cultural norms and values also influence the beliefs formation of teachers (Woolfolk Hoy et al., 2006). While previous studies shed light on specific teacher beliefs about the practice of teaching, research on primary teachers' general beliefs about the nature of 'good' education remains unexplored. Furthermore, a belief system is constituted by different subsystems and the mutual relationships between these different subsystems are an interesting area of investigation. However, there is less research into the relationship between the general beliefs about the nature and purposes of primary education and the practice of teaching and classroom processes. Therefore, one of the main purposes of this dissertation is to gain insight into Flemish primary teachers' educational beliefs and to extend our theoretical understanding of the structural relationships between clusters of educational beliefs.

(2) The purpose of research on classroom use of ICT

The use of ICT in our society has been expanding rapidly in terms of its presence in business and personal life. While these new technologies have also found their place in schools, they are not fully grounded in educational practice. Some teachers report feeling challenged when integrating new technologies into their (daily) classroom practice, while others are still at the threshold of the digital age and encounter barriers in implementing these technologies in their daily classroom practice (Campbell, 2006; Jones, 2004). Recent studies also indicate a limited integration of computer use in primary education in Flanders.

Most of the research investigating the antecedents of educational computer use appears to be limited in terms of its sole use of technology-related variables, such as attitudes to computers (see e.g. Albirini, 2006; van Braak, 2001), experience with computer (see e.g. Becker, 2001; Williams, Coles, Wilson, Richardson, & Tuson, 2000), and demographical variables like sex and age (see e.g. Bradley & Russell, 1997; Shapka & Ferrari, 2003; van Braak et al., 2004). When teachers' beliefs are taken into account, the research mostly focuses on the perceived contribution of ICT to the learning environment (see e.g. Smeets, 2005) or on the relation between constructivist beliefs and computer use (see e.g. Becker, 2001). The relation between teachers' educational beliefs and the technological and demographic variables is rarely investigated.

The present dissertation explores Flemish primary teachers' actual use of computers in the classroom by investigating the relationship between primary teachers' educational beliefs and their integration of (innovative use of) ICT in the classroom practice

(3) The purpose of research on educational innovations.

Research on educational innovations indicates that the adoption and integration of educational innovations can only be explained and fully understood when teachers' educational beliefs are taken into account (see e.g. Cuban, 1988; Ertmer, 2005). However, Harris (2003) states that there is only limited empirical evidence to suggest that structural change also leads to changes in beliefs, knowledge and comprehension, which underlie instructional practices and are assumed to be important precursors to (fundamental) change (Cuban, 1988; Fullan, 2001). Furthermore, the effectiveness of school improvement initiatives seems to be strongly dependent on both the extent to which it creates conditions to render change in teaching practices and the extent to which it can create the capacity for shared learning. Gess-Newsomme, Southerland, Johnston and Woodburry (2003) indicate that this can be problematic because a lack of formal change is often connected to the failure of innovations to change important aspects of teacher thinking, such as knowledge and beliefs. Furthermore, Harris (2003) notes that implementing change in classroom practice involves more than just providing and assimilating new knowledge and skills. In order to change the approach to teaching it is necessary to alter the teacher's attitudes, views and personal theories about teaching. As stated above, the persistence of teachers' educational beliefs caused by their numerous

biographical experiences means that changing these beliefs is a complex and difficult task.

Apart from studies on teachers' cognitions, research investigating the relation between educational innovations and educational beliefs is limited. Therefore, this dissertation focuses on the individual teacher's idiosyncratic beliefs in relation to educational innovations by examining whether the integration of an innovation is fostered or hindered by teachers' educational beliefs.

Research questions

The present dissertation follows two inter-related lines of investigation. Firstly, in order to clarify our understanding of Flemish primary teachers' educational beliefs, an explorative investigation is carried out on the possible underlying structure for primary teachers' educational beliefs. Secondly, we investigate the relationships between primary teachers' educational beliefs and their use of ICT in primary education. As mentioned above, the use of ICT in primary school education is understood as an example of a significant innovation which has affected Flemish primary school education over the last few decades. In this dissertation the following question is explored:

What is the influence of Flemish primary teachers' prevailing educational beliefs on the use of ICT as an educational innovation in primary education?

In order to formulate an answer to this main research question, two research questions are formulated (in relation to the two lines of investigation stated above), and five subsidiary research questions are investigated:

Research Question 1

What are Flemish primary teachers' prevailing beliefs about purpose and nature of education and about learning and instruction?

Subsidiary research questions to Research Question 1:

- a. *Is it possible to develop a reliable instrument to measure primary teachers' educational beliefs?*
- b. *Is there a difference between primary teachers' general educational beliefs about purpose and nature of education and more classroom related beliefs about learning and instruction?*

Research Question 2

What is the influence of primary teachers' educational beliefs on their use of ICT for educational purposes?

Subsidiary research questions to Research Question 2:

- a. *What is the influence of Flemish primary teachers' educational beliefs on their classroom use of computers when the influence is controlled by technology related variables?*
- b. *What can be understood by innovative classroom use of ICT in Flemish primary education?*
- c. *Is there any relationship between Flemish primary teachers' educational beliefs and their innovative classroom use of ICT?*

Research design

A combined method design is used in this dissertation (Miles & Huberman, 1994). While a combined method design is suitable for the combination of both quantitative and qualitative approaches, in the present thesis more emphasis is laid on the quantitative component.

In order to generalize the research findings to the Flemish population and estimate the probability of (non-)existing relationships between the different variables, a survey research design using inferential statistics is chosen. In composing the samples needed for the different surveys, a proportionate sample design was used. By doing so, representation of various subgroups in the population is taken into account (Rodeghier, 1996). In deciding the strata, stratification variables were related to sex, location (region), and the type of educational network. In order to gather a large sample, we aimed for at least one teacher at each grade level to participate in this study.

The qualitative or interpretative part of the studies is restricted to the design of different instruments. Semi-structured interviews are carried out in order to get a richer understanding of both the educational context as well as the complex context of educational innovation. The interviews complement our data gathering by providing background information in the conceptual development and instrumentation. Table 2 gives an overview of the methods used in this dissertation.

Table 2
Overview of methodological choices in the dissertation.

Study (Chapter)	RQ ^a	Research design		
		Data collection	Sample	Method of analysis
I (Ch2)	1a	Literature review		
	1a	Survey	Student Teachers 2005	EFA ^b
	1a	Survey	Primary Teachers 2004	CFA ^c
	1a	Survey	Primary Teachers 2005	Correlation analysis
II (Ch3)	2a	Literature review		
	2a	Survey	Primary Teachers 2005	Multilevel Modelling
III (Ch4)	1a	Literature review		
	1a	Semi-structured interviews	Primary Teachers 2005	Development of instrument
	1a	Survey	Primary Teachers 2008	EFA ^b , CFA ^c
	1b	Survey	Primary Teachers 2008	Path analysis
IV (Ch5)	2b	Literature review		
	2b	Open ended questionnaire	Experts	Development of instrument
	2b	Survey	Primary Teachers 2008	CATPCA ^d
	2c	Survey	Primary Teachers 2008	Multivariate Multilevel Modelling

^a Research Question

^b Exploratory Factor Analysis

^c Confirmatory Factor Analysis

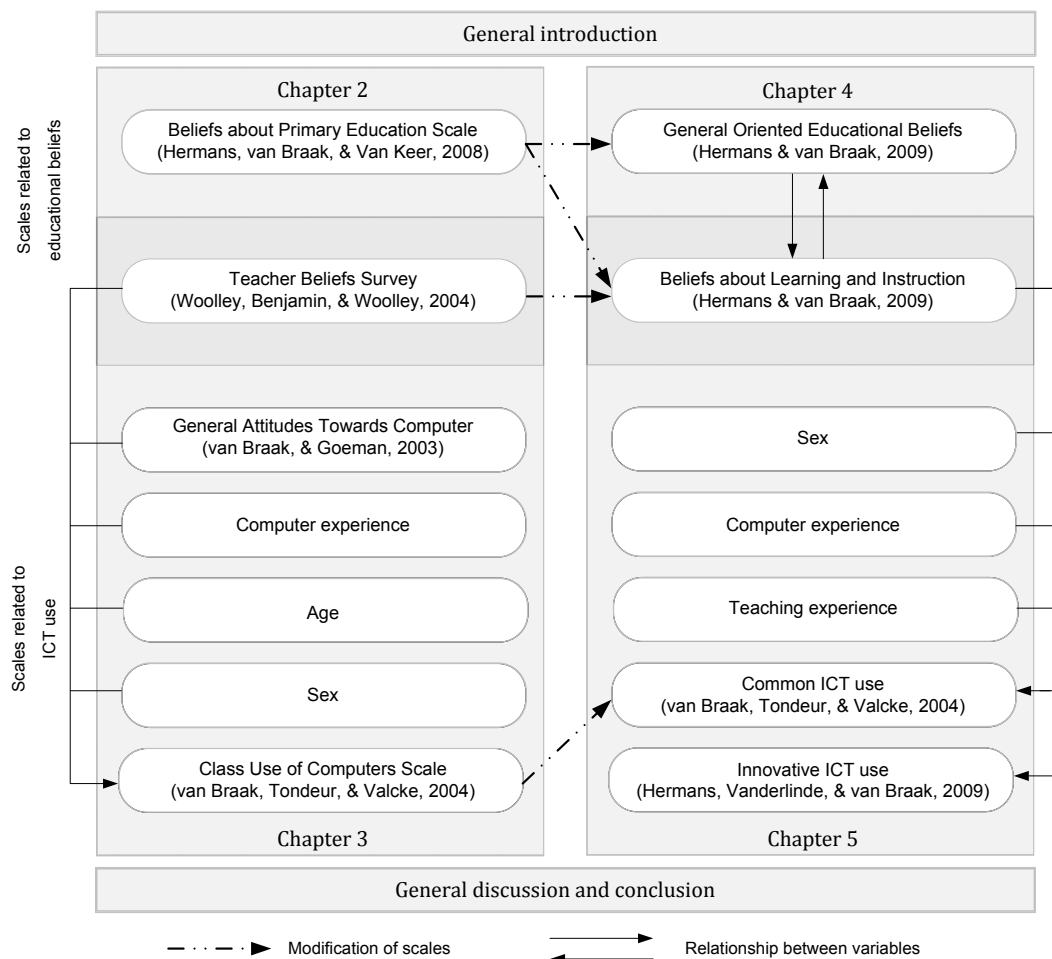
^d Categorical Principal Components Analysis

Overview of the dissertation

The present chapter outlines how this dissertation is situated within a broader context of ICT as an educational innovation and also introduces the concept of (educational)

beliefs. In the following chapters two lines of investigation will be carried out. Figure 2 gives overview of this dissertation, the relationships between the different chapters, and an indication of the mutual relationships between the different scales used in each study.

Figure 2
Schematic overview of the study.



As previous studies focus on specific teacher beliefs about the practice of teaching, research on primary teachers' general and underlying beliefs about the nature of 'good' education is limited. Chapter 2 focuses on the development and validation of a reliable measure of primary teachers' educational beliefs. The chapter starts by outlining the

development and validation of the 'Beliefs about Primary Education Scale' (BPES). This scale is used to assess teachers' beliefs about the general orientation and objectives of education, the nature of educational content, and desirable ways of knowledge acquisition. The process of developing this scale is divided into two phases whereby exploratory factor analysis and confirmatory factor analysis is used, followed by the construction of the Beliefs about Primary Education Scale (BPES). Finally, in order to investigate the construct validity of the BPES, its relationship with Woolley et al.'s (2004) 'Teacher Beliefs Survey' (TBS) is examined. The TBS is assumed to have a strong substantial overlap with the BPES. However, whereas the BPES examines general beliefs toward 'good' education, the TBS assesses beliefs with regard to the practical organization of the learning and teaching environment. Chapter 2 therefore provides an answer to Research Question 1 and related Subsidiary Questions 1a and 1b.

Chapter 3 provides evidence for the value of investigating the influence of primary teachers' educational beliefs on their classroom use of computers. While ICT includes all technology used for informative and communicative purposes, Chapter 3 focuses on the classroom use of computers. This is because the integration of computers in Flemish primary education has only recently become a large scale innovation. As a consequence, it can be assumed that the majority of Flemish primary teachers still experience the use of computers in their daily classroom practice as a novelty. The purpose of Chapter 3 is to explore the influence of primary teachers' educational beliefs as antecedents to classroom use of computers. Previous research has mainly focused on technology-related and demographical variables in determining antecedents to the use of computers in the classroom. We focus on teachers' educational beliefs (constructivist beliefs, traditional beliefs) as antecedents of computer use, while controlling for technology-related variables (computer experience, general computer attitudes) and demographical variables (sex, age). Multilevel modeling is applied to the data in order to take into account the similarities and differences between schools and teachers. In explaining the variance of the dependent variable 'class use of computers,' the BPES showed non-significant results. Furthermore deleting the BPES from analysis resulted in better results on explained variance. Therefore, we chose to present a parsimonious model. Chapter 3 addresses Research Question 2 and provides an answer to the subsidiary research question 2a.

Chapter 4 concentrates on the relationships between different clusters of educational beliefs. Building on the results and conclusions of Chapter 2, the aim of Chapter 4 is to get further insight into the relation between two main clusters of educational beliefs, namely general educational beliefs about the purpose and nature of primary education and classroom related beliefs about learning and instruction. The question as to what extent beliefs about learning and instruction are affected by the more general educational beliefs about the nature and purposes of primary education is presented. However, before formulating an answer to this question the first part of Chapter 4 concentrates on a revision of the BPES (Hermans, van Braak, & Van Keer, 2008) and the TBS (Woolley et al., 2004). Due to substantial overlap between these instruments, the decision was made to develop two new item pools: the first item pool contains primary teachers' beliefs about learning and instruction and the second item pool represents primary teachers' general beliefs about the purposes and nature of primary education. In order to develop and validate these instruments, factor analyses (explorative and confirmatory) are performed. To study the relationships between these instruments path analysis is applied. In line with Chapter 2, Chapter 4 provides an answer to Research Question 1 and related subsidiary questions 1a and 1b.

Whereas the focus of Chapter 3 was on the classroom use of computers, in Chapter 5 the focus is broadened to ICT use in general, and antecedents of common and innovative use of ICT in particular. However, given the contextual influence of what is meant by innovative use of ICT and the absence of proper instruments to measure innovative ICT use in primary education, the purpose of Chapter 5 is to develop a scale which measures Flemish primary teachers' innovative use of ICT.

In examining the antecedents of common and innovative ICT use, Chapter 5 further examines the influence of primary teachers' educational beliefs on ICT. By means of multivariate multilevel modeling the differentiated influence of beliefs about learning and instruction on both modes of ICT use (common and innovative) is explored. Chapter 5 addresses research question 2 and provides an answer to subsidiary questions 2a and 2b.

Following an integrated overview of the main conclusions and answers to the presented research questions, the final chapter outlines the practical implications of our findings and provides suggestions for further research.

CHAPTER 2²: MEASURING TEACHER BELIEFS: DEVELOPMENT OF THE BELIEFS ABOUT PRIMARY EDUCATION SCALE

Introduction

In educational research, there is a growing interest in the study of teachers' cognitive processes. In the past, a behaviourist paradigm encouraged studying the relationship between teaching behaviour and learner performance. These studies were catalogued as process-product studies (Brophy & Good, 1986) and could be characterized by an unidirectional focus on 'the process of teaching' and the impact of that process on 'the products of learning' (Fang, 1996). In many cases this rather positivistic research led to the formulation of recommendations on how to improve teaching practices in favour of student achievement (Fang, 1996; Shulman, 1986).

In the last decennia, there has been a shift in educational research in focus from teacher behaviour to teacher thinking. Under the influence of cognitive psychology and a diversification of research paradigms, the unidirectional emphasis on (observable) teacher behaviour in relation to pupil outcomes is decreasing, while the attention paid on the 'inner teacher' is gaining ground. Concepts such as teacher thinking, teacher beliefs, and teacher perceptions are gaining popularity in educational research (Clark & Peterson, 1986; Fang, 1996; Shulman, 1986). Building on this evolution, this study explores the nature of educational beliefs that precede or coincide with teachers' organization of teaching and learning practices. More specifically, the present study attempts to empirically describe how primary school teachers think about three educational issues: (a) the general goals of primary education, (b) the general nature of the educational content, and (c) ways of knowledge acquisition.

² Based on: Hermans, R., van Braak, J., Van Keer, H. (2008). Development of the Beliefs about Primary Education Scale: Distinguishing a developmental and transmissive dimension. *Teaching and Teacher Education*, 24, 127-139.

Theoretical framework: The concept of teacher beliefs

Defining teacher beliefs

In the last decennia a growing body of research characterizing teacher beliefs can be noticed. Based on prior reviews and analyses of teacher beliefs (Bryan, 2003; Fang, 1996; Kagan, 1992; Nespor, 1987; Pajares, 1992; Shulman, 1986; Vartuli, 1999) and on contributions in handbooks including chapters on teacher knowledge and beliefs (Clark & Peterson, 1986; Richardson, 2003; Woolfolk et al., 2006), it can be argued that there seems to be considerable agreement on some basics of teacher beliefs.

First, teacher beliefs can be represented as a set of conceptual representations which store general knowledge of objects, people and events, and their characteristic relationships (Clark & Peterson, 1986; Fang, 1996). Moreover, beliefs are often defined as psychologically held understandings, premises, or propositions felt to be true (Richardson, 2003). As a result, beliefs are the permeable and dynamic structures that act as a filter through which new knowledge and experience are screened for meaning (Campbell, Kyriakides, Muijs, & Robinson, 2004; Kagan, 1992; Nespor, 1987; Pajares, 1992; Smith & Croom, 2000). In consequence, as Harvey says: *‘a belief system is a set of conceptual representations which signify to its holder a reality or given state of affairs of sufficient validity, truth and/or trustworthiness to warrant reliance upon it as a guide to personal thought and action’* (Harvey, 1986, p. 660). Belief systems therefore serve as a personal guide by helping individuals define and understand the world and themselves (Pajares, 1992).

Second, a substantial body of research suggests that both the professional development of teachers and their classroom practices are influenced by educational beliefs (Bryan, 2003; Campbell et al., 2004; Clark & Peterson, 1986; Fang, 1996; Nespor, 1987; Pajares, 1992; Shulman, 1986, Vartuli, 1999; Woolfolk Hoy et al., 2006). Moreover, when teachers construct their professional identity, educational beliefs are acknowledged to play an important role (Kagan, 1992). According to Nespor (1987), beliefs reside in episodic memory of which the content is generated by earlier experiences, episodes, or from cultural sources of knowledge transmission. This rather affective and emotional aspect of beliefs plays an important part in storing, assimilating,

and retrieving knowledge by evaluating and judging gathered information (Nespor, 1987; Pajares, 1992). This provides support for the assumption that teacher beliefs, as a substructure of one's general belief system and coloured by former experience, underlie planning, decision making, and behaviour of teachers in the classroom (Fang, 1996; Kagan, 1992; Nespor, 1987; Pajares, 1992; Smith, 1997).

Finally, there is considerable agreement that the different substructures of the belief system are not necessarily logically structured (Richardson, 2003). Contrasting beliefs remain within the belief system as long as they are not examined against each other (Bryan, 2003). Furthermore, Rokeach (1976) suggested that some beliefs are more central than others. As a consequence, the more a belief is connected with others within the system, the more central and resistant it is to change (Brownlee, Boulton-Lewis, & Purdie, 2002; Bryan, 2003; Rokeach, 1976).

The measuring of teacher beliefs

A methodological problem in studying teacher beliefs is that they are far more difficult to measure than knowledge acquisition (Clark & Peterson, 1986). Moreover, the concept of beliefs can be situated in a whole range of concepts within each proxy, such as knowledge, thinking, perceptions, expectations, or attitudes (Calderhead, 1996; Clark & Peterson, 1986). Educational beliefs can cover different domains and several instruments have been developed and validated in the past (Bunting 1981, 1984, 1985; Kerlinger & Kaya, 1959a, 1959b; Silvernail, 1992; Smith 1993, 1997; Smith & Croom, 2000; Woolley et al., 2004). At first, Kerlinger & Kaya (1959a, 1959b) developed a robust instrument assessing 'traditional beliefs' and 'progressive beliefs' about education. Inspired by Dewey, Kerlinger and Kaya delimitate 'traditionalism' by stressing discipline, subject matter, and moral standards. The teacher acts as an authority that supervises the process of learning acquisition. He is the expert in a highly structured learning environment. Opposed to this, 'progressivism' is delineated with accents on the individual needs and interests of the child. Individual differentiation, social learning, and the larger demands of society form part of a progressive viewpoint as well (Kerlinger & Kaya, 1959a; 1959b). Besides a two-dimensional conceptualization of educational beliefs, some researchers have turned toward a multidimensional approach of belief

structuring (Denessen, 1999). Built upon the work of Kerlinger and Kaya, Silvernail (1992) identified three dimensions of educational beliefs. Next to a 'traditional' and a 'progressive' dimension, Silvernail added a 'romantic' orientation to the former model. This romantic factor contains items that are related to the importance of schools as sources of new ideas and promoters of self-awareness. Whereas teachers act as facilitators, students should have more responsibilities in the learning process (Silvernail, 1992).

In the field of early childhood and primary education, Bunting (1981, 1984, 1985) observed four belief dimensions with respect to teachers' educational attitudes. Along with a traditional 'directive' dimension, a rather student-centred orientation epitomizes an 'affective', a 'cognitive', and an 'interpretive' dimension. The 'directive' dimension affirms the value of traditionalism in education. It refers to the belief in the teacher's role as decision maker in the classroom and the lack of confidence in the student's ability to monitor his behaviour appropriately. The 'affective' component focuses on the emotional development. Self-awareness and self-esteem are significant objectives within the purpose of empathetic, supportive relationships. The 'cognitive' dimension stems from cognitive psychology. Accordingly, it contains descriptions of instructional techniques oriented toward the active and direct involvement of students during instruction by focusing on the maximum engagement of the mental processes. Finally, the 'interpretive' dimension reflects beliefs that a maximum effort has to be made to increase the meaning and relevancy of subject matter. Another study in the field of research on primary education is the development of the Primary Teacher Questionnaire (PTQ) conducted by Smith (1993). With an orientation toward child-centred, mostly constructivist principles, the PTQ was used to assess teacher beliefs about 'traditional' versus 'developmental appropriate practices' in primary-grade settings. Recently, Woolley et al. (2004) developed a three-dimensional 'teacher beliefs survey' to measure primary teacher beliefs. The dimensions 'traditional teaching' and 'traditional management' mainly zoom in on traditional approaches to the curriculum and assessment of the teaching component and behaviour management of the management component. In addition to the traditional dimensions, the validation study revealed the 'constructivist teaching' dimension which focuses on constructivist approaches to teaching and learning.

Purpose of the study

Thirty years ago, Brophy and Good (1974) wrote that a better understanding of teacher beliefs can contribute significantly to increased educational effectiveness. Notwithstanding the expanse of the body of research on primary teachers' beliefs, the focus of research has been predominantly on beliefs of prospective teachers (e.g. Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003; Stuart & Thurlow, 2000). Moreover, most instruments on in-service primary teachers' beliefs (e.g. Smith, 1993; Woolley et al., 2004) solely focus on assessing teachers' specific beliefs about the practice of teaching and classroom processes. However, primary teachers' beliefs are not only influenced by the immediate contexts of the classroom and students (Alexander, 2000; Woolfolk Hoy et al., 2006), but by the larger context of the national policies and the surrounding context of cultural norms and values as well (Woolfolk Hoy et al., 2006). In this respect, it can be argued that although previous studies shed light on rather specific teacher beliefs about the practice of teaching, research on primary teachers' more general and underlying beliefs about the nature of 'good' education still remains underexposed.

Taken into account the shortcomings in prior research, the purpose of the present study is to develop and validate a measure to empirically assess and describe primary teachers' beliefs about the nature of good education. That is, the major focus is on primary teachers' beliefs that undergird their beliefs about how the practice of teaching should be organized. Therefore it is necessary to have a reliable scale at one's disposal. To serve this purpose, the present article is divided into three distinct phases. In a first phase we endeavour to develop an item pool on primary teacher beliefs about the nature of education and explore its factor structure. A second phase involves confirming and refining the received instrument. In a final phase we focus on validating the measure by relating it to other instruments.

Methods

Item construction: Thinking about the nature of good education

A comprehensive review of the literature on educational beliefs was conducted in order to collect material for item construction. A set of belief statements was generated in

order to assess teachers' beliefs with regard to three general questions underlying the process of educational practice: (1) what should be the general goals of primary education, (2) what should be the general nature of the educational content, and (3) what are the desirable methods for knowledge acquisition.

(1) Goals of primary education

Beliefs on the general goals of education can be situated in the historical debate between traditionalism and progressivism (Ackerman, 2003; Dewey, 1999; Jackson, 1986; Kerlinger & Kaya, 1959a, 1959b ; Minor et al., 2002). Although we are aware of the subjective connotations of both labels, we use them to point at some differences in the field of tension overshadowing the debate on goals of education in general, and on primary education in particular.

Traditionalism, as a legacy of the Enlightenment, declares the primacy of knowledge and the scientific method (Eisner, 2001). With a focus on the discovery of regularities and supported by the conviction in the rational abilities, scientific progression becomes a benchmark of historical progress (Husén, 1997). Transposed into an educational context, more traditional or economic-technical approaches to education are characterized by an increased focus on the output. Mechanisms of central steering of education subscribe and consolidate the sensitivity towards results and measurable student output (Eisner, 2001; Standaert, 2001). In a comparative study of primary educational systems Alexander (2000) pays attention to the government's requirements for basic education. Consequently, due to the prescribed curriculum, education serves the purpose of preparing students in line with the expectations of society and as such guarantees the cultural heritage (Alexander, 2000; Dewey, 1999; Silvernail, 1992).

Next to traditionalism, progressive orientations can be noted. According to Jackson (1986), progressive approaches are characterized both by a tendency towards making the process of schooling more pleasurable and by placing greater control in the hands of the students. Progressive paradigms are conducted by a holistic view on man, nature, and society (Brooks & Brooks, 1999; Minor et al., 2002). Focusing on a harmonious development, the goals of primary education should be dictated in accordance with

individual needs and interests, as well as with the larger demands of society (Alexander, 2000; Kerlinger & Kaya, 1959a, 1959b; Minor et al., 2002).

(2) Nature of primary education

In accordance with Bernstein's collected and integrated code, a disjunction can be made with regard to the educational content (Bernstein, 1971). In a collected code, the different contents of the curriculum stand in a closed relation with each other. Due to strong boundaries, there is a good insulation between the different contents, which in turn leads up to specialization (Bernstein, 1971; Matthijssen, 1982). Consequently, this leads to subject-centred curricula focused on the acquisition of well-defined skills and content (Minor et al., 2002). Despite the division of the primary curriculum into different subjects, these subjects are taught by the same teacher (Roelofs, Visser, & Terwel, 2003). Nevertheless, basic skills as reading, writing, and arithmetics are still crucial components of the primary curriculum (Alexander, 2000; Kerlinger & Kaya, 1959a, 1959b; Silvernail, 1992).

At the other end of the continuum, the integrated code refers to a reduced insulation between the educational contents and subjects, an open relationship between subject teachers, and blurred boundaries between school-specific knowledge and commonsensical (everyday) knowledge (Bernstein, 1971; Matthijssen, 1982). In favour of the personal aspects of knowledge, there is an emphasis on the authenticity of the pedagogical framework (Roelofs & Terwel, 1999). By assessing students' interests and needs and taking into consideration students' individual differences, a connectedness to students' personal worlds is created (Brooks & Brooks, 1999; Roelofs & Terwel, 1999; Silvernail, 1992). The need for curriculum balance and a strong emphasis on personal development is further given by applying knowledge in diverse and authentic contexts and by stimulating students to engage in complex, meaningful, problem-based activities (Alexander, 2000; Windschitl, 2002).

(3) Knowledge acquisition in primary education

In the last decades, many authors in the field of psychology and education have proposed a shift in the way knowledge and skills should be obtained. Theories of constructivism support a learning model that moves away from passive transmission of knowledge to a model of active knowledge construction in a social context (Jonassen, 1991).

Central to transmissive models is the conviction that, as an abstraction of reality, knowledge can be constrained into a static strait-jacket built-up by separate bits and pieces. This conviction is mirrored in the notion of education as an activity of transmitting well-defined bodies of information and isolated skills from the teacher to the child (Dewey, 1999). Focusing on the mastery of the material, the teacher acts as an expert supplying direction, guidance, and control (Ackerman, 2003; Kerlinger & Kaya, 1959a). For the child a passive role in transmissive processes of knowledge acquisition is reserved (Dewey, 1999; Silvernail, 1992). In sum, in line with Deweyian thinking transmissive models of knowledge acquisition are one of imposition from above and from the exterior (Dewey, 1999).

With a shift towards a model of active knowledge construction, stress is laid on the active engagement of the learner in the learning process, independently as well as cooperatively (Bunting, 1981; Minor et al., 2002). One of the underlying assumptions is that in many primary classrooms, the children are not simply recipients of a teacher's pedagogy but are also participants and partners in it (Alexander, 1995). For example, research by Murphy et al. (2004) on second-grade students', preservice teachers', and in-service teachers' beliefs about good teachers and good teaching confirms the common belief that active teaching leads to active learning in which students are communicating ideas. Moreover, relinquishing knowledge as a 'mirror' of external reality is attended by the assumption that teachers have far less control over learners' learning process (Brooks & Brooks, 1999; Jonassen, 1991).

Item and scale development

Based on the literature study in educational philosophy and curriculum theory, a number of items were generated to reflect beliefs about primary education. A Likert-type item bank of 26 items was constructed in order to assess the general orientation and objectives of education, the nature of the educational content, and desirable ways of knowledge acquisition. Respondents were asked to rate each belief item separately, where 0='totally disagree', 1='disagree', 2='nor agree/nor disagree', 3='agree', and 4='totally agree'. In order to avoid academic wording and complexity, six primary school teachers were asked to reflect on the item content. This resulted in the refinement of some item statements. Then, the item pool was examined by three university experts in education. The screening process resulted in a pool of 22 items.

Participants

Three samples were included in the present study. Data collected from a first sample of student teachers and undergraduate students in educational sciences were used for scale construction (student sample). Given their theoretical and practical knowledge of the teaching profession, both groups of students were expected to express their primary education beliefs in a pronounced way. Data from a second sample of teachers were used to confirm the stability of the scale structure (teacher 2004 sample). The third sample was used to test the relationship of the Beliefs about Primary Education Scale (BPES) with other belief instruments (teacher 2005 sample).

Results*Student sample*

A sample was taken of student teachers and undergraduate students in educational sciences in order to investigate the factor structure of the educational beliefs scale. Student teachers in five teacher education institutions in Flanders (Belgium) were asked for cooperation, as well as undergraduate students in one university. A total of 352 questionnaires were filled in, consisting of 186 student teachers and 166 undergraduate

students. The respondents had an average age of 21.3 years (range 19–38 years; SD=2.6). Of all respondents, 79.6% were female.

In order to investigate the underlying structure of the 22 items, maximum likelihood exploratory factor analysis was used. The calculations of the exploratory factor analysis were based on the assumption that the factors were not correlated (orthogonal rotation). A first analysis showed four items with high loadings on several components or having structure coefficients lower than 0.40 and were therefore removed for further analysis. A second analysis was conducted on the basis of the 18 remaining items. Both the scree test (Cattell, 1966) and the minimum average partial technique (Velicer, 1976; Zwick & Velicer, 1986) were used in order to determine the number of factors to retain. Both techniques suggested a two-factor solution. The two-factor model accounted for 35.1% of the common variance. Items with a high loading on the first component could be labelled as a transmissive dimension (TD), while items loading high on the second model could be labelled as a developmental dimension (DD). The eigenvalues were 3.8 and 2.9, respectively (Table 3).

Table 3

Pattern/structure coefficients for the transmissive and developmental scale: Student teacher data (n=355).

		Component	
		I	II
Item 04	The content of a lesson has to be completely in line with the curriculum	.671	-.086
Item 01	Starting from the primary school experience, education has to be directed towards helping pupils get a position in the labour market. (i.e. get a job, or be 'employable')	.655	.148
Item 06	The school should be driven by the expectations of society	.634	.073
Item 03	'Good teaching' ultimately is aiming to raise economic productivity	.607	.131
Item 05	A teacher must define, in advance of the lesson, the learning content of each individual lesson	.597	-.031
Item 07	Schools always have to focus on the acquisition of knowledge	.579	-.214
Item 02	An important task of schools is to prepare young people for the professional world	.571	.092
Item 08	It is recommended that a teacher does not deviate from the content of an agreed learning program	.562	-.171
Item 09	The main task of a teacher is to transmit knowledge and skills to learners	.462	-.151
Item 13	Learners must get the opportunity to build up their own knowledge in a collaborative way or together with the teacher	-.106	.637
Item 11	During a lesson, we use resources and artefacts that the pupils bring to the classroom as well as those from the school (own books, etc.)	-.045	.634
Item 16	The emphasis on cross-curricular goals is important in primary education	-.057	.591
Item 17	The school has to promote the total and harmonious development of young people	.075	.573
Item 10	The learning process always has to start from the learning needs of the pupils	.069	.569
Item 14	A shift from 'knowledge orientation' to 'skills orientation', is right for primary education	-.020	.563
Item 15	Good teaching always relates to the personal experiences of the pupils and to their own 'world'	-.048	.551
Item 12	The learning process has to be in line with what learners know and are able to do	.104	.538
Item 18	It is important to follow broad themes and undertake the associated projects in a class even without being sure what the exact learning outcomes will be	-.146	.426

The first component, labelled 'transmissive beliefs' assesses the extent to which respondents believe education serves external goals and is outcome oriented with a closed curriculum. It also evaluates to which extent knowledge acquisition is perceived as being most adequately achieved through transmission. The second component was labelled 'developmental beliefs' and determines to what degree education should be oriented towards broad and individual development, be process oriented with an open curriculum, and to what degree knowledge should be acquired through construction. More specific

and in line with Smith (1997), central in this dimension is the notion that children are active participants in and contributors to their own development. For this reason, schooling is not delineated by an autonomous reality of social positions, objective rules, and decontextualized abstraction (Packer & Goicoechea, 2000). In contrast, the focus is both on the active engagement in the construction of knowledge by taking the learning needs and experiences of students as starting point as on the harmonious development of pupils. In this way, the foundations for the developmental line of thought are in line with Piaget, Dewey, Vygotsky, and Bruner.

Teacher 2004 sample

In order to collect teacher data, 76 primary school principals in Flanders (Belgium) were contacted by written mail and telephone and asked to participate. A condition of participation was that at least four teachers would fill in a questionnaire on educational beliefs. Written questionnaires were distributed by the school principal and completed anonymously. Six principals refused to participate, mostly due to work overload. The whole sample consisted of 399 teachers in 70 primary schools. Respondents with missing cases for the belief items ($n=22$) were removed from the sample. In this respect, the final sample consisted of 377 teachers in 70 primary schools. Consistent with the population mean, the majority of the participants were female (76.1%). The average age of the sample was 37.8 years (range 22–64 years; $SD=9.9$). There was a significant age difference between men and women ($F(1,375)=8.03$, $p<.01$). On average, males were 40.4 years ($SD=9.6$) and females 37.0 years ($SD=9.9$). This finding corresponds with the diminished intake of male teachers into the primary teaching profession.

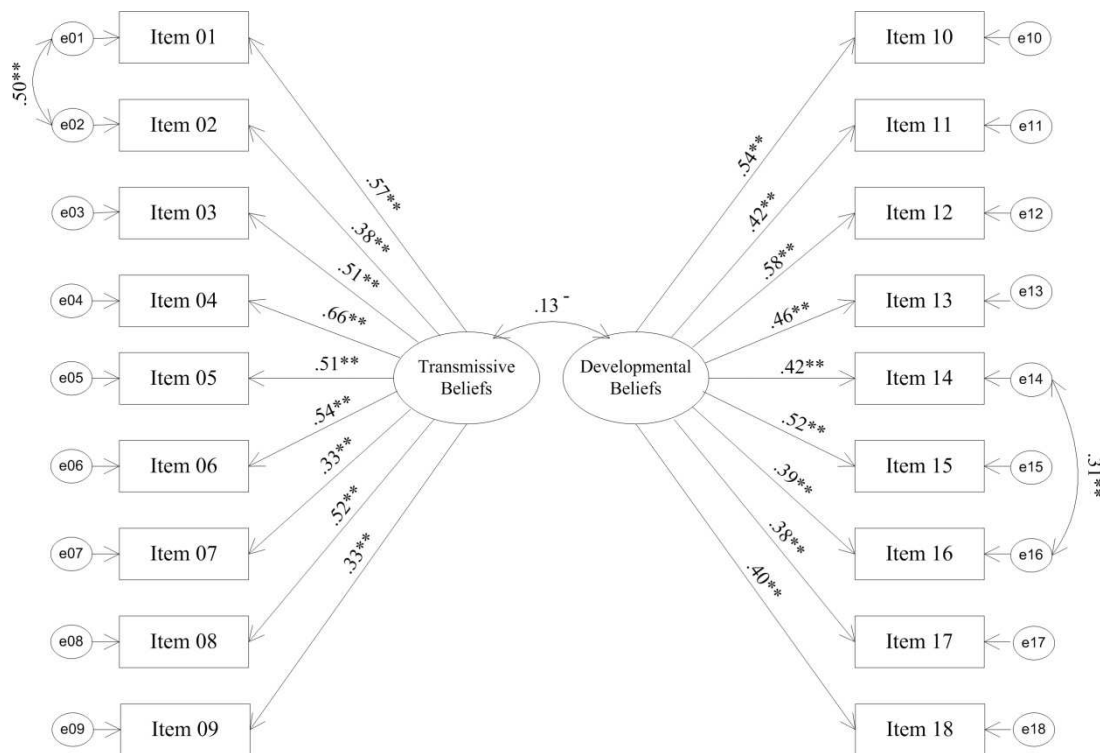
A confirmatory factor analysis (CFA) with a two-factor structure was used in a second sample in order to investigate the structure stability of the TD and DD. AMOS 5.0 (Arbuckle, 2003; Arbuckle & Wothke, 1999) was used to assess how well the data fit the hypothesized structure. Several fit indices were calculated to provide information on the adequacy of the fitted model: (a) the χ^2 and p-value, (b) the root mean square error of approximation (RMSEA), (c) the goodness of fit index (GFI) and the adjusted goodness of fit index (AGFI), and (d) the comparative fit index (CFI) (Bentler, 1990). A cutoff value close to .06 for RMSEA is needed before a relatively good fit can be concluded (Hu

& Bentler, 1999). Brown and Cudeck (1993) stated that values of RMSEA in the range between .05 and .08 indicate a fair fit. GFI, AGFI, and CFI should be above .90 to indicate an adequate fit.

The nine developmental items were hypothesized as indicators of the developmental beliefs factor and the nine transmissive items of the transmissive factor. A covariance coefficient was estimated between both factors. Two of the 18 belief items showed some skewness (item 15: -1.14; item 17: -1.39) and three items showed high kurtosis (item 13: 2.23; item 15: 1.25; and item 17: 1.67). The results of the CFA are presented in Figure 3.

Figure 3

*Results of the confirmatory factor analysis: structure/pattern coefficients for the transmissive and developmental belief items: teacher 2004 data (n=377); – not significant; **p<.001.*



The CFA, based on the nine developmental and nine transmissive belief items, confirmed the suggested structure that was obtained from the exploratory analysis on the student data. The results show a good fit between the hypothesized model and the observed data

(df=132, $\chi^2=272.0$, $\chi^2/df=2.06$). The goodness of fit estimates were CFI=.87, GFI=.92, and AGFI=.90. The RMSEA of .053, with a 90% interval of .044 and .062, indicates that the two-factor solution represents a reasonably good approximation. The narrow confidence interval is attributable to the relatively large sample.

No developmental items cross-loaded on the transmissive factor and vice versa. As can be seen in Figure 3, we allowed the residuals (e) to be correlated for two pairs of items, e01 and e02, and e14 and e16. This led to a significant decrease in χ^2 compared to the model without correlated residuals (from 385.1 to 272.0). The correlated residuals of item 01 and item 02 suggest a substantial overlap between the two items. Both items assess the belief toward an external orientation of educational goals, operationalized in the allocation function toward labour market and the preparation for the professional world. Yet, both items are clear indicators of a transmissive belief system. Both item 14 and item 16 assess aspects of a conceptual shift with regard to the nature and boundaries of the curriculum (a shift from knowledge towards skills and attitudes in a cross-curricular framework).

Reliability coefficients, descriptive statistics, and correlates for the two samples

A reliability analysis was performed to examine the internal consistency of the DD and TD. The results are presented in Table 4.

Table 4

Reliability coefficients, descriptive statistics, and correlates for the first and second sample.

	α	M	SD	r
Developmental dimension (DD)	.73 (.71)	77.1 (74.8)	12.3 (10.4)	-.05* (.02*)
Transmissive dimension (TD)	.77 (.75)	49.7 (52.5)	13.6 (13.6)	

Note: Coefficients without brackets for student sample ($n=352$). Coefficients between brackets for teacher sample ($n=377$).

* Correlation is statistically non-significant.

Due to acceptable internal consistency scores for both samples ($\alpha > .70$), items of the DD and TD could be summarized into a sum scale, ranging from a minimum score of 0 to a maximum score of 100. The higher the both scale scores are, the stronger the

developmental and transmissive beliefs are, respectively. In both samples, respondents reported higher scores on the DD compared to the TD.

The Pearson product-moment correlation between both sum scales was -.05 for the student sample and .02 for the teacher sample, indicating non-significance. For the teacher sample, this result is in line with the correlation coefficient between the two latent constructs ($r=.13$, $p>.05$) we found in the CFA (Figure 3).

Teacher 2005 sample

The sampling procedure in the teacher 2005 study was identical to the teacher 2004 study. In order to validate the developmental and transmissive belief dimension of the BPES, primary schools were contacted and asked to participate. None of the schools in the 2004 sample were included in the 2005 sample. In total 380 primary school teachers participated. The average age was 37.1 years (range 21-58 years). In line with the 2004 sample, a majority of participants were female (72.9%). Although men on average were 1.5 years older, age differences were statistically not significant ($F(1,374)=1.69$, $p=.19$).

This third study was set up in order to examine the relationship of the DD and TD with other belief instruments in proxy. Woolley et al. (2004) developed the Teachers Educational Beliefs Survey (TBS), containing two subdimensions which are assumed to have a strong substantial overlap with the BPES developmental and transmissive scale. Woolley et al.'s instrument differs from the instruments in our study with regard to the generality of educational beliefs. Whereas the items in our instrument assess general beliefs toward 'good' education, the former instrument assesses beliefs with regard to the practical organization of the learning and teaching environment. However, it is hypothesized that developmental beliefs toward education underlie favourable beliefs towards constructivist teaching practices. Similarly, we assume transmissive beliefs to be strongly underlying traditional teaching practices. In other words, we assume that the rather economic or outcome-oriented slant of the TD is a key factor in explaining more traditionalistic classroom approaches. The TBS has scores on a 6-point rating scale ranging from strong disagreement to strong agreement. Constructivist Teaching contains six items, traditional teaching nine items.

Before Woolley et al.'s instrument for assessing constructivist and traditional teaching could be used to construct validity purposes, the factor structure of all instruments had to be confirmed. Table 5 presents fit indices for both the BPES two-factor model, and the constructivist and traditional teaching beliefs two-factor model.

Table 5

Relative fit of models: Teacher 2005 sample.

	χ^2	df	χ^2/df	CFI	GFI	AGFI	RMSEA
Developmental/transmissive beliefs one-factor model	731.5	135	5.42	.37	.75	.68	.111
Developmental/transmissive beliefs two-factor model	322.0	132	2.44	.80	.90	.88	.063
Constructivist/traditional teaching one-factor model (Woolley et al., 2004)	330.6	90	3.67	.65	.88	.84	.085
Constructivist/traditional teaching two-factor model (Woolley et al., 2004)	212.1	89	2.38	.82	.93	.90	.061

The results in Table 5 indicate that both the BPES two-factor structure and the Constructivist Belief (CB)/TB structure could be reproduced. Even the fact that we used a Dutch translation of Woolley et al.'s constructivist and traditional teaching beliefs, the indices of fit showed that the hypothesized model is represented by the data. Furthermore, results indicate that both the BPES one-factor solution and the TBS one-factor solution did not lead to a satisfactory fit and are were therefore unsuitable for further analyses.

Next, the construct validity of the BPES DD and TD was investigated by examining correlations with the constructivist teaching and traditional teaching beliefs. Results in Table 6 confirm the strong relationship between the DD and the CB ($r=.52$), and the TD and the TB ($r=.50$). In line with the findings in the teacher 2004 sample, scores on the DD and TD were not correlated ($r=-.09$) and comparing the mean index scores on the DD and TD teachers seem to favour developmental beliefs ($M=73.7$; $SD=10.0$) rather than transmissive beliefs ($M=57.1$; $SD=11.8$).

Table 6

Reliability coefficients, descriptive statistics, and correlates for the teacher 2005 sample.

	<i>α</i>	<i>M</i>	<i>SD</i>	{1}	{2}	{3}
{1} Developmental dimension (DD)	.69	73.7	10.0	1		
{2} Transmissive dimension (TD)	.71	57.1	11.8	-.09	1	
{3} Constructivist beliefs (CB)	.62	65.4	11.8	.52	-.01	1
{4} Traditional beliefs (TB)	.70	60.5	11.5	-.38	.50	-.28

Discussion and conclusions

In the past decennia, much research focusing on teacher beliefs has been generated. As suggested earlier, an interesting and remarkable development of research on beliefs is that researchers have turned their attention from a one-dimensional to a multidimensional, layered belief construct. At first, Kerlinger and Kaya challenged the underlying assumption that the aggregate structure of social attitudes should basically be bipolar (Kerlinger, 1967; Kerlinger & Kaya, 1959a, 1959b). Bipolar means that ‘traditional’ and ‘progressive’ should be two ends of a single dimension of educational thought; one positive and the other negative (Kerlinger, 1967). Their investigation provided support for the assumption that ‘progressivism’ and ‘traditionalism’ are two relatively independent and orthogonal factors (Kerlinger & Kaya, 1959a, 1959b). In consequence, their study provides the groundwork for the opinion that teachers may simultaneously hold both progressive beliefs and traditional beliefs about education, an assumption also supported by Bunting's (1985) conceptualization of teachers’ beliefs toward education in a rather progressive ‘student-centred’ orientation and a traditional ‘directive’ orientation as two independent factors. Woolley et al. (2004) also subscribed this multidimensional view to teacher beliefs. Although more research is needed in order to clarify the inner structure of the teacher belief concept, the results in this study seem to provide evidence for a multidimensional structure as well.

Initially, the attempt to develop and validate a measure for assessing and describing primary teachers’ beliefs toward good education resulted in an item pool of 18 items. Investigating the underlying structure, exploratory factor analysis on student teacher data revealed a two-component model. In this initial stage the factors were labelled as ‘developmental beliefs’ and ‘transmissive beliefs’. Further investigation of the suggested

structure in two independent teacher samples confirmed the structure stability of the two-factor model. The results lend force to a conceptualization of beliefs about the nature of education as two relatively independent dimensions. In other words, primary teachers can hold both developmental and transmissive beliefs in relation to the goals of primary education, the nature of primary education, and knowledge acquisition in primary education.

The research also provides support for the assumption that more general beliefs of primary school teachers about the nature of education underlie their more specific beliefs about the practice of teaching. It can be assumed that favourable developmental beliefs about the nature of education could lead to positive beliefs toward constructivist teaching approaches. Correspondingly, transmissive beliefs can lead to positive beliefs toward traditional teaching practices. Future research should examine possible causalities between general teacher beliefs and beliefs on teaching and learning.

In future studies, also the effects of transmissive and developmental beliefs on conceptions of learning should be investigated. For example, Bolhuis and Voeten (2004) found five dimensions underlying teachers' conceptions of learning: self-regulation of learning, knowledge as actively constructed by the learner, the social nature of learning, a dynamic model of intelligence, and tolerance of uncertainty. A relevant question is whether teachers reporting high levels of transmissive beliefs will foster these new conceptions of learning that go with educational change. It is our assumption that transmissive beliefs will impede the acceptance of new ways of teaching and learning.

Finally, embedded in the implicit theories teachers hold toward the nature of education, teachers' educational beliefs influence teaching practice as well as the development of a professional identity (Campbell et al., 2004; Clark & Peterson, 1986; Fang, 1996; Nespor, 1987; Pajares, 1992; Shulman, 1986; Uhlenbeck et al., 2002). Better understanding of teacher beliefs might contribute to the improvement of understanding in teaching effectiveness (Brophy & Good, 1974; Fang, 1996). Therefore, the BPES may be a first step to conceptualize primary teacher beliefs toward the nature of good education. Furthermore, it could be argued that, as a layered construct, beliefs may vary with regard to different academic contents (Kagan, 1992). The question regarding the difference

between general beliefs about the nature of good education and specific, subject-related beliefs lends itself for further investigation. Furthermore, it can be put forward that the context overwhelms educational beliefs of teachers. This context is, for example, constituted by factors related to the classroom, the different grades in primary education, pupil characteristics, the learning content, the textbooks, and the larger context of the school influences (Uhlenbeck et al., 2002; Vartuli, 1999). As a result, a supposed consistency between teachers' beliefs and their practice could be questioned.

Although further research is required, the BPES is a valid instrument contributing to the conceptualization of primary teacher beliefs. In addition, the BPES can serve as an instrument for reflection. The complexity of the teaching practice and the role of educational beliefs within make it necessary that primary teachers (preservice as well as in-service) become more aware of their knowledge basis. At the one hand, a cross-sectional study of beliefs about 'good teachers' and 'good teaching' Murphy et al. (2004) suggested that powerful beliefs about teaching are formed early. Moreover, the study provided support for the assumption that students assembled entire belief systems about both what it means to be a good teacher and which knowledge is required for good teacher performance as early as primary education. In essence, practioners need to understand the power and the impact of beliefs shaped in their classrooms (Murphy et al., 2004). On the other hand, gaining insight in one's own beliefs is useful for preservice teachers in their guidance to become a teacher (Beijaard et al., 2000) and may lead up to a balanced and coherent view about the purpose and process of schooling. For both reasons, research that illuminates beliefs, the relationships among belief systems, and the role of beliefs in instructional decision making can be useful for primary teachers to become self-reflective in their approach to their classroom behaviour (Smith, 1997). Also from this reflective point of view, a broader perspective on beliefs about primary education and the internal relationships between general and specific beliefs about primary education is desired; certainly due to the contextual influences primary education has to deal with. As mentioned above, further research is needed to provide more insight in the complex relation between general teacher beliefs about the nature of education and the more specific beliefs about the practice of teaching. In order to achieve this aim, Pajares (1992) argues that surveys should be supplemented with complementary research methods, like narrative research and the use of concept maps.

CHAPTER 3³: THE IMPACT OF PRIMARY SCHOOL TEACHERS' EDUCATIONAL BELIEFS ON THE CLASSROOM USE OF COMPUTERS

Introduction

The history of education is characterised by successive innovations that aim at the implementation of higher quality. For many years, scholars have pursued more effective, efficient and/or satisfying teaching and learning practices. This is reflected in the adoption of a variety of curriculum approaches that have shifted from a mental discipline and humanistic tradition to approaches that centre on social efficiency, child development and/or social meliorism that aim at empowering learners to advance society (Kliebard, 1989). Whereas traditional instructional methods have been criticised for failing in preparing students to meet the challenges of contemporary society, the current educational focus is on learner-centered constructivist approaches (Hannafin & Land, 1997). The latter has affected the decision-making process of teachers about the types of learning objectives, the learning content, the selection of media, organisational issues, the choice of instructional strategies and the adoption of approaches towards assessment and evaluation. However, the slow uptake of the innovative ideas in mainstream education questions the success of the implementation of the innovative approach. As Fullan (2001) pointed out, the perceptions of the actors involved in educational innovations are a critical factor in the success of an innovation. Therefore, the notion that teachers are to be considered the most crucial player in educational change is not surprising (Van Driel, Verloop, Van Werven, & Dekkers, 1997). It is stated that past educational reforms have failed, due to the mismatch between the meanings attached to the innovation by those involved in the instructional process (van den Berg et al., 1999). In this respect, the personal willingness of teachers to adopt and integrate innovations into their classroom practice seems to be of crucial importance (Ghaith & Yaghi, 1997).

³Based on: Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*, 51, 1499-1509.

In the present study, we focus on an educational innovation that builds upon the integration of computers in classroom practice. According to Watson (2006), the introduction of information and communication technologies (ICT) is often inspired by a widespread and technocentric belief about the transformative nature of these new technologies. This assumption assigns to technology the capacity to support powerful and sophisticated learning environments. Technology is seen as a golden key in facilitating technology-enhanced, student-centred teaching environments (Hannafin & Land, 1997). According to these authors, technology provides opportunities for access to resources and tools that facilitate the construction of personal meaning by relating new knowledge to existing conceptions and understanding. However, the current level of ICT implementation of ICT has yet not reached a critical mass (Scrimshaw, 2004) and there is a tension between the input of enthusiastic forerunners and the reality of a more widespread implementation (Watson, 2006). For example, research of Tondeur et al. (2007b) on the link between national curricula and the use of ICT in primary education in Flanders has shown that Flemish primary-school teachers still to a large extent stress technical ICT skills. Smeets (2005) also argues that current ICT-use in Dutch primary schools seems to reflect a rather traditional, skills-oriented instructional use with the emphasis on skills-based applications.

The gap between the innovation objectives and the current level of ICT integration has inspired researchers to focus on the individual factors affecting the nature of ICT adoption in the classroom. Identification of factors explaining computer use might provide answers to why some teachers embrace the use of computers in the classroom and others don't. In search of antecedents of computer use, many studies focussed thus far on teacher attitudes, computer self-efficacy and computer proficiency (e.g., Albirini, 2006; Demetriadis, Barbas, Molohides, Palaigeorgiou, Psillos, Vlahavas, et al., 2003; van Braak et al., 2004). These studies try to explain educational computer use mainly through technology-related teacher characteristics. Within the context of the present study, this list of technological determinants is extended with educational beliefs. The main contention is that teachers' classroom use of computers cannot be fully understood without taking their underlying educational beliefs into consideration (Becker, 2001; Dede, 2000).

Theoretical framework

The concept of teacher beliefs

It is difficult to describe teacher beliefs in unequivocal terms considering the myriad ways they have been defined in the research literature. However, building on the substantial body of literature about teacher beliefs and teacher belief systems, a list of shared defining characteristics can be developed. A first defining characteristic is that teacher beliefs can be considered to be ‘the individual conceptions about desirable ways of teaching and conceptions about how students come to learn’ (Beijaard, 1998). Those beliefs are grounded in teachers’ personal belief systems and represent psychologically held understandings, premises, or propositions felt to be true (Richardson, 2003). The set of someone’s beliefs about the physical, the social world, and the self is clustered in a belief system (Rokeach, 1976). In fact, belief system seems to consist of an eclectic mix of rules of thumb, generalisations, opinions, values, and expectations grouped in a more or less structured way (Lowyck, 1994; Rokeach, 1976). In primary education, examples of belief systems are reflected in teacher-centred and learner-centred approaches towards teaching (e.g., Jackson, 1986; Schuh, 2004).

Second, teacher beliefs are established by earlier experiences and influenced by the professional context (Pajares, 1992). By the time students enter teacher education programs, their beliefs are already shaped by their personal experiences as pupils (Keys, 2007; Pajares, 1992; Raths, 2001). As a result, teachers’ beliefs appear to be relatively stable and resistant to change (Kagan, 1992; Pajares, 1992; Van Driel, et al., 1997). According to Rokeach (1976), the stability of a belief is also clear when considering the position of beliefs within the central-peripheral dimension in a person’s belief system. That is to say, the more a belief is related to other beliefs, the more it is positioned at the centre of the belief system and the less this belief is subject to change.

The former implies that it is important to consider the mediating impact of beliefs in the adoption process of educational innovations. Teacher beliefs appear to influence teaching practices and their identity (e.g., Clark & Peterson, 1986; Fang, 1996; Kagan, 1992; Kane, Sandretto, & Heath, 2002; Pajares, 1992; Prawat, 1992; Zeichner & Tabachnick, 1985). This is particularly true when educational innovations centre on

classroom related phenomena that teachers have to deal with as a complex set of interacting variables and processes, and related to a variety of actors such as pupils, parents, colleagues, management, ... (Bruner, 1996; Uhlenbeck et al., 2002). At a micro-level, teachers enter the teaching setting with their personal theories about teaching and learning, as well as their personal interpretation of the instructional situation (Uhlenbeck et al., 2002; Shulman, 1987). This reinforces the earlier statement that teachers are important agents in the concrete implementation of an innovation process within a classroom setting (Albirini, 2006; Van Driel, et al., 1997).

The concept of teachers' educational beliefs related to ICT

As part of the worldwide proliferation of ICT use in society, ICT has entered the educational field in a pervasive way and is often credited with the potential to revolutionise a so-called outmoded educational system (Albirini, 2006). ICT is expected to offer both a means to operationalise constructivist principles and to create effective constructivist learning environments (Bellefeuille, 2006). Smeets (2005), for example, investigates Dutch primary teachers' views regarding the potential contribution of ICT to the creation of powerful learning environments in which the emphasis is laid on rich contexts and authentic tasks for the pupils, where active and autonomous learning is stimulated, where co-operative learning is fostered, and where the curriculum is tailored to the needs and capabilities of individual pupils. Furthermore, educationists expect ICT to help students to meet the challenges of the fast-changing world (Hawkrigde, 1990; Kearns & Grant, 2002). For example, students need to learn how to seek information, to think critically, and to take initiatives. ICT is expected to mediate in this process of socialisation and enculturation (Lim, 2002; Dede, 2000).

In order to realise the potential of ICT, national governments have supported ICT's integration in education. For example, in the Flemish educational context where this study is based, cross-curricular attainment targets for ICT have been prescribed for primary education (Ministry of the Flemish Community, Department of Education, 2007). Here, ICT is no longer seen as a particular knowledge domain, but rather as a supportive tool to improve teaching and learning. Nevertheless, the current level of ICT-implementation in primary schools remains rather restricted (Scrimshaw, 2004). In

addition, research evidence also reveals that significant differences can be observed between and within schools in the way ICT is currently being implemented (e.g., Goodison, 2002; Loveless & Dore, 2002). For example, in reviewing both the municipal and school ICT plans in Denmark, Bryderup and Kowalski (2002) noticed significant differences between schools regarding the forms and content of the individual plans, varying from an emphasis on pedagogical considerations to more instrumental accents. Other differences were found concerning the description of content and details on how goals were to be achieved. Similar remarks were made in a recent study of Tondeur et al. (2007b) on the integration of ICT competency frameworks in Flemish primary education. Their study revealed that government-imposed ICT competencies do not automatically result in changes in classroom practices.

Recent research about differences in ICT adoption by teachers is often limited to technology-related variables, such as ‘computer experience’ (Becker, 2001; Williams et al., 2000) and ‘attitudes towards computers’ (Albirini, 2006; van Braak, 2001). A general finding is that computer experience is positively related to computer attitudes. The more experience teachers have with computers, the more likely they will report positive attitudes towards computers (Rozell & Gardner, 1999). Positive computer attitudes are expected to foster computer integration in the classroom (van Braak et al., 2004). Other factors frequently related to ICT integration include age (e.g., Bradley & Russell, 1997) and gender (e.g., Shapka & Ferrari, 2003). Many researchers have stressed the ‘gender gap’ in computer use. Studies report e.g., lower levels of classroom use of computers by female teachers (Van Braak et al., 2004).

However, building on the earlier discussion about the relationship between educational innovations and teacher beliefs, the process of ICT integration cannot solely be explained by referring to technology-related variables and/or demographic variables. As stated earlier, at a more individual level, teachers’ educational use of computers can only be fully understood when taking into account their educational beliefs (Becker, 2001; Dede, 2000). Recent studies demonstrate that teacher beliefs about learning and instruction are indeed a critical indicator for the classroom use of computers (Becker, 2001; Dede, 2000; Ertmer, 2005). On the one hand, research indicates that teacher beliefs can be barriers to ICT integration (Ertmer, 2005). On the other hand, findings suggest that

highly active computer users seem to adopt a constructivist position (Becker, 2001). This is in line with Duffy and Jonassen's statement (1992) about the strong correlation between ICT use and the constructivist perspective. Yet, individual's decisions to accept technology is *'affected by multiple key factors or considerations pertinent to the technology, the user and the organizational context'* (Hu, Clark, & Ma, 2003, p. 227).

The available research evidence clearly illustrates that the question of ICT integration cannot only be explained by referring to teacher demographics or computer proficiency, experience and attitudes. Rather, it seems to be valid to shift the focus towards a broader debate about the central role and position of mindsets, assumptions, beliefs, and values of individuals and organisations (Tearle, 2003).

Purpose of the study

The present study links questions about the integration of computer use in the classroom to research about teacher thinking and the innovation of primary education. The purpose of the present study is to investigate the relationship between teachers' educational beliefs and their computer use, while controlling for the impact of technology-related determinants (computer experience, supportive computer use, general computer attitudes) and teacher-related demographic variables (gender and age). To study this complex relationship, multilevel modelling will be applied.

Methods

Participants

In order to empirically investigate the effect of teachers' educational beliefs on the classroom use of computers, a questionnaire was administered to a sample of 525 primary school teachers from 68 schools in Flanders (the Dutch-speaking area of Belgium). The participants were distributed evenly across all primary-school grades. Of the respondents, 81% were female and 19% were male. Ages ranged from 22 to 64 years old ($M = 37$, $SD = 10$).

Statistical analysis approach

Nevertheless, building on the earlier discussion about the nature and the development of teacher beliefs and belief systems, interplay can be assumed between teachers as individuals and the social context (team or school) to which they belong. It can also be hypothesised that the properties of the particular social context influence individual teacher beliefs and in turn this context is also influenced by the individuals who make up the particular social context. In other words, the observations of individual teachers are not completely independent of what teachers share in their school setting (Hox, 1995). This assumption strongly determines the nature of the statistical analysis procedures to be adopted when studying teacher beliefs. While standard linear regression techniques attempt to explain the variation in a dependent variable (such as classroom use of computers) in terms of one or more independent variables (such as teacher demographics or computer experience), the adoption of multilevel modelling techniques is helpful to take different levels within a hierarchy of nested variables into account (Gorard, 2003). It is critical to recognize that within- and between-subject level relationships are independent (Nezlek, 2001). For this reason, Nezleck (2001) stipulates that using techniques that do not examine “phenomena at different levels simultaneously can provide misleading descriptions of the relationships within a data set”.

In the present study, teachers ($N = 525$) are nested within 68 Flemish primary schools. Therefore, the problem under investigation reflects a typical hierarchical structure. For this reason, multilevel modelling (MLwiN 2.02) was applied to investigate the effect of demographics, computer experience in years, general computer attitudes, supportive computer use in hours, and teachers’ constructivist and traditional beliefs on the classroom use of computers.

Considering the aim of the study, three main models will be tested. After testing the null model, a compound model will be created by respectively adding teacher demographics, technology-related variables and teacher beliefs to the null model. Stepwise multilevel modelling enables us to check the additional value for each consecutive model. In doing so, the different subsets of variables can be compared to one another as to the proportion of explained variance. Model improvement is assessed by studying the decrease in the deviance value compared to the previous model. Within this

respect, the difference in deviance is used as a test statistic having a chi-squared distribution (Hox, 1995; Snijders & Bosker, 1999).

Variables

Dependent Variable

Classroom Use of Computers. In this study, ICT is delineated to the classroom use of computers. To examine this dependent variable, a modified version of the ‘Class Use of Computers’ scale of van Braak et al. (2004) was used. Items in this scale ($n = 8$) build on a five-point scale: 0 (never), 1 (once a term), 2 (monthly), 3 (weekly) and 4 (daily).

Independent Variables

Teacher Beliefs: Constructivism and Traditionalism. The ‘Constructivist Beliefs’ and ‘Traditional Beliefs’ scale of Woolley et al. (2004) was used in this study. Whereas ‘Constructivist Beliefs’ ($n = 7$) focuses on constructivist, student-centered approaches to teaching and learning, ‘Traditional Beliefs’ ($n = 9$) mainly zoom in on a teacher-centered approach (Hermans, van Braak et al., 2008; Woolley et al., 2004). Items in both scales are rated by using a five-point Likert scale ranging from ‘totally disagree’ to ‘totally agree’.

Teacher Demographics. Building on the theoretical framework, gender and the teacher’s age are expected to influence the classroom use of computers.

Computer Experience and Supportive Use of Computers. Respondents were questioned about their computer experience expressed in number of years. Each respondent was asked to indicate the number of years he or she had been using computers. Beside computer experience, respondents were also asked to calculate the extent to which they use computers to support their classroom practices in numbers of hours (e.g., use of a computer as a diary, to prepare lessons or to develop materials).

Computer Attitudes. The instrument used for measuring computer attitudes is the ‘General Attitudes Towards Computers’ of van Braak & Goeman (2003). The scale comprises items related to computer liking, computer anxiety and computer confidence.

Items in the scale ($n = 5$) build on a 5-point Likert scale ranging from ‘totally disagree’ to ‘totally agree’. The items help to calculate an overall value for the variable ‘General Computer Attitude’, varying within a 0-100 range. The higher the scale score, the more positive the attitudes towards working with computers were.

Results

Descriptive Statistics and Reliability of the Research Instruments

In the questionnaire, to measure the dependent variable ‘Class Use of Computers’, a total of eight items was included covering different applications of the classroom use of computers. As shown in Table 7, the three most applied applications of ‘Class Use of Computer’ were (1) ‘use of educational software for training skills’, (2) ‘differentiation’ and (3) ‘cooperative learning’.

Table 7
Descriptives of the ‘Class Use of Computer Scale’.

Items	<i>M</i>	<i>SD</i>	Never (%)	Half a year (%)	Monthly (%)	Weekly (%)	Daily (%)
Encouraging pupils to train skills	2.11	1.08	8.9	20.0	28.0	37.1	6.0
As a tool for differentiation	1.86	1.25	20.6	16.9	25.5	29.8	7.2
Encouraging cooperative learning	1.83	1.15	16.9	21.4	27.2	30.4	4.1
Asking pupils to do assignments on the computer	1.66	1.26	26.5	17.5	23.3	28.5	4.2
Encouraging pupils to search for information on the Internet	1.34	1.24	37.5	16.2	23.8	19.7	2.7
As a tool for demonstration	.97	1.10	46.6	23.1	19.0	9.4	2.0
As a tool for instruction	.96	1.15	49.5	21.1	15.3	12.2	1.9
Teaching about the possibilities of computers	.69	.99	59.8	20.6	11.3	7.8	.6

The mean scores for the teacher belief scales ‘Constructivism’ and ‘Traditionalism’ were $M = 64.7$ ($SD = 12.2$) and 59.3 ($SD = 11.7$) respectively (see Table 8). The average computer experience was 10.34 years. With respect to supportive computer use, primary teachers reported using the computer 5.93 hours a day for pre-active and post-active tasks. Concerning ‘General Computer Attitudes’, with a mean score of $M = 72.0$ ($SD = 18.9$), primary-school teachers indicated a predisposition towards computers. Finally, building on the individual item scores, an overall scale score was calculated and reliability of the instruments was examined using Cronbach’s alpha. As shown in Table 8, all instruments showed satisfactory internal consistency.

Table 8
Descriptives, reliability coefficients & correlates.

	α	M	SD	1.	2.	3.	4.	5.	6.	7.
1. Age	-	36.79	9.87	1						
2. Gender	-	-	-	.07	1					
3. Computer Experience	-	10.34	3.98	-.08*	.13	1				
4. Supportive Computer Use	-	5.93	4.53	-.24	.01*	.20	1			
5. General Computer Attitudes (N=5)	.85	72.04	18.85	-.35	.18	.38	.21	1		
6. Constructivism (N=7)	.68	64.72	12.16	-.11	.01*	.02*	.18	.14	1	
7. Traditionalism (N=9)	.74	59.26	11.68	.11	.00*	-.13	-.25	-.15	-.27	1
8. Class Use of Computers (N=8)	.76	35.81	17.79	-.04*	.16	.23	.15	.24	.25	-.20

Note: * Correlation is non significant

Multilevel Model

Null model. Since no independent variables at teacher level (level1) were included in the random intercept null model, the intercept of the null model (Model 0) represents the overall mean of the score on the ‘classroom use of computers’ of all teachers in all schools. Scrutinising the results reported in Table 9, we find clear support for applying multilevel modelling in studying the classroom use of ICT. Both variances at teacher level ($\chi^2 = 228.75$, $df = 1$, $p < 0.001$) and school level ($\chi^2 = 12.86$, $df = 1$, $p < 0.001$) are significantly different from zero. The proportion of variance attributed to between-school differences can be calculated by dividing the total variance of the ‘Class Use of Computers’ ($57.674 + 259.313$) by the within-school (259.313) variance. This results in

18.19 percent of the variance to be attributed to differences between schools, and 81.81 percent of the variance due to differences at the teacher level.

Model 1. As mentioned above, in earlier research, demographical teacher variables such as gender and age have been found to influence the classroom use of computers. In a first model, ‘Gender’ and ‘Age’ were added to the fixed part of the model (Model 1a). Since ‘Age’ ($\chi^2 = 0.121$, $df = 1$, $p = 0.73$) did not contribute significantly, it was excluded from the model. But a significant effect of ‘Gender’ (Model 1b) was observed with an average difference in favour of males ($\chi^2 = 15.549$, $df = 1$, $p < 0.001$). Compared to the null model, the inclusion of ‘Gender’ resulted in a significant model improvement ($\chi^2 = 31.347$, $df = 1$, $p < 0.001$).

Model 2. At a second stage of model specification, a compound model including teacher gender and technology-related variables was estimated (Model 2). Considering the non-significant effect of ‘Supportive Computer Use’ in Model 2a ($\chi^2 = 2.94$, $df = 1$, $p = 0.09$), this variable was omitted from further analyses. Next to a significant contribution of ‘Gender’ ($\chi^2 = 9.42$, $df = 1$, $p < 0.01$), ‘Computer Experience’ and ‘General Computer Attitudes’ also contribute in a significant way ($\chi^2 = 10.93$, $df = 1$, $p < 0.001$, $\chi^2 = 12.44$, $df = 1$, $p < 0.001$, respectively). The intercept of 35.01 in Model 2b stands for the overall mean across female teachers with an average score on ‘Computer Experience’ and ‘Computer Attitudes’. Model improvement by moving from Model 1 to Model 2b was clearly significant ($\chi^2 = 86.69$, $df = 1$, $p < 0.001$).

Model 3. At the final stage, Model 2 was extended by adding teacher beliefs to the regression equation (Model 3). This final model allows us to explore whether teachers’ beliefs have a significant effect on the classroom use of computers. The analysis results confirm the latter and support the assumption that constructivist beliefs about teaching and learning have a significant positive effect on the ‘Class Use of Computers’ ($\chi^2 = 21.69$, $df = 1$, $p < 0.001$). By contrast, traditional beliefs were found to have a negative impact ($\chi^2 = 7.36$, $df = 1$, $p < 0.05$). Other significant determinants of the ‘Class Use of Computers’ were ‘Gender’ ($\chi^2 = 12.96$, $df = 1$, $p < 0.001$), ‘Computer Experience’ ($\chi^2 = 11.85$, $df = 1$, $p < 0.001$), and ‘Computer Attitudes’ ($\chi^2 = 5.71$, $df = 1$, $p < 0.05$). Compared to Model 2b, the final model results in a significantly better fit ($\chi^2 = 89.7$, $df = 1$, $p <$

0.001). As can be seen in Table 9, 16.68 per cent of variance in the dependent variable is to be situated at school level.

Table 9

Estimates from a random intercept model (dependent variable: 'Class Use of Computers').

	Model 0	Model 1a	Model 1b	Model 2a	Model 2b	Model 3
	B	B	B	B	B	B
<i>Fixed</i>						
Intercept	36.13 (1.19) ***	34.87 (1.23) ***	34.86 (1.23) ***	35.10 (1.17) ***	35.01 (1.17) ***	34.73 (1.11) ***
Age		-.027 (.08)	-	-	-	-
Gender (man)		7.59 (1.92) ***	7.55 (1.91) ***	6.56 (1.93) **	5.82 (1.90) **	6.45 (1.85) ***
Computer Experience				.55 (.20) **	.64 (.19) ***	.66 (.19) ***
Supportive Computer Use				.29 (.17)	-	-
General Computer Attitudes				.12 (.04) *	.14 (.04) ***	.09 (.04) *
Traditionalism						-.17 (.08) ***
Constructivism						.29 (.06) **
<i>Random</i>						
Level 2 – school σ^2_{u0}	57.67 (16.39) ***	57.01 (16.18) ***	57.53 (16.21) ***	48.89 (14.57) ***	50.62 (14.67) ***	43.93 (13.13) ***
Level 1 – teacher σ^2_{e0}	259.31 (17.15) ***	252.35 (16.74) ***	251.70 (16.68) ***	235.42 (15.93) ***	235.85 (15.73) ***	219.44 (14.73) ***
<i>Model Fit</i>						
Deviance	4455.91	4416.97	4424.56	4226.79	4337.87	4248.17
χ^2			31.35		86.69	89.7
df			1		2	2
ρ			< .001		< .001	< .001
Reference			M0		M1b	M2b
<i>Variance</i>						
ρ (%)	18.19		18.60		17.67	16.68

Note: Values between brackets are the standard errors

* $p < .05$, ** $p < .01$; *** $p < .001$

Finally, in order to investigate the additional contribution of each subset of variables in explaining a proportion of variance in the regression model, the squared multiple correlation coefficient (R^2) can be computed based on the method of Snijders and Bosker (1999). The variance explained is divided into the variance accounted for both at teacher

and at school level. Table 10 presents the R^2 at teacher (R^2_{micro}) and school level (R^2_{macro}) for each model. Calculation of the added value (ΔR) gives us insight in the proportion of variance explained by each individual subset. As shown in Table 10, an increase in the proportion of variance of 7,2 % at teacher and 9,8 % at school level can be noticed for Model 2b (compared to Model 1b). The additional contribution in the proportion of explained variance is explained by the extension of Model 1b with the technological-related variables ‘Computer Experience’ and ‘General Computer Attitudes’. Correspondingly, by adding teacher beliefs to Model 2b, the results show an increase of 7,3 % at teacher level and 9,7 % at school level (Model 3). As becomes clear from Table 10, the additional proportion of variance explained by teacher beliefs and technology-related variables is comparable at teacher and school level.

Table 10
Proportion of variance explained at each level.

	Model 1b	Model 2b	Model 3
R^2_{micro} (Proportion of variance explained at teacher level)	.024	.096	.169
ΔR^2_{micro}		.072	.073
R^2_{macro} (Proportion of variance explained at school level)	.012	.111	.207
ΔR^2_{macro}		.098	.097

Discussion and conclusions

In this study, empirical evidence was found supporting the hypothesis that teacher beliefs about the practice of teaching are a significant determinant in explaining why teachers adopt computers in the classroom. Though the reported classroom use of ICT can hardly be described as ‘innovative’ in nature, constructivist teacher beliefs were found to be a strong predictor of classroom use. In contrast, traditional teacher beliefs seem to have a negative impact on the integrated classroom use of computers. These findings are in line with earlier research suggesting that teachers with a strong constructivist orientation are more prone to adopting tools that foster constructivist learning approaches (Riel & Becker, 2000). Next to the impact of educational beliefs, the final multilevel analysis model shows that gender, computer experience and general computer attitudes do have a significant effect on the class use of computers.

Furthermore, the stepwise approach in the multilevel modelling analysis allowed studying the complex interplay of beliefs, demographic, and technology-related variables, and this both at teacher and school level. The additional contribution in the proportion of explained variance by demographic, technology-related variables and educational beliefs could be compared with one another. Building on the results, teacher beliefs seem to be at least as important as technology-related teacher characteristics such as computer experience, general computer attitudes and gender. Therefore, and this is an important result, the present study sheds light on the mediating role of primary teachers' educational beliefs in the resistance and receptiveness of primary school teachers to integrate computers in their classroom practice. As mentioned earlier, the teacher as an "innovator" or "preserver" is a critical actor to influence change in the classroom (Albirini, 2006; Watson, 2006). In further investigations, the focus of research can be extended to teachers' attributions and perceptions about the extent to which ICT might play a role in supporting their teaching. Furthermore, the dominant role of beliefs as a mediating factor in adopting educational innovations has major implications for professional teacher development (Watson, 2006).

At school level, the results point to the need to emphasise the educational context. Since about 18 per cent of the variance in the dependent variable is related to the school level, these results also suggest a shared set of educational beliefs in particular schools. This introduces a further direction for future research that centres on specific school conditions and school culture variables. This can be related to the statement of Pajares (1992) that teachers can form mutually supportive groups in which their participation is based on sharing their particular beliefs. Belonging to these groups enables teachers to gain confidence. Also Paris and Combs (2006) point at this topic when they discuss the concept "meaning giving". They conclude that teachers share teaching practices and the meaning assigned to these practices in a particular school context. Similarly, it might be interesting to investigate whether teachers' educational beliefs are part of a culture, shared and/or negotiated at school level. Though the purpose of the present study focussed primarily on the relationship between primary-school teachers' educational beliefs and the classroom use ICT (both variables at the teacher level), the results indicate multilevel modelling as a worthwhile technique when studying educational innovations. Though multilevel modelling is a complex technique (Gorard, 2003), it allows to study of

the dependence between individual scores on dependent variables and the nested nature of these scores at a hierarchically higher level. A study of Janssen Reinen (1996) about the integration of computer use in Dutch primary schools indicates that mainly interaction and communication about technology and computer use exert a direct effect on the intensity of computer use. Riel and Becker (2001) also found a relationship between constructivist orientation and the degree of a teacher's involvement in professional community activities. However, the interplay between variables at school-level and teacher-level is not that clear. Further research into this point is needed.

The adoption of a multi-level perspective is also in line with the prevalent literature that stresses the need to study ICT use from a socio-cultural perspective. According to Lim (2002), ICT must be studied within a broader context. Next to a statistical analysis of this complex interplay between nested variables, in-depth studies are also needed to identify how teachers respond e.g., to innovative ICT-curricula and give meaning to these new classroom practices. The results of the present study made clear that a clear understanding of educational beliefs is a first step in the development of this deeper understanding of innovations in complex classroom realities.

CHAPTER 4⁴: ON THE INTERRELATEDNESS OF PRIMARY TEACHERS' EDUCATIONAL BELIEFS

Introduction

Over the last decade, teachers' beliefs have become a prominent item on the educational research agenda in the study and explanation of teachers' behavior and teachers' education (Pajares, 1992). As the concept of 'belief' has been conceptualised in different ways by different authors, it is an ambiguous term in educational research (Pajares, 1992). In an attempt to conceptually delineate the belief construct, several analyses, reviews, and contributions to handbooks have been published (see e.g. Calderhead, 1996; Fang, 1996; Kagan, 1992; Muijs & Reijnolds, 2001; Nespor, 1987; Pajares, 1992; Richardson, 1996; Wyer & Albarricín, 2005). Nowadays, it can be assumed that consensus regarding the theoretical and conceptual issues on the concept of beliefs has been reached.

One assumption held in research on educational beliefs is that different beliefs can be structured into an overarching belief system (e.g. Green, 1971; Pajares, 1992). Individual beliefs always emerge in groups and are not held by each member independently of one another (Green, 1971). This assumption has led to myriad studies on different clusters of educational beliefs, such as pedagogical/didactical beliefs (Woolley et al., 2004), beliefs about the nature and purpose of education (Hermans, van Braak et al., 2008), beliefs about knowledge and knowledge acquisition (Hofer & Pintrich, 2002), motivational beliefs (Stipek, Givvin, Salmon, & MacGyvers, 2001), self-efficacy (Bråten & Strømsø, 2004), personal teaching efficacy (Poulou, 2007), general and subject-related beliefs (Buehl, Alexander, & Murphy, 2002), and beliefs about teaching and learning (Van Driel, Bulte, & Verloop, 2007).

The relatedness of teachers' beliefs is an important subject to study as it has an indispensable influence on the learning environment. As beliefs and belief systems

⁴ Based on: Hermans, R., & van Braak, J. (2009). *On the interrelatedness of primary teachers' educational beliefs*. Manuscript submitted for publication.

operate as filters for new experiences and knowledge and are assumed to guide teachers' behavior, they can act as a support as well as a barrier when change and innovation are introduced (Nespor, 1987; Pajares, 1992).

The present study aims to provide further insight into the interrelatedness of primary teachers' educational beliefs. The goal of the study is twofold. First, it aims to further clarify the concept of educational beliefs. The possibility of the existence of two main clusters of educational beliefs will be explored, namely beliefs about the purpose and nature of primary education and beliefs about learning and instruction. Second, as it can be expected that beliefs related to learning and instruction are influenced by underlying beliefs about the nature of 'good' education, this study explores possible relationships between these clusters of educational beliefs.

Theoretical framework

Characterising beliefs and belief systems

In a recent study Richardson (2003) states that beliefs can be described as psychological understandings, premises or propositions felt to be true. That is to say, beliefs represent a subjective conviction that knowledge is correct, that new information or knowledge about something is true, or that an event or state of affairs will occur (Wyer & Albarricín, 2005). In so far as teachers' beliefs are considered to be a component of their thought processes, they are often distinguished from knowledge. Beliefs are often differentiated from knowledge in that beliefs are based on judgment and evaluation (subjective probability), whereas knowledge refers to 'objective' verifiable facts (Pajares, 1992). That is, knowledge requires a 'truth condition'; an epistemic guarantee and evidence to back up the claim (Richardson, 1996).

Beliefs derive their 'subjective power, authority, and legitimacy' from particular episodes or events (Abelson, 1979; Nespor, 1987). Consequently, they signify a certain reality, reduce dissatisfaction caused by doubt, guide desires, shape actions and act as a filter for new knowledge and experiences (Campbell et al., 2004; Cunningham et al., 2005; Pajares, 1992). As such, it could be said that beliefs are a personal guide through

the world; people draw upon their beliefs whenever they are active in the world and have to deal with the unpleasant state of doubt (Cunningham et al., 2005). This offers a plausible explanation as to why several scholars in the field of educational research emphasise the importance of teachers' beliefs and their possible impact on the practice of teaching (e.g. Fives & Buehl, 2008; Nespor, 1987; Pajares, 1992; Richardson, 1996).

Rokeach (1976) points out that the sum of an individual's beliefs about the self, the physical, and the social world is clustered as a set of interrelated beliefs in a general belief system (Pajares, 1992). In sum, a person's belief system seems to consist of an eclectic mix of rules, generalizations, opinions, values, and expectations, grouped in relatively structured manner (Lowyck, 1994; Rokeach, 1976). In this system, the structural relationship between beliefs can be characterised as 'quasi-logical' (Green, 1971). That is, belief systems seem to be ordered by the logic of the holder (Furinghetti & Pehkonen, 2002) and according how the holder connects different beliefs. In this sense, some beliefs appear to be primary and some derivative (Furinghetti & Pehkonen, 2002; Green, 1971). This quasi-logical order reflects the values and thoughts of the person in question (Furinghetti & Pehkonen, 2002).

Furthermore, not all beliefs within the system are equal to one another and some beliefs are more important for one individual than for others (Furinghetti & Pehkonen, 2002) and the same beliefs may be more important to some people than to others (Green, 1971). Beliefs can be placed along a core (or central)-peripheral continuum (Brownlee et al., 2002; Green, 1971; Rokeach, 1976). The more central the belief is nested in the system, the more this belief could be said to be psychologically important (Furinghetti & Pehkonen, 2002). In addition, central beliefs appear to be more interrelated with others within the system. As a consequence, the more central the belief and the more interrelated the belief, the more difficult it is to change (Brownlee et al., 2002; Pajares, 1992; Rokeach, 1976). Central beliefs are mostly derived from personal experience and are supported by unanimous social consensus (Bar-Tal, 1990). Therefore, belief systems are described as being relatively static and hard to change and when they do change, Nespor suggests, it is more a kind of conversion or 'gestalt shift' rather than a matter of 'argumentation or a marshalling of events' (Nespor, 1987). Finally, people tend to order their beliefs in clusters or subsystems (Green, 1971). Due to this clustering property

people can hold conflicting beliefs within their belief system (Furinghetti & Pehkonen, 2002)

Clusters of educational beliefs

For teachers, educational beliefs can be understood as constituting one of their main belief subsystems and can be specified as the premises and propositions held about education (Denessen, 1999). While educational research on primary teachers' beliefs proposes that several clusters of related beliefs lie in close proximity to one another, the present study explores two main clusters of educational beliefs: (1) beliefs about learning and instruction and (2) beliefs about the purpose and nature of primary education.

(1) Beliefs about learning and instruction

It can be argued that, since education deals with knowledge, epistemology should be education's most fundamental theme (Fitzgerald & Cunningham, 2002). Since teachers regularly encounter new information, the adequacy of their underlying epistemological theories determines the way in which information is interpreted and understood (Hofer, 2001). Therefore, individual beliefs and belief systems have been studied in terms of the role and nature of personal epistemology.

While the concept of personal epistemology has been discussed widely and from different perspectives in educational research, a clear delineation of the construct is difficult to find. However, a comprehensive review by Hofer and Pintrich (1997; 2002) on the theoretical background and different conceptualisations of personal epistemology led to consensus regarding key concerns on this topic. According to these authors, the construct of epistemological beliefs should be limited to an individual's belief about the nature of knowledge and the process of knowing. The authors further argue that those epistemological beliefs are situated at the core of the individual's epistemic belief system. Hofer and Pintrich (1997; 2002) suggest situating beliefs about learning and teaching in the periphery of personal epistemologies. From this perspective, it is assumed that beliefs about the acquisition of knowledge are related to beliefs about the best ways of teaching people and their corresponding preference for particular learning environments. Therefore, beliefs about learning and teaching practices are thought of as derived from a core belief about knowledge and knowing (Brownlee et al., 2002).

Throughout the twentieth century a distinction between two main orientations to learning and instruction seems to be prominent and are labelled differently by different authors. For example Dewey (1999) was keen to depict them as ‘progressive’ versus ‘traditional’ approaches. Jackson (Jackson, 1986) gives preference to ‘progressive’ and ‘liberal’ beliefs about education at which ‘liberal’ refer to traditional oriented approaches. Egan (Egan, 2002) characterises both orientations as ‘the natural and progressive’ and the ‘forced and traditional’. Woolley, et al. (2004) relate teachers’ beliefs to ‘constructivist’ and ‘traditionalist’ approaches to teaching and learning. Despite the subjective connotations of these labels, the present study uses the labels ‘constructivist’ and ‘transmissive’ orientation to outline some main differences between the orientations.

Within the constructivist orientation towards learning and instruction, emphasis is laid on pupils constructing their own understanding. In this sense, learning is conceptualised as a process of active meaning making. In other words, the creation of meaning and the way people make sense of situations is emphasised (Loyens, 2007). Social constructivist theories emphasise the situational and contextual nature of learning (Tynjälä, 1999) and support a learning model that moves away from the passive transmission of knowledge to a model of active construction of knowledge in a social context (Jonassen, 1991).

Furthermore, these assumptions are mirrored in the process of instruction where the focus is on the active engagement of learners in the learning process both independently as well as cooperatively (Bunting, 1981; Minor, 2002). As it is acknowledged that each individual is different in terms of their experience, whereby the same thing can be attributed different meanings (Tynjälä, 1999), learning is organised in interactive and cooperative forms so that individual interpretations and understandings can be shared. The purpose of learning here is understood as qualitatively altering the pupil’s knowledge, and assessment methods are integrated in the learning process itself (Tynjälä, 1999). This reveals itself in a child or pupil-centred classroom practice. Here, ‘child-centred’ refers to the teacher functioning as a resource to childrens’ self-initiated activities, providing open-ended opportunities for them to explore concrete materials, encouraging them to interact with each other, and teaching them basic skills embedded in everyday, meaningful activities (Stipek & Byler, 1997).

It can be assumed that constructivist practices are related to a relativist world view (Schraw, 2008). In this orientation of epistemic beliefs, it is assumed that entities may exist in a dynamic, ever-changing manner. Related to this, relativist-oriented believers may also assume that one can never know with certainty the real existence of something (Schraw, 2008). Schraw and Olafson (2008) indicate that from an educational perspective this epistemic view reveals itself in, for example, the belief that a curriculum is not fixed or permanent or the belief that there is no indisputable answer to questions on a classroom task. Concerning the content of the learning process, knowledge is interpreted as complex and contextual, something which can also be retrieved in problem-based inquiry (Schraw, 2008).

At the other end of the continuum, the transmissive mode of learning is seen as the transmission of discrete bodies of information and isolated skills from teacher to child (Dewey, 1999). Central to this model is the conviction that the same material can be learned by all students at the same time (Brooks & Brooks, 1999). In this orientation to learning, the teacher acts as an expert giving direction and guidance and exerting control (Ackerman, 2003; Kerlinger, 1959a, 1959b). The instructional focus is on the mastery of the material and the curricular focus is determined by a hierarchy of curricular importance (Ackerman, 2003). With an eye on academic competence, instructional practices are determined by effectiveness, expressed in time and potential outcome (Ackerman, 2003). Therefore, the assessment methods are organised in a formal way; often with a separate examination at the end of the course (Tynjälä, 1999) or by means of external standards (Olafson & Schraw, 2006).

Whereas constructivist practices are related to relativist world views, transmissive models of learning seem to be guided by realist oriented world views. Instead of dynamic entities, realists believe in the existence of an objective body of knowledge which is best acquired through experts via transmission (Olafson & Schraw, 2006). This kind of world view leaves its mark on the educational curriculum in terms of the knowledge base and how learning skills have been previously identified (Olafson & Schraw, 2006).

In primary education, the constructivist orientation to learning and instruction is increasingly supported. In mainstream primary curriculum in Flanders, for example, the

focus has become a broad core curriculum at which extra attention is paid on coherence between different subject areas. As a consequence, the common curriculum not only consists of areas of learning but also on cross - curricular themes such as ‘learning to learn’, ‘ICT’, and ‘social skills’. Furthermore, teachers are encouraged by the government to integrate approaches of active learning by which pupils are stimulated to seek solutions, acquire experiences, and gain insight in conjunction with fellow-pupils and the teacher (Eurydice, 2008; Ministry of the Flemish Community, Department of Education, 2008). More in general, Alexander (1995) states that children in primary schools are not simply recipients of the teacher’s pedagogy, but are also participants and partners in it. Stipek and Byler (1997) show that there is a relationship between first grade teachers’ beliefs about how pupils learn and their views on the goals of early education. Their study suggests that first grade teachers can appropriately subscribe to a diverse set of instructional strategies, some child-centered and some basic-skills oriented.

(2) Beliefs about the purpose and nature of education

As teachers function in a larger social context, it can be assumed that it is not only the immediate context of the classroom (Woolfolk Hoy et al., 2006) that influences their beliefs about ‘good practice.’ Hermans, van Braak and Van Keer (2008) suggest that the nature of good teaching comprises more than solely focusing on their beliefs about learning and instruction. The authors propose that it is necessary to study specific beliefs about the practice of teaching and classroom processes in relation to more general educational beliefs about the purposes and nature of primary education. Analogous to beliefs about learning and instruction, a developmental orientation on beliefs about the purpose and nature of primary education can be outlined against a more transmissive orientation.

Main starting points in the developmental orientation to education are the (learning) needs and experiences of pupils as well as their harmonious development (Hermans, van Braak et al., 2008; Marsh & Willis, 2007). In order to develop the capacity and potential of each pupil (Kelly, 1993) the focus in the developmental curriculum is on cognitive, physical, and affective development (Marsh & Willis, 2007). Education is seen as a matter of individual empowerment as it attempts to provide pupils with ‘the kind of

knowledge and understanding which will enrich all aspects of the life of the individual, by enabling hem/her to operate on a higher plane intellectually, aesthetically, socially, morally, and indeed politically (Kelly, 1993). Related to this and compatible with the essentials of a democratic society, an assumed purpose of education is that pupils learn to think critically and for themselves (Kelly, 1993).

Outlined against this developmental orientation, the focus of the transmissive orientation is on the transmission of information and moulding of pupils to fit the needs and expectations of society (Marsh & Willis, 2007). Here, knowledge is seen as control and as a tool in the imposition of ideology (Kelly, 1993). As a consequence, teaching is equated with the transmission of information and learning is equated with the assimilation of knowledge (Kelly, 1993). Su (1992) argues that the maintenance of social, economic and political order and stability are central to this rather 'conservative' view of the purpose of education and the goals of schooling.

In a recent study on primary education in Flanders, Hermans, van Braak and Van Keer (2008) created the Beliefs about Primary Education Scale (BPES). This scale measures primary teachers' beliefs about general educational issues. The BPES comprises three subcategories to measure primary teachers' educational beliefs: (1) goals of primary education, (2) general nature of the primary educational content, and (3) ways of knowledge acquisition in primary education. The results of their study indicate two independent clusters of transmissive and developmental beliefs about primary education. In this sense, the BPES subscribes to a multidimensional view of teacher beliefs: teachers hold both developmental beliefs as well as transmissive beliefs about the goals of primary education, the nature of primary education, and knowledge acquisition in primary education (Hermans, van Braak et al., 2008). In the developmental dimension the central questions concern whether education should be oriented towards broad and individual development, be process-oriented with an open curriculum, and to what degree knowledge should be acquired through construction. In the transmissive dimension the central questions concern the extent to which education serves external goals, is outcome oriented with a closed curriculum, and to what degree knowledge acquisition is perceived as being most adequately achieved through transmission.

Purpose of the study

The purpose of the present study was twofold. First, we aim to develop and provide validating evidence for measuring belief clusters related to (1) learning and instruction in primary education, and (2) the general purpose and nature of primary education.

The second purpose of this study was to explore the associations between primary teachers' educational beliefs about (1) learning and instruction in primary education, and (2) about the purpose and nature of education of primary education. It can be hypothesised that teachers who emphasise basic skills in primary education do so in order to fulfil the requirements of primary education or to meet the demands of the labour market. On the other hand, it can be assumed that teachers who emphasise a child-centred approach do so in favour of more developmental purposes in education.

Methods

Instruments

A review of the relevant primary school education literature revealed two instruments that are appropriate for the purpose of this study. The first instrument is the 'Teacher Belief Survey' (TBS; Woolley et al., 2004) which was created to represent both constructivist and traditional approaches. The second instrument is the 'Beliefs about Primary Education Scale' (BPES; Hermans, van Braak et al., 2008) which assesses developmental and transmissive beliefs about the general orientation and objectives of primary education, the nature of the educational content, and desirable ways of knowledge acquisition (Hermans, van Braak et al., 2008). However, as both instruments contain items relating to knowledge acquisition, the decision was made to use these items to develop two new item pools. To do so, a review of the literature was complemented with an examination of data from semi-structured interviews with primary school teachers. In order to increase the validity of the creation of the item pools, twelve primary school teachers were interviewed individually to explore their personal epistemological beliefs and their beliefs on the purpose and nature of primary education. The selection of those teachers was based on results of a preliminary investigation on which teachers were subjected to the BPES (Hermans, van Braak et al., 2008) and the TBS (Woolley et al.,

2004). Further selection criteria comprised a range in age, teaching experience and gender. Based on a review of the literature and an examination of data from the semi-structured interviews, two item-pools were created to be further analysed in this study: the first item pool assesses primary teachers' beliefs about learning and instruction and the second item pool assesses general beliefs about the purposes and nature of primary education.

Beliefs about learning and instruction. The first instrument focuses on primary teachers' beliefs about learning and instruction in primary education (BLI). Due to overlap between both instruments, an adapted version of Woolley et al.'s (2004) 'Teacher Belief Survey' was merged with the items about knowledge acquisition stemming from the BPES. Because several items from the TBS are formulated as attributions or attitudes, these items were rephrased. During additional interviews (n=12) topics with regard to epistemological beliefs were tested out on primary teachers. Answers to questions, such as 'What does knowledge means to you?' 'What does learning mean to you?' revealed that all teachers' answered these questions in terms of their own classroom practice experiences. Therefore, in order to optimise the comprehensibility the starting point for the formulation of the items measuring epistemological beliefs was therefore the classroom practice. Finally, during the interviews teachers reported that instruction manuals and attainment targets provided by the Flemish Government are the leading guides in planning primary teachers' classroom practice. Therefore items related to both subjects were added. The final item pool with regard to primary teachers' beliefs about learning and instruction consisted of 30 items and used a 5-point Likert scale answer format ranging from 0 (completely disagree) to 4 (completely agree).

Beliefs about the purpose and nature of primary education. In order to assess teachers' general educational beliefs about the purpose and nature of primary education (GB), the instrument used in this study is based on the BPES (Hermans, van Braak et al., 2008). Using the data from semi-structured interviews (n=12), items regarding several issues were added. During the interviews, primary teachers reported that apart from the economical purposes of primary education, they also considered it important to prepare students for secondary education and reach the appropriate attainment targets. Next, regarding the nature of primary education, basic skills came to the fore. In terms of

developmental beliefs about primary education, the interviewees reported that critical thinking, learning to express one's own opinion and deal with other people were the main purposes of primary education. Finally, in terms of the nature of primary education, the wellbeing of pupils and giving them opportunities for self-exploration were the main considerations of teachers. The final item-pool consisted of 28 items addressing the beliefs about the purpose and nature of primary education. These items used a 5-point Likert-scale answer format ranging from 0 (completely disagree) to 4 (completely agree).

After creating the item pools, the first version of the survey was evaluated by stakeholders (experts in the field of primary education and additional primary teachers). The purpose of this evaluation was to examine the comprehensiveness of the survey and comprehensibility of the different items.

In order to back up the data collection, a representative sample of school teachers in Flanders was gathered. To encourage participation, respondents were given the option of filling out a hard copy of the survey or doing so via an online application form that we created. Furthermore, incentives in the form of a small financial reward and comprehensive feedback were offered if at least 60% of the teachers at the school level participated in the survey.

Participants

The data for this study come from 471 primary school teachers from 62 primary schools in Flanders. The participants were distributed evenly across all primary schools. The average age of teachers included in the sample is 38 years, with approximately 78% female. The sample was randomly divided into two groups. The derivation sample used for the exploratory factor analysis consisted of 235 respondents with a mean age of 38 years. The age range varied from 27 to 61 years and 82% of this subsample was female. The replication sample used for the confirmatory factor analysis consisted of 236 respondents (177 females and 59 males), with a mean age of 38 years. The age ranged from 23 years old to 58 years old.

Statistical analysis

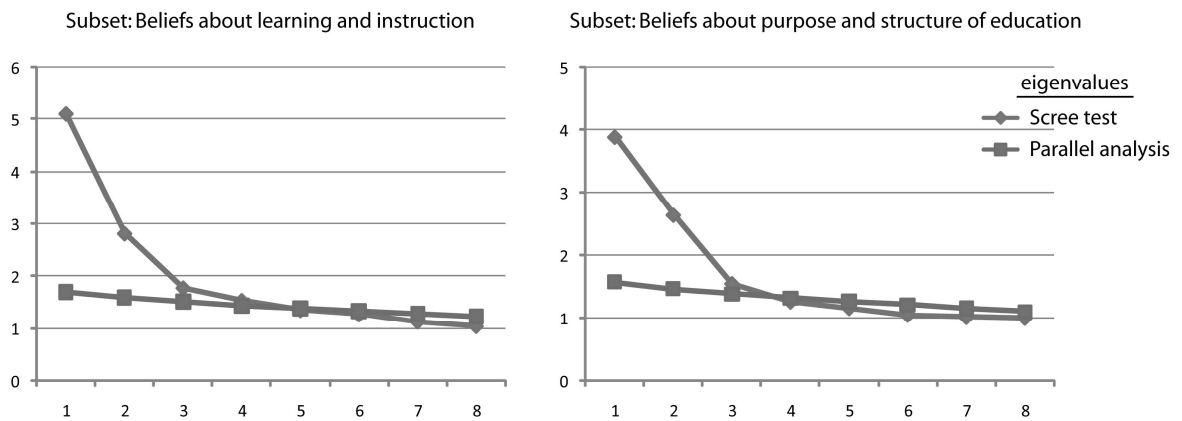
Before investigating the underlying structure of the items, all items were investigated on normality. Due to high kurtosis eight items were removed from further analysis. Furthermore, in an initial stage the factorability of the items was examined by the Kaiser-Meyer-Olkin measure of sampling adequacy (Tabachnick & Fidell, 2001). The results of this measure for the BLI and the GB were approximately .79 and .72 respectively. Given these good indications of sampling adequacy, principal factor analysis with varimax rotation was performed on both subsets of items to investigate their underlying structure (Tabachnick & Fidell, 2001). The final scale construction was carried out in two main stages: (a) exploratory factor analysis, and (b) confirmatory factor analysis (CFA).

Results

Exploratory factor analysis

General description. In determining the number of factors, an appropriately used criterion is the investigation of the scree test. Hereby, the eigenvalues per factor are plotted (Tabachnick & Fidell, 2001). In order to assess the number of factors an inspection of this plot at the moment where discontinuity in eigenvalues occurs can be used (Furr & Bacharach, 2008; Tabachnick & Fidell, 2001). However, as the scree test depends on the reliability of the researchers' judgment, the interpretation of the test is not always exact (Finch & West, 1997; Tabachnick & Fidell, 2001). Complementary parallel analysis (Cattell, 1966) and the minimum average partial technique (Velicer, 1976; Zwick & Velicer, 1986) are more accurate of the number of factors that should be retained (Finch & West, 1997). As shown in Figure 4, based on the scree test a two-factor solution is appropriate for both the 'beliefs about learning and instruction in primary education' (BLI) and the 'general beliefs about purpose and nature of primary education' (GB) subsets. Yet, the results of the parallel analysis (see Figure 4) indicated that a 3-factor solution is feasible for both subsets. Decisive were the results of the minimum average partial analysis which indicated a two-factor structure as appropriate for both subsets. In sum, based on the results of the Scree Test, PA and the MAP, a two-factor solution was chosen for both the BLI subset and the GB subset. Below, the process of item reduction for both subsets separately will be taken into consideration.

Figure 4
Results of scree test and parallel analysis.



Beliefs about learning and instruction. Due to low factor scores or high loadings on both factors, 5 items were removed from the initial BLI item-pool. The two factors accounted for 31.6% of the total variance.

The remaining 10 items with high loadings on the first factor indicates an interrelation between items with a focus on cooperative forms of studying, self-evaluation and observation as assessment methods, the importance self-initiation of activities by pupils, and fitting up to pupils' personal interests. As this first factor centres on pupils' personal meaning making and construction of understanding, it was labelled 'Construction oriented beliefs about learning and instruction' (COBLI).

The subset of items with high loadings on the second factor comprises items in which educational content is based on external sources, knowledge construction is seen as the transmission of information, and classical instruction is seen as the ultimate way of enhancing learning achievement. Therefore, this second factor was labelled 'Transmissive oriented beliefs about learning and instruction' (TOBLI).

General beliefs about the purpose and nature of primary education. An investigation of the underlying structure of the GB item-pool indicated that 5 items either failed to load (less than .30) on any one factor, or loaded highly (greater than .30) on both factors.

These items were removed from the item-pool. The 2-factor GB model explained 36.44 % of the common variance. Due to the interrelationships among this set of variables and the central focus of the items on broad and individual development and the well-being of pupils, this factor was labelled 'Developmental oriented general educational beliefs' (DOB). Items which loaded on the second factor showed a strong focus on education which serves economical purposes. These items were related to the preparation of pupils on the vocational market and social productivity. Besides this economic focus, the second factor also assesses the extent to which respondents believe primary education serves external goals, such as reaching attainment targets and preparing pupils for secondary education. Due to the strong economical rationale and the outcome orientedness, the second factor was labelled 'Economical oriented general educational beliefs' (EOB).

Confirmatory factor analysis

General description. As indicated above, the sample of primary school teachers was divided into two subsamples. the second of the subsamples was used to investigate the stability of the 2-factor structure found for the scale in the exploratory factor analysis. To perform a confirmatory factor analysis maximum likelihood in AMOS 6.0.0 was used. Cases with missing responses for the belief items were removed from the sample resulting in a final sample size of 223 respondents (beliefs about purpose and nature of education) and 221 respondents (beliefs about learning and instruction).

In a second step, items with low factor loadings were removed from the model and cross-loadings were not permitted. Finally, to investigate the extent to which our hypothesised models fit the sample data, several fit statistics were explored. To select the most appropriate fit index, we follow Finch and West (1997). The following strategy was used: (1) we use χ^2 test and the associated p-value, (2) we are heedful of the influence of estimation method to fit indices. The Adjusted Goodness of Fit Index (AGFI) was measured as it is least influenced by estimation method (Fan, 1999). Bearing in mind the small sample sizes, the adequacy of the models was further verified by (3) Root Mean Square Error of Approximation (RMSEA) and (4) the Comparative Fit Index (CFI) which seem to be least influenced by sample size (Bentler, 1990; Byrne, 2001; Fan, Thompson, & Wang, 1999; Finch & West, 1997) and (5) Hoelter's critical N to estimate the

adequacy of sample size (Byrne, 2001). In terms of values that would indicate that the models provide an adequate fit to the data, a high value on the χ^2 test is not unexpected as it is overly influenced by the sample size (Byrne, 2001; Fan et al., 1999). To overcome the shortcomings of the χ^2 statistic and its sensitivity to sample size (Fan et al., 1999), it is more pragmatic to examine other goodness-of-fit indices. As a rule of thumb a cut-off value of .90 has traditionally been used for the AGFI and CFI (Finch & West, 1997). Nevertheless, recently, a cut-off value close to .95 has been advised for the CFI being indicative of good fit (Byrne, 2001). For the RMSEA a value of .05 or less indicates a close fit of the model and values equal to .08 indicate adequate fit, whereas values greater than .10 indicate room for improvement in the model (Brown & Cudeck, 1993). However, as the RMSEA has a tendency to reject true population models the option to work with the 90% confidence interval instead of pointing the estimate of model fit is recommended for the RMSEA (Byrne, 2001). Finally, a value in excess of 200 for the Hoelter test indicates that the model adequately represents the sample data (Byrne, 2001). Table 11 shows the results of the goodness-of-fit indices for both estimated models.

Table 11
Relative fit of models.

	χ^2 (df)	<i>p</i>	AGFI	CFI	RMSEA	Hoelter	
						0,05	0,01
BLI two-factor model	184,85 (133)	0,002	.89	.92	.04	192	207
GB two-factor model	93,18(64)	0,010	.92	.95	.05	200	223

Beliefs about learning and instruction. A confirmatory factor analysis of the final item-pool for the BLI was performed to test whether the purported a two-factor structure of the scale emerged. Items with low standardised regression weights were removed from further analyses. The remaining model consisted of 10 items loading high on the COBLI dimension and 8 items loading high on the TOBLI dimension (see Table 12). A correlation between the residuals of item T3 and item T10 were allowed as it led to a decrease in χ^2 compared to the model without correlated residuals (from 200.5 to 184.8). The correlation between the residuals suggests a substantial overlap between these items. Both items assess beliefs about usefulness of manuals or handbooks compared to the attainment targets. The goodness-of-fit indices suggested that the model had good fit to the data. The AGFI was equal to .89; the CFI was .92; and the point estimate of the

RMSEA was .04 (90% confidence interval ranging from .03 to .06 and a p value of .81). This is less than the recommended .05 value (Brown & Cudeck, 1993) and is indicative of good fit. Hoelter's critical N was sufficient at .01 ($N = 207$) level and approximated the .05 level ($N = 192$).

Table 12
Standardised regression weights (BLI).

Item	Maximum Likelihood Estimates	
	Factor 1: COBLI	Factor 2: TOBLI
C1. I think it is a priority to give students time to work together when I am not directing them	.58	
C2. Good teaching always relates to the personal experiences of the pupils and to their own 'world'	.57	
C3. I believe that expanding on students' ideas is an effective way to build my curriculum	.52	
C4. During a lesson, we use resources and artefacts that the pupils bring to the classroom as well as those from the school (own books,...)	.51	
C5. To assess students through observations (and conferences) is a good way for gaining insight in what students know and their capacities	.46	
C6. Learning of difficult subject matter succeeds best when there is cooperation	.45	
C7. Students have to be involved in evaluating their own work and setting their own goals	.40	
C8. It is important to follow broad themes and undertake the associated projects in a class even without being sure what the exact learning outcomes will be	.37	
T1. Because the subject matter related to learning at school is fixed, it is useless to discuss over this		.63
T2. Education only has to spend time on assignments which results in a good or false answer		.62
T3. It is sufficient to use teaching manuals as they are fully based on the attainment targets and the curricula of the educational networks		.62
T4. For evaluating students' learning performances it is sufficient to base on homework, quizzes and tests		.60
T5. To be sure that all necessary content and skills are given a chance in education, it is good following a textbook or workbook in its entirety		.55
T6. In essence, learning is the assimilation of certain facts and insights		.47
T7. Classical instruction is the best guarantee for good results		.46
T8. Students learn best when the subjects are taught separately		.45
T9. Learning on their own still is the best way for mastering (difficult) subject matter		.43
T10. The handbooks of the different teaching methods do reflect perfectly the attainment targets		.39

Beliefs about the purpose and nature of primary education. Analyses were conducted to investigate the stability of the two-factor structure comprising teachers' general beliefs about the purpose and nature of primary education (GB). The latent variables were estimated by the corresponding factors obtained from the EFA. The error of the different items was left uncorrelated. Items that failed to load highly on the corresponding factor were eliminated from further analyses. As a consequence, the model was reduced to 8 items loading highly on the DOB dimension and 5 items loading high on the EOB dimension (Table 13). Considering the two factor structure under investigation, the AGFI was .92; the CFI was .95, all supporting strong model fit (Table 11). Also, the point estimate of the RMSEA was .05 indicating a good fit (with the 90% confidence interval ranging from .02 to .06 and a p value of closeness of fit equal to .63). As Hoelter's critical N should exceed the 200 to yield an adequate model fit for a χ^2 test (Byrne, 2001), the sample seems to be satisfactory at both .05 and .01 ($n = 200$ and $n = 223$, respectively).

Table 13
Standardised regression weights (GB).

Item	Maximum Likelihood	
	Estimates	
	Factor 1: DOB	Factor 2: EOB
D1. Besides cognitive aspects, it is good that education pay attention to social and emotional aspects	.80	
D2. The primary school has to promote as much as possible the total and harmonious development	.67	
D3. Students' well-being always has to be central in education	.66	
D4. The content of education has to be subject of ongoing reflection	.60	
D5. Initially, primary education should be concerned with the self-exploration of their students	.47	
D6. Because reality differs for everyone, it is better that students learn to shape and express their thoughts	.37	
D7. Expressive arts is as important as mathematics and languages	.36	
D8. A shift from 'knowledge orientation' to 'skills orientation', is an improvement for primary education	.33	
E1. An important task of schools is to prepare young people for the professional world		.65
E2. Starting from the primary school experience, education has to be directed towards helping pupils get a position in the labour market. (i.e. get a job, or be 'employable')		.58
E3. Good teaching' ultimately is aiming to raise economic productivity		.57
E4. A main task of primary education is to ensure that each student reaches the attainment targets		.54
E5. In the first place, the focus of primary education has to be on the adaptation of primary education students on secondary education		.53

Investigation of the relationships between the scales

To test the psychometric properties of the scale, the alpha values of the items corresponding to the dimensions of the BLI and the GB were calculated. The results are presented in Table 14 and show acceptable internal consistency of the scales (α approximately .70). Table 14 also represents the different scale means.

Table 14
Number of items, reliability, standard deviation and correlations of the different scales.

	N	α	M	SD	DOB	EOB	COBLI	TOBLI
DOB	8	.75	3.01	.40	1			
EOB	5	.67	2.65	.51	.19*	1		
COBLI	8	.70	2.7	.40	.66*	.18*	1	
TOBLI	10	.80	1.67	.48	-.30*	.25*	-.25*	1

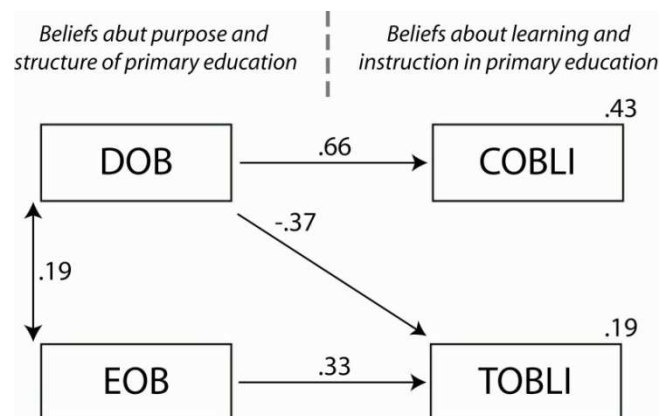
* $p < .001$

Further, Table 14 shows the correlations between the different scales. Although all correlations are significant, the correlations between the different scales are relatively low. As expected, a low correlation was found between the DOB and EOB ($r = .19$). Also as expected, a slightly stronger correlation was found between EOB and TOBLI ($r = .25$). Furthermore, a negative correlation was found between COBLI and TOBLI ($r = -.25$). Remarkably, a high coherence between DOB and COBLI ($r = .66$) is indicated.

As stated above, it was hypothesised that general beliefs about the purpose and nature of education would influence specific beliefs related to learning and instruction. In the next step of the analysis, we examined the underlying belief structure in terms of the causal relations between the different scales included in the study. To do so a path model was generated in AMOS 6.0.0.

Figure 5

Relationships between the different variables.



The results of the analysis support the hypothetical relationships. As indicated in Figure 5, DOB has a strong direct effect on COBLI ($\beta = .66$), and EOB has a moderate direct effect on TOBLI ($\beta = .33$). The TOBLI is negatively affected by DOB ($\beta = -.37$). The assumed effect of EOB on COBLI was not significant and was removed from further analysis. While DOB accounted for 43% of the variance in COBLI ($R^2 = .43$), EOB and DOB accounted for 19% of the variance in TOBLI ($R^2 = .19$). Finally, the positive correlation between DOB and EOB ($r = .19$) indicates a small relationship between both variables. A test of the overall SEM model results in relevant goodness of fit statistics: $\chi^2(df=1) = 5.90$, $p = .052$; AGFI = .97, CFI = .99, RMSEA = .07 (with the 90% confidence interval ranging from .00 to .13 and a p value of closeness of fit equal to .26).

Discussion and conclusions

A review of the research into primary teachers' educational beliefs indicates that the concept of 'belief' has been conceptualised in different ways by different researchers and is an ambiguous term in educational research (Pajares, 1992). In this study, two main clusters of related beliefs were investigated and the associations between them were explored.

In terms of the coherence of the belief clusters, the results indicate two reliable instruments to measure primary teachers' educational beliefs about (1) learning and instruction in primary education and (2) the purpose and nature of primary education. Regarding learning and instruction in primary education, the results of this study confirm the two presupposed directions of constructivist and transmissive beliefs. With regard to primary teachers' educational beliefs about the nature of primary education, the data revealed a developmental oriented dimension and an economic oriented dimension.

In terms of the conceptualisation of teachers' educational beliefs, the results indicate that this is a multidimensional construct, which is in line with earlier research (Hermans, van Braak et al., 2008). Woolley et al. (2004), for example, undergird the assumption that the traditionally oriented and constructivist oriented beliefs about learning and instruction are not both ends of a single dimension. Indeed, the reality appears to be more complex as teachers embrace both kinds of beliefs. As mentioned above, this is mirrored in the

diversity of instructional strategies that primary teachers use (Stipek & Byler, 1997). Recently, Hermans, van Braak and Van Keer (2008) confirm this multilayered conception of primary teachers' beliefs. Their study provided evidence for the assumption that teachers hold both developmental and transmissive beliefs about the purpose and nature of primary education, and beliefs about knowledge acquisition in primary education. Even though the notion can be abandoned that educational beliefs should be conceptualised as a dichotomous construct, it still seems attractive to do so.

Studying the relatedness of the different clusters of educational beliefs, the complexity of the structure of primary teachers' educational beliefs came to the fore. This study provides support for the existence of a logical relationship in which beliefs about learning and instruction in primary education are preceded by more general beliefs about the purpose and nature of primary education. More specifically, primary teachers' constructivist oriented beliefs about learning and instruction seem to derive from more general beliefs about the purpose of education which stresses a developmental orientation. To a lesser degree, beliefs about learning and instruction which stress a transmissive and teacher centred approach were preceded by more economic and outcome oriented beliefs about the purpose of education. However, as the results of this study indicate that these clusters are not totally independent, the results suggest that the majority of the primary teachers involved do not have a clear-cut preference for one orientation. Instead we found an eclectic mix of traditional, constructivist, developmental and transmissive beliefs. As a consequence, a deeper investigation of these profiles may be of interest in future educational research.

Concerning the measurement of teachers' educational beliefs, and following Hofer and Pintrich (2002), a number on a continuum can not capture the complexity of a broader system of beliefs about primary education or theories on primary education. With a focus solely on the structure of the belief concept and the interaction between related belief systems, the interaction among beliefs, experiences, and actions becomes lost. Furthermore, one should be aware that teacher rhetoric is often contradicted by classroom structure, as well as by reward system (Hofer, 2001). Therefore, further investigation with a longitudinal nature and / or mixed method approaches on teacher thinking have been

suggested to overcome the lack to capture this rich interplay of variables (Bryan, 2003; Richardson, 2003).

Nevertheless, the value of validated scale measures should not be underestimated. For the reason that beliefs have been found to remain stable over time, and the establishment that teachers often are not aware of their educational beliefs (Fang, 1996), it seems to be more prudent to reflect upon their beliefs. That is to say, in his 'knowledge filter model' Keys (2007) brings the implementation of a science curriculum in conjunction with the shaping influence of teachers' knowledge on curriculum development. Keys' study provides evidence for the entanglement of teachers' educational beliefs and their daily classroom practice. Emerging from the study where different interconnected dimensions of teachers' beliefs that influenced and reshaped the science curriculum. In addition to teachers' expressed beliefs, teachers are often not aware of more entrenched modes of belief. Furthermore, Keys' study suggests that the more teachers' educational beliefs are embedded in teachers' daily classroom practice, the more those beliefs are reinforced over time by experience. As a consequence, those beliefs take part in the daily routing and are acted upon consciously or subconsciously (Keys, 2007). Although the relationship between teachers' beliefs and their daily classroom practice is complex and the consistency between educational beliefs and teachers' practice is only partly supported (Fang, 1996), the importance of teachers' beliefs for teachers' practice is repeatedly emphasized.

Also in terms of research on educational change, teacher beliefs are coming more and more to the forefront. For example, Gess-Newsome and colleagues (2003) made the assumption that the failing of formal innovations is often related to the fact that those innovations do not succeed in changing important aspects of teacher thinking, like knowledge and beliefs (Gess-Newsome, Southerland, Johnston, & Woodbury, 2003). Moreover, Harris came to a similar a conclusion (2003). Changes in the classroom require more than supplying and acquiring new knowledge and skills. With an eye to changing the personal way of teaching, it seems to be indispensable to take the change of attitudes, beliefs and personal theories into consideration. Not surprisingly, teachers are often appointed as change agents in educational reform (Haney, Lumpe, & Czerniak, 2003; Cuban, 1990). However, teachers' beliefs are often ignored (Haney et al., 2003). When

beliefs are under discussion research seems to be restricted to capacity (i.e. beliefs like self-efficacy, self-confidence ...) and beliefs about aspects of the context in which teachers work (Leithwood, Jantzi, & Steinbach, 2003). This is rather strange as the deep practical knowledge teachers hold is closely tied to the classroom practice. Moreover, this action is understood by teachers and therefore should be the focus of change (Richardson, 1996). In this way, the descriptive use of the scales presented in this study may offer insight into primary teachers' own beliefs. Furthermore, when those results are use in an appropriate way, the use of scales not only makes the 'invisible visible,' but also can be used as a useful way to make underlying beliefs about the purpose and nature of primary education and beliefs about learning processes and instruction processes in primary education as a subject of discussion.

CHAPTER 5⁵: IN SEARCH OF ANTECEDENTS FOR INNOVATIVE AND COMMON USE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Introduction

The progressive transformation of our society into a knowledge society has seen Information and Communication Technology (ICT) become prominent in peoples' lives (ten Brummelhuis & Kuiper, 2008). Nowadays, our culture can be characterised by an inundation of information and a commodification of knowledge (Anderson, 2008; Aronowitz, 1997; David & Foray, 2003), where ICT leaves its mark on social and economic life. Not only have blogs and social networking sites created new modes of interaction and expression (ten Brummelhuis & Kuiper, 2008) the need for 'new' skills has emerged from the changing nature of the job market (Anderson, 2008). As a consequence, the role and process of education as well as the role of ICT in teaching and learning are being increasingly studied (Mioduser, Nachmias, Forkosh-Baruch, 2008; Pelgrum & Law, 2008). Moreover, educators and policy makers are challenged to deal with ICT and the rapidly evolving knowledge society (Anderson, 2008).

ICT has been promoted as being both complementary to educational needs as well as being a catalyst for educational change (Guttman, 2003; ten Brummelhuis & Kuiper, 2008). Education serves the purpose of helping students meet the challenges of the fast-changing world (Hawkrige, 1990; Kearns & Grant, 2002). In this context, ICT is perceived as a tool to help students master the skills required for information and communication systems (Anderson, 2008). Moreover, ICT is often perceived as a catalyst for educational reform (Dexter, Anderson, & Becker, 1999) offering the potential for being 'pedagogically innovative' (Conole, de Laat, Dillon, & Darby, 2008). In this sense, technology in general has been promoted as being disruptive to the practice of education. In other words, contemporary ICT is pushing the educational boundaries and is depicted

⁵ Parts of this chapter are based on:

Hermans, R., van Braak, J., & Vanderlinde, R. (2009). *Development of a scale to measure innovative use of ICT in primary education*. Manuscript submitted for publication.

Hermans, R., & van Braak, J. (2009). *In search of antecedents for innovative and common use of information and communication technology (ICT)*. Manuscript submitted for publication.

as a tool to ‘revolutionise’ an outmoded system (Albirini, 2006). This means that, on a continuum of instructional styles, technology is often used as a tool to make possible a shift from ‘instructional’ styles in favour of an approach to teaching that is advocated under the ‘constructivist’ label (Dexter et al., 1999). In this respect, ‘instruction’ can be equated with a teacher-centered approach with the emphasis on imparting isolated facts and procedural skills from teacher to pupil. The ‘construction’ style can be categorised as a student-centred approach where the focus is on active learning and construction of knowledge. Following Pelgrum (2001), this shift can be described as ‘from the learner as passive consumer of educational offerings to an active knowledge gathering and productive participant in educational activities.’ Furthermore, Niederhausser and Stoddart (2001) argue that technology can support the use of the constructivist approach to teaching and learning.

Within the latter perspective the benefit of ICT seems to be the independent context through which it offers opportunities in all subject domains and also increases the flexibility of education by a desynchronization of space, time, and place. That is to say, ICT not only offers increasing opportunities to bring interactive content and real-world problems into the classroom, it also provides opportunities to build local and global learning communities including students and teachers, as well as parents and experts (ten Brummelhuis & Kuiper, 2008). As a consequence, ICT can be used to simplify learning beyond the formal institutions of schools, involving everyone, at any time, at any place (Anderson, 2002; ten Brummelhuis & Kuiper, 2008).

In this context, particular attention has to go to web 2.0 environments as they appear to have the potential to enhance education (Voogt & Knezek, 2008). Web 2.0 environments is a ‘catch all’ term to describe a variety of technologies, services and trends in which web use is characterised by active participation, creation and sharing (Crook & Harrison, 2008). Furthermore, web 2.0 environments have the potential to support life-long competence development (Klamma, Chatti, Duval, Hummel, Hvannberg, Klavcik et al. , 2007). Where first generation internet made publishing and retrieving information possible, second generation internet further provides the possibility to contribute to the creation of information and to participate in learning communities. By doing so, contemporary internet environments not only connect people to information, but

also connect people to people (Klamma et al., 2007). In that way, ICT offers the potential to change the interaction within the classroom and to involve people outside the classroom in pupils' learning activities. (Harris, in Anderson, 2002).

Although ICT has been promoted as being disruptive, the actual integration of ICT in the classroom is still limited. For example, following the ISETT studies Kozma and Anderson (2002) conclude that there is still a low number of teachers using ICT in their classroom practice to prepare students for the knowledge society. Similarly, recent research carried out within the Flemish educational context indicates that the integration of computers into the teaching and learning processes is limited (Tondeur et al., 2007b; van Braak et al., 2004). Research in the Dutch primary school context performed by Smeets (2005) indicates that ICT-use is mainly characterised by a rather traditional or skill oriented instructional use. Furthermore, Mumtaz (2001) highlights a discrepancy between computer use at home and at school of primary school pupils in the UK. The author stresses the limited and highly unattractive use of computers in primary school classrooms and cited the most frequent activities at school as traditional drill and practice exercises, such as word processing. Niederhauser and Stoddart (2001) argue that computers have been primarily used as teaching machines rather than serving as a catalyst for educational reform.

In the last decade research into what may be the potential barriers to ICT integration has been carried out. Ertmer (1999), for example, builds on Cuban's framework of first and second order changes which helps identify barriers to educational change, by applying it to the integration of technology in education. Ertmer characterises first-order barriers to the integration of technology as extrinsic to teachers, such as missing or inadequately provided resources, lack of access, and lack of support. Second-order barriers that interfere with or impede change are intrinsic to teachers and are typically embedded in teachers' beliefs about teaching and learning. As they are more personal, second order barriers are often less tangible and more deeply ingrained. Indeed, nowadays feasible explanations for the speed of the change process are sought by taking teacher characteristics into account (see e.g. Dexter et al., 1999; Drent & Meelissen, 2008; Ertmer, 1999; Hew & Brush, 2007; Niederhauser & Stoddart, 2001).

Recent studies reveal that teachers' beliefs regarding the potential contribution of ICT (e.g. Smeets, 2005) or attitudes towards computers (Albirini, 2006; van Braak, 2001) are relevant variables in explaining classroom use of ICT. Moreover, teachers' educational beliefs seem to be powerful parameters for their application of ICT for educational purposes. In this line of thought, scholars hypothesise that teachers' computer use can be bound up with their underlying belief system. Tondeur, Hermans et al. (2008), for example, concluded that more traditional teaching profiles were related to drill and practice oriented activities. Computer activities in which pupils were given more freedom and where computers were used to research and process information were related to constructivist oriented belief profiles. Therefore, it certainly can be stated that the adoption of educational innovations can only be explained when teachers' beliefs are taken into account (Valcke, Sang, Rots, & Hermans, 2009).

Theoretical framework: (Innovative) use of ICT: What to measure?

Since the introduction of computers and ICT to education, their use has been measured in many different ways. Baylor and Ritchie (2002) state that many researchers operationalise computer use within a basic dichotomy; either the computer is the actual subject of study or the computer is used as an instructional tool to teach other content. Other researchers operationalise computer use by measuring the amount of ICT use in the classroom by the teachers or the student, the time students spend working with ICT or computers, or the use of specific ICT applications or software programmes. For instance, Smeets (2005) measured both the frequency of ICT use during classes, as well as the frequency of use of specified types of ICT applications (e.g. Word processing, E-mail, etc.). ICT use has also been described as a complex phenomenon in terms of the various different types of computer use (e.g. Baylor & Ritchie, 2002; Tondeur, et al., 2007b). In this context, Tondeur et al. (2007b) make a distinction between three types of computer use: 1) the use of the computer as an information tool, 2) the use of the computer as a learning tool, and 3) learning basic computer skills. Although valuable, the instruments developed to measure ICT use do not take into account the 'innovative' use of the computer, nor do they include issues like cooperative learning or learning in authentic contexts.

The innovative use of ICT in education is a difficult concept to define in univocal terms. Recent studies of Kozma and Anderson (2002) and Drent and Meelissen (2008) operationalised innovative ICT use as those practices that are perceived as new, in which ICT plays a substantial role in supporting educational objectives, and are important in preparing pupils for lifelong learning in the knowledge society. As a consequence, the integrative use of ICT in the educational process has become a subject of study, as the focus is not on specific technologies, but on the way ICT is used to support student centred learning approaches (Drent & Meelissen, 2008). However, what is conceived as being innovative is partly determined by the cultural and historical context in which the innovation takes place. In other words, the cultural dependency of innovations must be underscored (Kozma & Anderson, 2002).

Therefore, we believe that a new measurement scale must be developed to assess the innovative use of ICT. Moreover, the changing context of ICT itself requires a new measurement scale. Indeed, none of the existing measurement scales take into account the use of web 2.0 applications which are also innovative as they foster communication, collaboration and knowledge sharing.

Purpose of this study

Preparing pupils to participate in the knowledge society has an effect on current understandings of teaching and learning. This results in a shift away from instructional approaches towards modes of teaching and learning in which active participation of pupils is expected. An emphasis is also placed upon higher-order, critical, creative and collaborative thinking (Loveless, 2002). From this perspective, the main challenge for educational institutions is to embrace the potential of ICT and the powerful learning environment it provides. The focus of this study is to measure the extent to which teachers in schools make use of ICT for innovative purposes and examine antecedents which influence their use of ICT.

It can be argued that the use of ICT in primary schools takes place in the wider context of the social, cultural, and economic arena (Loveless & Dore, 2002). Nowadays young children have also gained experience with ICT both at school and at home (Loveless & Dore, 2002). Moreover, as the content of ICT is changing rapidly, there is

little consensus among educators about how ICT should be integrated in schools and their curricula (Anderson, 2002). Therefore, measuring innovative modes of ICT use in primary education should offer insight into the extent to which primary teachers embrace the potential of ICT. However, bearing in mind the contextual influence on what is meant by innovative use of ICT and given the absence of instruments measuring innovative use of ICT in primary education, the first aim of this study is to develop a scale that can measure innovative use of ICT in primary education in Flanders.

As mentioned above, recent studies stress the importance of teachers' intrinsic barriers to the integration of new technologies into their classroom. Therefore, the second aim of this study is to examine the impact of primary teachers' educational beliefs on innovative use of ICT in primary education, while controlling for gender, teaching experience and experience working with computers. Considering teachers' resistance to (technological) change in the classroom practice, it could be wise to take into consideration more institutionalised or common forms of ICT use. By making the comparison between both forms of ICT use, namely innovative uses of ICT and common uses of ICT, the differentiated influence of educational beliefs as antecedents for innovative and common ICT uses can be examined.

This study was conducted in two stages. In the first stage the focus is on the development of a scale to measure the innovative use of ICT. The second stage centres on explaining the different influences on innovative ICT use and their relation to common use of computers.

Stage 1: Development of a scale to measure innovative use of ICT

Methods

Item and scale development

In order to define innovative ICT use in Flanders, the first step of this study was to create an item-pool that covers the wide range of possible activities. To do so, a sample of experts in the field of ICT and education was contacted. In total, 46 experts representing primary education, educational government, educational networks, teacher training, in-service training, and scholars with expertise in the field of ICT and / or primary education

agreed to participate. These experts were provided with a broad description of what can be understood as innovative use of ICT and were invited to formulate one (or more) examples of an innovative activity in which ICT plays a substantial role and which, according to them, should be present in primary education.

The next step in the creation of the item-pool was to gradually elaborate a small set of generalisations that cover the consistencies discerned in the examples of the experts by means of an interpretative analysis conducted in two main stages. At first, a within-case analysis was performed for each of the respondents (Miles & Huberman, 1994). A line by line review of the examples was applied and initial codes were affixed using Nudist (version 6.0). In a second stage, a between-case analysis was performed by identification of similarities and differences between the affixed codes. This led to the identification and description of 7 possible patterns or groups of patterns and an initial categorisation of the data. Table 15 gives an overview of these categories, a small description of each category, and some examples given by the experts.

Table 15

Item categories for the ‘innovative ICT use’ scale.

Category	Small description	Mentioned examples
1. Social software	Dynamic software or systems that force the user to actively participate in the process of data sharing or to interact with each other	Facebook, MySpace, YouTube ...
2. Collaborative software	Software or systems for collaborative publishing that allow multiple users to contribute to and collaborate in an online document or discussion	Blog, wikis, podcast ...
3. Electronic communication tools	Tools used for the creation and maintenance of social networks or to enhance communication with people who are difficult to reach	e-mail, Skype, forum-use, MSN, iChat ...
4. Digital databases	(Multimedia) collections of content	Wikipedia, GoogleEarth, GoogleBooks ...
5. Electronic learning environments	Electronically supported learning tool where teaching and learning activities are organised through digital technologies.	Smartschool, think.com, Dokeos ...
6. Standalone software applications	Standalone software applications used for a variety of purposes	Simulation software, mind mapping software, word processors, graphics painting programs, music composing and audio programs, presentation programs, games ...
7. Electronic devices	Electronics used for recording, storing or presenting information	Digital cameras, audio recorders, whiteboards, beamers ...

Finally, each example was examined on the extent to which it met the conditions of the proposed definition of innovative uses of ICT. Examples which did not meet the conditions were restrained. Finally, a Likert-type item-pool of 18 items was generated. In order to get a representation of the primary teachers' innovative use of ICT, respondents were asked to rate each of the items separately, where 0 = Never, 1 = Quarterly, 2 = Monthly, 3 = Weekly, and 4 = Daily.

Participants

In order to investigate the consistency of the items, data from 472 primary school teachers from 62 primary schools in Flanders were analysed. The participants were distributed evenly across all primary schools. The average age of teachers included in the sample is 38 years, with 78% female.

As the purpose of the study was to explore and affirm the latent structure of the items, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were carried out on the data. In order to perform both analyses, the sample was randomly divided into two equal subsamples.

Statistical analysis

Exploratory factor analysis (EFA). The aim of the EFA was to explore the underlying structure of the items. As the items included in the survey were treated as categorical variables, linear data reduction methods were not suitable. Therefore, the analysis was performed by means of Categorical Principal Component Analysis (CATPCA). This nonlinear technique is used in the analysis of categorical data (Linting, Meulman, Groenen, & van der Kooij, 2007; Peralta & Cuesta, 2005).

In reducing the data by means of CATPCA, optimal scaling is applied. In this procedure category labels are replaced by category quantifications while accounting for as much of the variation as possible in the original set of variables (Linting et al., 2007). In determining the adequate number of components, the scree test is analysed. Typical for nonlinear PCA is that the number of analysed components can influence the place of the 'elbow' in the scree plot. Therefore, Linting et al. (2007). suggest generating scree plots

from different component solutions and investigate the different solutions in terms of the consistency of the place of the elbow at the same component. The number of components to retain in the analysis is indicated when the elbow is consistently placed at a particular component. The scree test was supplemented by Velicer's minimal average partial (MAP). MAP is thought to be a more accurate and reliable procedure in determining the number of factors than the scree test or the commonly used eigenvalues-greater-than-one rule (O'Connor, 2000; Zwick & Velicer, 1986). Finally, the internal consistency for the one-component solution was verified using item-total correlations and Cronbach's alpha. All analyses of the EFA were performed using SPSS for Windows (version 15.0.0).

Confirmatory factor analysis (CFA). In the next stage of the scale construction we examined the stability of the obtained factor structure. In evaluating the model fit, confirmatory factor analysis was conducted using AMOS (version 6.0.0). In determining an appropriate estimation procedure for analysing categorical data in which the assumption of multivariate normal distribution is violated (skewness > 2, kurtosis > 7; Finney & DiStefano, 2006), unweighted least squares estimation (ULS) was used. ULS does not depend on the assumption of normal distribution (Blalock & Blalock, 1985; Schumacker & Lomax, 2004).

In evaluating the model fit, the sensitivity for sample size and distributional misspecification of the χ^2 test makes it advisable to obtain the fit index by other absolute, incremental, and parsimony goodness of fit indices (Byrne, 2001; Hu & Bentler, 1999). Absolute fit indices assess how well an a priori model fits the sample data. The benefit of the Adjusted Goodness of Fit Index (AGFI) is that it is least influenced by estimation method (Fan et al., 1999). Furthermore, incremental fit indices assess the proportion of improvement in fit by comparing the target model with a baseline model (Hu & Bentler, 1999). A classic example of an incremental fit index is the Normed Fit Index (NFI). The Relative Fit Index (RFI) represents a derivative of the NFI. Parsimony fit indexes as the Parsimony Normed Fit Index (PNFI) and the Parsimony Goodness of Fit Index (PGFI) take into account the complexity of the hypothesised model in the assessment of overall fit (Byrne, 2001; Kaplan, 2000).

To interpret these indices the following rules were employed: that the values of all mentioned fit indices range from 0 to 1. A general rule of thumb used for the AGFI is a cut-off value of .90 (Finch & West, 1997). Values above .95 indicate good fit for the GFI, AGFI, and NIF. A value close to .95 for the RFI indicates a superior fit (Hu & Bentler, 1999). While a perfect fit for the PGFI and PNFI is represented by the value 1, values close to 1 are not expected. Moreover, goodness-of-fit indices in the .90's, accompanied by parsimony-fit-indices in the .50's are not unexpected in sound-fitting models (Byrne, 2001; Dorman, 2003).

Results

Exploratory factor analysis (EFA). In the analysis all variables were treated as ordinal and missing values were deleted at the beginning. The remaining 'split' sample consisted of 218 primary teachers. In determining the adequate number of components scree plots for a one-dimensional and a two-dimensional solution were calculated on a correlation matrix of the quantified variables of a one-dimension solution. As different solutions did not place the elbow consistently at the second component, a one-dimensional or two-dimensional solution was selected (see Figures 6 & 7). However, it appeared that the second component in the two-dimensional solution was theoretically difficult to interpret. Complementary analysis by means of Velicer's MAP revealed a one-component solution as most appropriate.

Figure 6

Scree plot of a one-dimensional CATPCA.

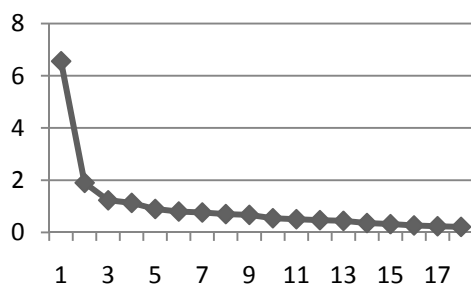
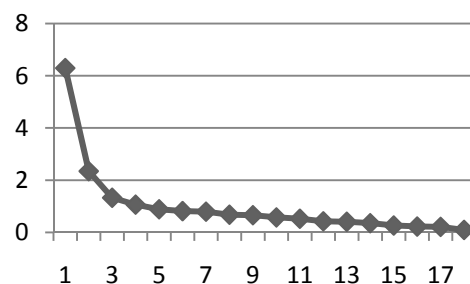


Figure 7

Scree plot of a two-dimensional CATPCA.



CATPCA for the 18 resulting items in the one-factor solution explained approximately 36% of the variance ($= 6.560/18$, with 6.560 being the eigenvalues and 18 being the number of variables). Based on the component loadings, one variable was excluded from further analyses. The final one-dimensional solution accounted for approximately 38% of the variance ($= 6.455/16$).

In terms of the reliability of the one-component solution, the corrected item-total correlation revealed three items with an overall correlation less than .3, indicating a low correlation with the overall scale. Therefore, these items were removed from further analyses. The remaining 14 items were retained and indicated good internal consistency ($\alpha=.86$).

Confirmatory factor analysis (CFA). A confirmatory factor analysis with Unweighted Least Squares (ULS) was conducted to assess how well the data fit the one-factor structure. Respondents with missing values were excluded from the analysis. The remaining ‘split’ sample consisted of 234 primary teachers. The items loaded well on the latent variable, ranging from .408 to .738. The final one-factor model yielded an overall χ^2 value of 30.01. Furthermore, the supplemental fit indices showed good fit for the model. Both the GFI and the AGFI were high (GFI= .981, AGFI= .974), as were the NFI and RFI (NFI= .966, RFI= .960). Expecting lower results for the parsimony fit indices, the PGFI and PNFI showed good results (PGFI= .719, PNFI=.817). Standardised factor loadings and a short description of the items are presented in Table 16.

Table 16

Standardized factor loadings of the Innovative use of ICT in Primary Education Scale.

	Factor I
Item01: use of ICT-applications to transform ideas in text, audio and / or visuals	.738
Item02: use of ICT to select and retrieve text, images and audio and incorporate it in digital stories	.721
Item03: use of digital databases (e.g. Wikipedia, GoogleEarth, GoogleBooks ...) to look up for information	.682
Item04: use of electronic communication tools (e.g. e-mail, Skype, forum, MSN, iChat ...) to stimulate pupils working on assignments out of school periods	.663
Item05: use of ICT to support 'learning to learn' by mean of, e.g. mind maps, schemes, summaries ...	.651
Item06: use of collaborative software (e.g. wiki, blog, podcast ...) to stimulate collaborative learning	.568
Item07: use of simulation software, whiteboards, beamers to exemplify and/or explain complex matters	.567
Item08: use of electronic communication tools (e.g. e-mail, Skype, forum, website, MSN, iChat ...) to stimulate communication with pupils and their parents	.536
Item09: use of electronic communication tools (e.g. e-mail, Skype, forum, MSN, iChat ...) to enhance communication with people who are difficult to be reached	.531
Item10: pupils use virtual musea in order to support project work	.483
Item11: pupils use of electronics (e.g. voice recorder, camera ...) to explore the environment	.479
Item12: use of electronic communication tools (e.g. e-mail, Skype, forum, MSN, iChat ...) for working together with pupils from other schools on assignments	.429
Item13: pupils build a thematic website to stimulate collaborative learning	.411
Item14: use of (electronic) learning environments (e.g. Smartschool, think.com, Dokeos ...) to easily integrate ICT during classes	.408

Stage 2: A multivariate approach to investigate determinants of common versus innovative use of ICT

After constructing a scale to measure innovative use of ICT in Flemish primary education, the purpose of this second stage of the analysis is (1) to investigate the differentiated influence of teachers' educational beliefs on innovative use of ICT; controlling for gender, teaching experience and experience using computers and (2) to analyse possible differences of influence when innovative use is compared to common ICT use in primary education.

Methods

Sample

In this study, the full sample as described in stage one was used ($N=472$).

Statistical analysis

Multivariate multilevel modeling. 'Innovative use of ICT' and 'common use of ICT' are closely related constructs indicating an underlying measurement of the integration of (new) information and communication technologies in the classroom. To obtain a better and more complete description of the influence of different variables on these constructs, simply carrying out two independent univariate regression analyses is inadequate (Hox, 2002). Hox (2002) points out the risk of inflating type I error when carrying out a series of univariate statistical tests. Secondly, in carrying out a regression analysis on each of the individual measures the differences may be small and insignificant. However, the joint effect of the response measures may produce a significant effect (Tabachnick & Fidell, 2001).

In performing the analysis, one also needs to pay attention to the social and constitutional contexts in which individuals are located (Browne & Rashbash, 2004). That is, teachers perform in schools. Therefore, it can be assumed that the performance of teachers within the same school in dealing with (innovative) ICT use will be correlated at the school level. This assumption is in line with previous research on primary teachers'

classroom use of computers in which approximately 18% of the variance was situated at school level (Hermans, Tondeur, van Braak, & Valcke, 2008).

Due to the nested structure of the data (472 teachers in 62 schools), we adopt an estimate technique which takes both the teacher as school level into account. Consequently, multilevel modeling is conducted to estimate the multivariate model. In conducting multilevel modeling it is common practice to first estimate a null model. In a null model, explanatory variables are left out of the equation. As a consequence, the intercept of the model represents the general mean of the dependent variables and is estimated while taking into account the variance at different levels. After testing the null model, a compound model is created to investigate the differentiated effect of teachers' beliefs on learning and instruction, gender, teaching experience, and teachers' computer experience. Model improvement is investigated by studying the decrease in deviance value compared to the previous model. The difference in deviance is used as a test statistic having a chi-squared distribution. As a consequence, the significance of the improvement of the model can be tested (Hox, 2002; Snijders & Bosker, 1999). In order to optimise the interpretability of the estimations, all analyses are performed on standardised variables (Voeten & van den Bercken, 2003).

Variables

Dependent variables

In this study, two dependent variables are used. The first dependent variable is the 'innovative use of ICT scale' developed in the first stage of this study. This scale assesses primary teachers' innovative use of ICT for educational purposes. The central focus is on the use of web 2.0 applications for instructional purposes and the use of electronics and ICT supportive to foster collaboration, knowledge sharing or communication in education. The second dependent variable is common ICT use. This variable assesses the institutionalised and regular use of ICT in the classroom. For this purpose, a modified version of the 'Class Use of Computers' scale of Tondeur et al. (2007b) was used. This scale is used to measure different types of ICT use in primary education. The types of ICT use embedded in the scale are (1) the use of ICT to train basic skills, (2) the use of ICT as a learning tool, and (3) the use of ICT as an information tool. Items on both scales,

build on a five-point Likert scale: 0 = Never, 1 = Once a term, 2 = Monthly, 3 = Weekly, and 4 = Daily.

Independent variables

Teachers' educational beliefs: Traditional and constructivist oriented beliefs about learning and instruction. In line with recent research on the relationship between primary teachers' educational beliefs and the use of ICT, an instrument of Hermans and van Braak (Hermans, & van Braak, 2009) is used to measure primary teachers' educational beliefs about learning and instruction. With this scale, the influence of two separate dimensions of beliefs about learning and instruction on both dependent variables can be investigated. The first dimension, namely Constructivist Oriented Beliefs about Learning and Instruction (COBLI), contains 9 items and focuses on constructivist, pupil centred approaches to learning and instruction. The second dimension, namely Traditional Oriented Beliefs about Learning and Instruction (TOBLI), contains 10 items and focuses on beliefs about teacher-centred or transmissive approaches to the classroom practice (Hermans, & van Braak, 2009). Items in both scales are rated using a 5-point Likert scale ranging from 0 = Totally disagree to 4 = Totally agree.

Gender. Assuming that gender differences do have an influence on the integration of ICT, gender was included in the study. This assumption is in line with earlier research on ICT integration in education (2003).

Teachers' experience. In the present study, teachers' experience was measured in two ways. Firstly, 'teaching experience' was included in the model as a potential individual characteristic in the explanation of primary teachers' use of ICT. In order to get an indication of teachers' classroom experience, respondents were asked to report their practical or classroom experience in terms of number of years. Secondly, respondents were asked to indicate their level of computer experience by reporting the number of years they have been using computers.

Results

Descriptive statistics and reliability of the research instruments.

Psychometric quality of the data was tested by Cronbach's alpha. As indicated in Table 17, all measures showed acceptable internal consistency. Table 17 also indicates that the correlations between the different measures included in the study were low.

Table 17

Overview of the scales, Number of items, Reliability, and Correlations.

		N	α	{1}	{2}	{3}	{4}	{5}	{6}
{1}	Innovative use of ICT	14	.86	1					
{2}	Common use of ICT	11	.90	.52**	1				
{3}	Teaching experience	-	-	-.15**	-.02	1			
{4}	Computer experience	-	-	.13**	.05	-.07	1		
{5}	COBLI	9	.70	.12*	.19**	-.14**	-.04	1	
{6}	TOBLI	10	.80	-.03	.01	.07	-.04	-.25**	1

* $p < .05$; ** $p < .01$

Results of the multivariate multilevel analysis.

Null model (M0)

The random part of the null model provides justification for applying multilevel modelling (Table 18). As the variances for 'common ICT use' and 'innovative use of ICT' were significantly different from zero ($\chi^2 = 10.4$, $df = 1$, $p = 0.001$, and $\chi^2 = 6.8$, $df = 1$, $p = 0.009$ respectively), the between school variance can be calculated by dividing the between school variance over the total variance (Browne & Rashbash, 2004). A higher the result of this calculation indicates a 'clustering' effect of teachers at the school level. In other words, the more differences occur between schools. This resulted in 24% and 11% of the unique variance attributed to between-school differences for 'common ICT use' and 'innovative use of ICT' respectively. The covariance of both dependent variables counts for 27% at school level.

Furthermore, the results of the correlations between both dependent variables in the null model indicate a close positive relation ($r = .89$) between 'common ICT use' and

‘innovative use of ICT’ at school level. This suggests that teachers from schools in which a higher level of ICT use is reported, also make more use of ICT for educational purposes in an innovative way. With some prudence, the same conclusion can be made at the teacher level where a moderate positive correlation ($r=.46$) indicates that teachers who indicated a higher level of common ICT use also indicate a higher score on innovative use of ICT.

Model 1

At first, compared to the baseline model (M0) a significant improvement of the model was found ($\chi^2= 174,2$, $df= 10$, $p < 0.000$). Looking further at the fixed part of the model, only the constructivist oriented beliefs about learning and instruction (COBLI) have a significant effect on ‘common ICT use’ ($\chi^2 = 20.02$, $df = 1$, $p < 0.000$). The results also highlight a significant positive effect of gender ($\chi^2 = 7.178$, $df = 1$, $p = 0.006$), teachers’ computer experience ($\chi^2 = 6.19$, $df = 1$, $p = 0.013$), and COBLI ($\chi^2 = 6.19$, $df = 1$, $p = 0.013$), whereas teaching experience has a significant negative effect ($\chi^2 = 9.937$, $df = 1$, $p = 0.002$) on ‘innovative use of ICT.’ The latter result indicates that less experienced teachers reported a higher innovative ICT use for educational purposes. The traditional oriented beliefs about learning and instruction (TOBLI) were found to have no significant effect on either of the dependent variables.

Further inspection of the results reveals that the random part confirms the justification for applying multilevel modeling. Significant variances were found at the school level for ‘common ICT use’ ($\chi^2 = 13.567$, $df = 1$, $p < 0.000$), ‘innovative ICT use’ ($\chi^2 = 5.36$, $df = 1$, $p = 0.021$) and the covariance between both dependent variables ($\chi^2 = 10.46$, $df = 1$, $p = 0.001$). Also the positive significant correlations at school and teacher level confirm the relation between both variables ($r = .97$ and $r = .46$ respectively) as mentioned in the null model.

Table 18

Results of the multivariate multilevel analysis.

	M0		M1	
	Common ICT	Innovative ICT	Common ICT	Innovative ICT
	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)
<i>Fixed</i>				
Intercept	.00 (.08)	.00 (.06)	-.06 (0.08)	.08 (0.07)
Gender (male)			.07 (0.11)	.31 (0.11)**
Teacher experience			.00 (0.05)	-.15 (0.05)**
Computer experience			.06 (0.05)	.12 (0.05)*
COBLI			.20 (0.05)***	.12 (0.05)*
TOBLI			.07 (0.04)	.02 (0.05)
<i>random (school level)</i>				
Innovative ICT use	.24 (.06)**	$r = 0.89$	.23 (.06)*	$r = .97$
Common use	.15 (.04)**	.11 (0.04)***	.14 (.04)**	.09 (.04)***
<i>random (teacher level)</i>				
Innovative ICT use	.76 (.05)***	$r = .46$	.72 (.05)***	$r = .46$
Common ICT use	.38 (.04)***	.89 (.06)***	.37 (.05)***	.88 (.06)***
<i>Model fit</i>				
Deviance		2434.05		2259.85
Df				10
p				< .001
Reference				M0
<i>variance at school level</i>				
ρ (%)	24.10	10.99		

* p < .05 **p < .01 *** p < .001

Discussion and conclusions

As ICT have become prominent in peoples' lives the role of ICT in teaching and learning are being increasingly studied. Consequently, the influence of ICT on the practice of teaching can not being denied anymore (van Braak, 2001) and teachers are increasingly challenged to deal with ICT in their daily classroom practice. However, while ICT can yield benefits in preparing students for the knowledge society in which we live and has been characterised as a catalyst for educational reform, previous research indicates that the level of ICT integration in the daily classroom practice is still low (see e.g. Kozma & Anderson, 2002; Smeets, 2005; Tondeur, et al., 2007b; van Braak et al., 2004).

In the past, a vast amount of research on the integration of ICT in education have been generated focussing on classroom use of computers (see e.g. Becker, 2001; Ertmer, 2005; Tondeur, Hermans et al., 2008). In line with this field of research the first aim of the present study was to widen the scope of computer use and to include and conceptualise innovative uses of ICT for educational purposes. The first part of this study therefore focused on the creation of a scale to measure innovative ICT use. A preliminary examination of the meaning of innovative ICT use given by experts in the field of ICT and education resulted in a pool of 18 items. Investigating the latent structure of this item-pool by means of a categorical component analysis revealed a one-dimensional structure to the 14 remaining items. A confirmatory factor analysis on the remaining 14 items provided validating support for the one-dimensional structure. The central focus of the items is on web 2.0 applications for educational purposes and the use of electronics and information and communication technologies supportive to foster collaboration, knowledge sharing or communication in education.

The second part of the study focused on the differentiated influence of primary teachers' educational beliefs on ICT use in the classroom. In order to delineate what is meant by ICT use for educational purposes, two modes of ICT use were included, namely 'innovative ICT use' and 'common use of ICT.' In explaining classroom use of ICT, the results of the multivariate multilevel regression analyses revealed an important and significant influence of primary teachers' constructivist oriented beliefs about learning and instruction (COBLI) on both 'innovative ICT use' and 'common use of ICT.' These findings can be placed alongside educational research on the influence of teachers' constructivist oriented educational beliefs on the classroom use of computers (e.g. Hermans, van Braak et al., 2008) or on the adoption of tools that foster constructivist learning approaches (Riel & Becker, 2000).

However, the picture becomes more complex when examining influences on each of the modes of ICT use. Besides the constructivist oriented beliefs about learning and instruction, the results revealed that gender, teaching experience, and computer experience have a significant influence on innovative use of ICT. In the past, gender (Shapka & Ferrari, 2003; van Braak et al., 2004; Williams et al., 2000) and computer experience (Becker, 2001; Hermans, van Braak et al., 2008; Williams et al., 2000) were

frequently reported as influencing variables on ICT integration and, in terms of teaching experience which is strongly related to age, this significant influence can be placed in line with earlier findings of the influence of age on classroom use of computers (e.g. Bradley & Russell, 1997; Hermans, van Braak et al., 2008). In trying to find factors that influence 'common use of ICT' only the COBLI appeared to be significant.

Interestingly, the results seem to be sensitive to contextual factors. As the null model explained a significant amount of variance at school level further research should examine variables at school level, which seems to be an important challenge for the ICT research community (Hew & Brush, 2007). While the results highlighted teachers' personal characteristics as being significant in explaining their innovative use of ICT, the results also indicated that the school level was significant in explaining common use of ICT.

Furthermore, the high and significant correlation between 'common use of ICT' and 'innovative use of ICT' at the school level makes the assumption likely that schools with more common ICT users function as a trigger for innovative computer use and vice versa. From this perspective, research into the factors which stimulate ICT use at the school level may be useful in explaining the integration of ICT in the daily classroom practice. As the Flemish government introduced a formal and compulsory ICT curriculum to primary schools in 2007, research into factors that influence school level conditions and ICT use is very important for Flanders. This curriculum stipulates that every child should be digitally literate when leaving compulsory education and put stress upon the integrated use of technology within the learning and teaching process. Furthermore, in putting the ICT curriculum into practice, Flemish schools receive great autonomy and responsibility (Vanderlinde, van Braak, De Windt, Tondeur, Hermans, & Sinnaeve, 2008). This increase in local school autonomy and responsibility for bringing the attainment targets into practice makes the question as to whether the integration of ICT in primary education is a process of sole-persons or cultural-influences (school culture) almost redundant. As the results of this study indicate an influence of both individual and school level on ICT integration in the classroom, the challenge for further research seems not only to be on deepening both levels. Even more, the challenge will be on getting insight in their dual relationship.

CHAPTER 6: GENERAL DISCUSSION AND CONCLUSION

Introduction

This dissertation investigates how primary teachers' educational beliefs influence the use of ICT as an educational innovation in primary education. Two main lines of investigation were followed. We first investigated the underlying structure of Flemish primary teachers' educational beliefs. Second, we examined the relationship between these beliefs and the use of ICT in primary education. Along these lines of investigation two main research questions and 5 subsidiary questions were formulated. In this final chapter, we once again outline the research questions presented in this dissertation and formulate possible answers to each of the questions. Limitations of each study are outlined and directions for further research are proposed. Finally, the practical implications of our findings are discussed.

Overview of the research questions, main results and discussion

Overview of the research questions

The central question of this dissertation was 'What is the influence of Flemish primary teachers' beliefs on the use of ICT as an educational innovation in primary education?' However, due to the wide scope of this question, subsidiary questions were formulated:

Research Question 1

What are Flemish primary teachers' prevailing beliefs about the purpose and nature of education and about learning and instruction?

Subsidiary research questions to Research Question 1:

- a. *Is it possible to develop a reliable instrument to measure primary teachers' educational beliefs?*
- b. *Is there a difference between primary teachers' general educational beliefs about the purpose and nature of education and more classroom related beliefs about learning and instruction?*

Research Question 2

What is the influence of primary teachers' educational beliefs on their use of ICT for educational purposes?

Subsidiary research questions to Research Question 2:

- a. *What is the influence of Flemish primary teachers' educational beliefs on their classroom use of computers when the influence is controlled by technological related variables?*
- b. *What can be understood by innovative classroom use of ICT in Flemish primary education?*
- c. *Is there any relationship between Flemish primary teachers' educational beliefs and their innovative classroom use of ICT?*

Overview and discussion of the main results

Below we discuss our findings in relation to each of the subsidiary questions. By dealing first with the subsidiary questions the main results of the different studies included in this dissertation will be outlined. In order to see the results in a wider context, an answer on the related overarching research question will be formulated and further discussed.

Main findings with regard to 'research question 1'

First Subsidiary Research question to Research Question 1:

Is it possible to develop a reliable instrument to measure primary teachers' educational beliefs?

This question is addressed in Chapter 2 where we attempted to construct a reliable instrument to measure Flemish primary teachers' educational beliefs; the Beliefs about Primary Education Scale (BPES). The process of developing and validating this measure initially resulted in a pool of 18 items assessing primary school teachers' beliefs about the nature of good education. Further investigation of the underlying structure by means of exploratory factor analysis ($n=352$) revealed a two-dimensional structure in the data.

These factors were labeled as ‘transmissive beliefs’ and ‘developmental beliefs’. Confirmatory factor analysis ($n=381$) confirmed the stability of this two-factor model.

In order to validate the developmental and transmissive dimension of the BPES, we investigated the relation between the BPES and the Teacher Beliefs Survey for assessing constructivist and traditional beliefs (TBS; Woolley et al., 2004). The results showed that there is substantial overlap between the instruments. Although both instruments measure primary teachers’ beliefs about ‘good’ education, the items in the BPES assess general beliefs about good education while the TBS assesses beliefs with regard to the practical organization of the learning and teaching environment. Based on this substantial difference, we decided to investigate whether two relatively independent clusters of educational beliefs were present in the data, namely general educational beliefs about the purpose and nature of primary education (e.g. BPES) and specific educational beliefs related to the classroom practice (e.g. TBS). However, due to the overlap in items related to knowledge acquisition in both instruments, and given the fact that the TBS not only measures educational beliefs, but also contains behavior-related items, the decision was made to create two new item pools using the same instruments. Chapter 4 concentrated on this revision.

In line with the main theme of the BPES, the first pool of items is related to beliefs about the purpose and nature of primary education. Exploratory factor analysis revealed a two dimensional structure ($n= 235$). The first dimension was labelled ‘developmental oriented general educational beliefs’, as the central focus of this dimension was on broad and individual development and the well-being of pupils. The second dimension was labeled ‘economically oriented general educational beliefs.’ The items on the second dimension were related to the preparation of pupils for the vocational market and social productivity, and also assess the extent to which primary education serves external goals. Confirmatory factor analysis ($n= 223$) confirmed the stability of this two-factor model.

The second item pool focuses on classroom practice. This cluster of beliefs comprises items assessing the process of learning and instruction. Exploratory factor analysis ($n = 235$) revealed a two-factor solution: the first factor was labeled ‘construction oriented beliefs about learning and instruction’ and contained items

focusing on pupils' personal meaning making and construction of understanding and the second factor was labeled 'transmissive oriented beliefs about learning and instruction' and contained items in which educational content is based on external sources, whereby knowledge construction is seen as transmission of information, and classical instruction is seen as the ultimate way of enhancing learning achievement. The stability of this two-factor structure was confirmed by means of a confirmatory factor analysis ($n = 221$).

Second Subsidiary Research question to Research Question 1:

Is there a difference between primary teachers' general educational beliefs about purpose and nature of education and more classroom related beliefs about learning and instruction?

In addition to developing instruments to measure educational beliefs, the mutual relationships between different clusters of educational beliefs were investigated. In Chapter 2 we made a distinction between the 'general beliefs' of primary school teachers about the nature of education that underlie their 'specific beliefs' about the practice of teaching. This distinction fits the assumption that beliefs always emerge in groups and are not held independently of one another (Green, 1971). Given this assumption, the aim of Chapter 4 was to provide further insight into the interrelatedness of two main clusters of primary teachers' educational beliefs, namely beliefs about the purposes and nature of primary education and beliefs about learning and instruction. The former cluster of beliefs focuses on educational beliefs about the general objectives of primary education. The latter cluster of beliefs focuses on educational beliefs related to the organization of classroom practices and desirable ways of knowledge acquisition. The process of exploring and confirming the clusters of educational beliefs was outlined above. Below we discuss the difference between these clusters of beliefs.

Based on the results of the correlation analysis in Chapter 2, the assumption was introduced that favorable developmental beliefs about the nature of education (e.g. BPES) may lead to positive beliefs toward constructivist teaching approaches (e.g. TBS; Teachers' educational Beliefs Survey; Woolley et al., 2004). In Chapter 2 it was suggested that transmissive beliefs may lead to positive beliefs toward traditional teaching practices. Chapter 4 investigated whether there is a causal relationship between

general teacher beliefs and their specific beliefs about teaching and learning. We hypothesized that general beliefs about the purpose and nature of education would influence specific beliefs about learning and instruction. This was explored in a path model ($n = 461$). The results indicate that specific beliefs about learning and instruction in primary education are preceded by more general beliefs about the purpose and nature of primary education. More specifically, primary teachers' constructivist oriented beliefs about learning and instruction seem to derive from their general beliefs about the purpose of education within a developmental orientation. To a lesser degree, beliefs about learning and instruction within a transmissive and teacher-centered approach were preceded by economic and outcome oriented beliefs about the purpose of education.

Discussion of the findings regarding 'Research Question 1'

Research Question 1

What are Flemish primary teachers' prevailing beliefs about purpose and nature of education and about learning and instruction?

The results of Chapter 2 and Chapter 4 are in line with Green's (1976) statement that beliefs never occur in total independence of one another. Our findings indicate that educational beliefs emerge in groups or clusters of related beliefs. Our results provide validating evidence for the existence of two clusters of primary teachers' educational beliefs, namely (1) the purpose and nature of primary education and (2) learning and instruction in primary education. These findings corroborate study of Denessen (1999), who classified the construct 'educational beliefs' into three domains of educational content; (1) educational goals, (2) pedagogical relation, and (3) instructional emphasis (content and shape). The operationalization of 'educational beliefs' in this dissertation subsumes Denessen's last two domains under the heading 'beliefs about learning and instruction', but puts more emphasis upon beliefs concerning knowledge acquisition. This characterization lends force to make the distinction between Flemish primary teachers' general beliefs and classroom related beliefs.

In general, in further exploring those educational beliefs it is attractive to think and speak about teaching and learning in two major categorisations. Teachers approach teaching and learning from a student-centred orientation, or they approach teaching and

learning from a teacher-centred orientation. Somehow caricatured, in the former orientation pupils' learning and knowledge building is assumed as most important. In the latter, stress is put predominantly upon the transmission of knowledge and information from the teacher to the pupils. In research literature on the dimensionality of educational beliefs, both orientations refer to different dimensions of educational beliefs (Denessen, 1999; Denessen, Michels, & Felling, 2000). In the example above, both orientations are presented as opposite ends of one dimension. This means that a high score on the student-centered orientation should coincide with a low score on the teacher-centered orientation.

However, the results of this dissertation clearly support a multidimensional view of Flemish primary teachers' educational beliefs. The results of Chapter 2 suggest that there are two dimensions of educational beliefs, namely developmental and transmissive beliefs about the purpose and nature of primary education, and beliefs about knowledge acquisition in primary education. In Chapter 4 these two dimensions were further confirmed and a distinction was made between a developmentally oriented dimension and an economic and outcome oriented dimension in relation to beliefs about the purpose and nature of primary teachers. Furthermore, within the cluster of educational beliefs about learning and instruction the results indicate that a constructivist oriented dimension can be distinguished from a transmissive oriented dimension. These results are in line with previous research on the dimensionality of teachers' educational beliefs. For example, Kerlinger and Kaya (1959a, 1959b) propose a two-dimensional conceptualization of educational beliefs, while Silvernail (1992) proposes three dimensions. In addition to 'traditional' and 'progressive' dimensions, Silvernail (1992) added a 'romantic' dimension. Other examples include Bunting (1981, 1984, 1985), who proposed a four dimensional structure, while more recently, Denessen (1999) proposed two dimensions and Woolley et al. (2004) developed a three dimensional operationalization. To conclude, we agree with Denessen (1999) that almost all operationalizations unveil a teacher-centered and pupil-centered dimension. Moreover, when more than two dimensions are proposed, it is frequently the case that the remaining dimensions correlate highly with one of the two dimensions.

Our findings also indicate that Flemish primary teachers hold developmental (or constructivist oriented beliefs) as well as transmissive (or economic) and outcome

oriented beliefs. This finding is in line with previous research on the dimensionality of educational beliefs in which beliefs are presented as a multilayered construct (e.g. Denessen, 1999; Kerlinger, 1959a, 1959b; Woolley et al., 2004). It may seem paradoxical for primary teachers to hold both traditionally oriented and constructivist oriented beliefs. However, it is not unusual to assume that primary teachers find it sufficient to evaluate pupils by means of homework, quizzes and tests while also finding it important to expand on pupils' ideas as an effective way to build a curriculum. In other words, the results indicate that inconsistent beliefs are consistent within a wider set of beliefs (Abelson, 1979). In relation to this, Furinghetti and Pehkonen (2002) refer to the clustering property of belief systems to explain inconsistencies in an individual's belief system. According to these authors, conflicting beliefs can be held in different clusters within an individual's belief system. This was also proposed by Levitt (2002), who found that elementary school teachers believe that science should be taught in such a way that it is personally meaningful to students, but also have underlying traditional beliefs about the classroom organization and their role as the teacher. In addition, Haney and McArthur (2001) investigated the beliefs of prospective science teachers in relation to constructivist teaching practices. The authors show that personal relevance and student negotiation (both constructivist core beliefs) can be held alongside beliefs about the importance of the science curriculum or a belief in didactic teaching strategies (i.e. the teacher as supplier of information).

According to Pajares (1992), clusters of beliefs around a particular object or situation form attitudes that can lead to action. Indeed, numerous studies have been carried out on the different clusters of teachers' educational beliefs and their relation to teachers' behavior (see e.g. Foss & Kleinsasser, 1996; Haney & McArthur, 2001; Levitt, 2002; Richardson, 2003). The present dissertation fits into this tradition as it studies the relation between two main clusters of educational beliefs and classroom use of ICT. While the results of this dissertation indicate that Flemish primary teachers hold both constructivist and traditional oriented beliefs, the results also suggest that some clusters of beliefs are more influential than others. In terms of classroom use of ICT, constructivist oriented beliefs seem to have more of a guiding influence than traditional oriented beliefs. This is discussed in more detail below.

Finally, an examination of the interrelatedness of the different belief clusters (in terms of the correlations and the regression coefficients) showed that there is a stronger correlation between the developmental and constructivist oriented beliefs than between the economic and outcome related beliefs and transmissive beliefs. This can be explained by the fact that constructivist/developmental beliefs more explicitly refer to the nature and mission of primary education (Alexander, 1995, 2000).

Main findings with regard to ‘Research Question 2’

First Subsidiary Research question to Research Question 2:

What is the influence of Flemish primary teachers’ educational beliefs on their classroom use of computers when the influence is controlled by technology related variables?

Chapter 3 focused on teachers’ educational beliefs (constructivist and traditional beliefs) as antecedent to computer use, while controlling for the impact of technology related variables (computer experience, general computer attitudes) and demographical variables (sex, age). A multilevel model was created ($n = 525$) in order to identify differences in determinants of classroom use of computers and take into account the nested structure of the data (teachers within schools). To measure primary teachers’ use of computers for support of the teaching or learning process, a modified version of the ‘Class Use of Computers’ scale of van Braak et al. (2004) was used. Primary teachers’ constructive and traditional beliefs were measured by administering two dimensions of the TBS (Woolley et al., 2004).

The results of Chapter 3 indicate that constructivist beliefs about teaching and learning have a significant positive effect on the classroom use of computers and, conversely, traditional beliefs were found to have a negative effect on the classroom use of computers. Next to educational beliefs, gender, computer experience, and general computer attitudes were included in the model as control variables. The final multilevel model indicates that gender, computer experience and general computer attitudes have a significant effect on the classroom use of computers at the teacher level.

However, using a stepwise approach to building the multilevel model, the additional contribution in the proportion of explained variance by demographic variables,

technology-related variables and educational beliefs was examined. These results indicate that primary teachers' beliefs related to the classroom practice are equally as important as technology-related teacher characteristics such as computer experience, general computer attitudes and gender in explaining teachers' computer use. Therefore, the study sheds light on the mediating role of primary teachers' educational beliefs in the resistance and receptiveness of primary school teachers to integrate computers in their classroom practice.

Second Subsidiary Research question to Research Question 2:

What can be understood by innovative classroom use of ICT in Flemish primary education?

Following Kozma and Anderson (2002) and Drent and Meelissen (2008), the concept of 'innovative use of ICT' can theoretically be defined as practices that are perceived as new, in which ICT plays a substantial role in supporting educational objectives, and are important in preparing pupils for lifelong learning in the knowledge society. There are two implications to this conceptualization of 'innovative use of ICT.' Firstly, by shifting the focus away from specific technologies, the practical and integrative use of ICT in educational processes is central. In other words, in this definition of innovative ICT use for educational purposes it is not the technology itself that is important but the way ICT is used to support student-centered learning approaches (Drent & Meelissen, 2008). Secondly, and given that education should prepare children for the knowledge society, the contribution of ICT for educational purposes concerns fostering communication, collaboration and knowledge sharing.

Bearing in mind the contextual influence of what is meant by innovative use of ICT, and given the absence of instruments measuring innovative use of ICT in primary education, we decided to develop a scale to measure innovative use of ICT in primary education in Flanders. This was carried out in the first part of Chapter 5. In order to get a representative image of what can be understood as innovative classroom use of ICT in Flanders education, examples of innovative activities (i.e. activities in which ICT plays a substantial role and which should be present in Flemish primary education) were elicited from a large sample of experts in the field of ICT and (primary) education. With the

examples provided we created an item pool and investigated the latent structure of this item pool.

A survey conducted with 472 primary teachers was used to investigate the extent to which the item pool was representative of a broader sample of Flemish primary teachers. By means of a Categorical Principal Component Analysis CATPCA and confirmatory factor analysis, a one-dimensional structure with fourteen items was identified and confirmed.

Third Subsidiary Research question to Research Question 2:

Is there any relationship between Flemish primary teachers' educational beliefs and their innovative classroom use of ICT?

Once an item pool was created to measure innovative ICT use in the classroom, the influence of primary teachers' educational beliefs on innovative ICT use was investigated (Chapter 5). In doing so, two factors were taken into consideration. First, considering teachers' resistance to (technological) change in the classroom practice, we decided take into account more 'common' forms of ICT use. Secondly, as previous research indicates that gender, age, and computer experience influence the integration of ICT (see e.g. Hermans, Tondeur, van Braak, & Valcke, 2008; Shapka & Ferrari, 2003; Williams et al., 2000) these personal characteristics were included in the study. In order to measure primary teachers' educational beliefs, two dimensions of Hermans and van Braak's Beliefs about Learning and Instruction (Hermans, & van Braak, 2009), namely Constructivist Oriented Beliefs about Learning and Instruction (COBLI) and Traditional Oriented Beliefs about Learning and Instruction (TOBLI), were used.

The results of a multilevel model (N=472) revealed primary teachers' constructivist oriented beliefs about learning and instruction (COBLI) have a significant influence on both 'innovative ICT use' and 'common use of ICT.' Traditional oriented beliefs about learning and instruction (TOBLI) were found to have no influence on either form of ICT use. However, in terms of personal characteristics the results indicate that gender, teaching experience, and computer experience have a significant influence on innovative

use of ICT, but have no influence on ‘common use of ICT’. Furthermore, in terms of factors that influence ‘common use of ICT,’ only the COBLI was significant.

Discussion of the findings regarding ‘Research Question 2’

Research Question 2

What is the influence of primary teachers’ educational beliefs on their use of ICT for educational purposes?

As previously indicated, in this dissertation teachers’ ICT use was examined in relation to their classroom use of computers (Chapter 3) and their classroom use of ICT (Chapter 5). These studies shed light on the mediating role of primary teachers’ educational beliefs in the use of ICT in their classroom practice.

The positive influence of constructivist beliefs on the integration of ICT in the classroom is in line with previous studies on the influence of constructivist oriented beliefs on the classroom use of computers (e.g. Becker, 2001; Tondeur, Hermans et al., 2008) and on the adoption of tools that foster constructivist learning approaches (Riel & Becker, 2000, 2001). Our finding that traditional beliefs have a negative influence on classroom use of computers supports Ertmer’s (1999) proposition that beliefs may be intrinsic barriers that interfere with or impede change. Watson (2001) reconciles this with a deficit model of teachers’ use of ICT in which teachers are characterized as technophobic, too traditional in their teaching style or reluctant to adopt change. Watson (2001) suggests that teachers’ use of ICT in the classroom should be viewed in relation to their pedagogic and subject philosophy (Watson, 2001). However, the results of both studies corroborate the findings of previous research indicating that the teacher has a critical role in affecting change in the classroom, as innovator or as preserver (Albirini, 2006; Watson, 2006).

Furthermore, our findings provide insight into the antecedents of classroom use of computers. As mentioned in the general introduction, previous research into the antecedents of ICT use in the classroom has limited its investigation by only using technological variables, such as attitudes to computers (e.g. Albirini, 2006; van Braak, 2001), experience with computers (e.g. Becker, 2001; Williams et al., 2000), perceived

contribution to the learning environment (e.g. Smeets, 2005), and personal characteristics such as sex and age (e.g. Bradley & Russell, 1997; Shapka & Ferrari, 2003; van Braak, Tondeur, & Valcke, 2004). In Chapter 3 we found that primary teachers' educational beliefs are equally as important as technological variables, such as computer experience and general computer attitudes and demographic variables, such as gender in explaining classroom use of computers. Moreover, although the belief clusters included in Chapter 3 were not ICT-related, we found that teachers' beliefs have a strong influence on classroom use of computers. Chapter 5 confirmed that primary teachers' constructivist oriented beliefs about learning and instruction have a strong and significant influence on both 'innovative ICT use' and 'common use of ICT.' More specifically, for 'innovative ICT use' we found that the influence of teachers' beliefs was mediated by teacher characteristics, while for 'common ICT use' teachers' beliefs was the only significant explanatory variable. The influence of the constructivist oriented beliefs about learning and instruction was even higher on 'common ICT use' as compared to their influence on 'innovative ICT use'. It is important to note that that in the scales used in Chapter 5 educational purposes were included in the formulation of the items. By this, emphasis was placed on the potential of ICT to contribute to the learning environment. From this point of view, it seems that teachers who recognize the pedagogical potential of ICT use it in accordance with their fundamental beliefs about learning and instruction.

The results of Chapter 3 and 5 also suggest that a successful integration of ICT in the classroom is not only dependent on the teacher. As teachers perform in schools, the influence of the school context should be respected while performing the analysis. Therefore, in Chapter 3 and 5 multilevel modeling was performed. By applying this technique it was possible to estimate the amount of the total variance of ICT that can be ascribed to individual differences and the amount of the total variance caused by the educational environment in which the teachers participate. Although most of the variance in primary teachers' computer use can be explained by individual differences, significant differences were observed in the frequency of classroom use of computers at the school level. Consequently, the results indicate that the teachers' use of ICT within the same school is correlated at the school level showing that there are significant differences between the different schools included in the studies. The application of multilevel regression techniques is quite new in research on the integration of ICT. Indeed, recent

research demonstrates that this technique is valuable for exploring the interaction of teacher and school characteristics and thus acquiring a richer understanding of the complex process of ICT integration (O'Dwyer, Russell, & Bebell, 2004; Tondeur, Valcke et al., 2008). The present dissertation further demonstrates the usefulness of this statistical technique.

General conclusions

From the overview of the main findings and the discussions of the results described in the previous sections, five general conclusions can be drawn.

1. When studying the conceptualization of primary teachers educational beliefs, the results in this dissertation clearly indicated that two specific clusters of primary teachers' educational beliefs could be identified: (1) beliefs about the purposes and nature of primary education, and (2) beliefs about learning and instruction in primary education.
2. Although two main clusters of related beliefs were identified, the studies in this dissertation further provided support for the assumption that primary teachers' educational beliefs can be conceptualized as a multidimensional, layered construct. Primary teachers may simultaneously hold both:
 - Developmental and economic oriented beliefs about the purposes and nature of primary education;
 - Constructivist and transmissive oriented beliefs about learning and instruction.
3. Studying the relationship between both clusters more in detail, the results suggest a (quasi-) logical order in which the classroom oriented beliefs about learning and instruction are derived from more general beliefs about purposes and nature of primary education.
4. When studying the influence of educational beliefs on the integration of ICT in the classroom, empirical evidence was found supporting the hypothesis that primary teachers' educational beliefs about the practice of teaching can be a significant determinant in explaining why teachers use ICT in the classroom. Specifically, the results suggest that certainly constructivist orientation beliefs positively influence ICT use in the daily classroom practice.

5. When studying the influence of educational beliefs on the integration of ICT in the classroom, the results further indicated that the integration of ICT cannot exclusively be explained by limiting to personal characteristics. Both studies on the classroom use of respectively computers and ICT consequently indicated a vast amount of the variation ascribed to school level characteristics

Limitations of the studies and suggestions for further research

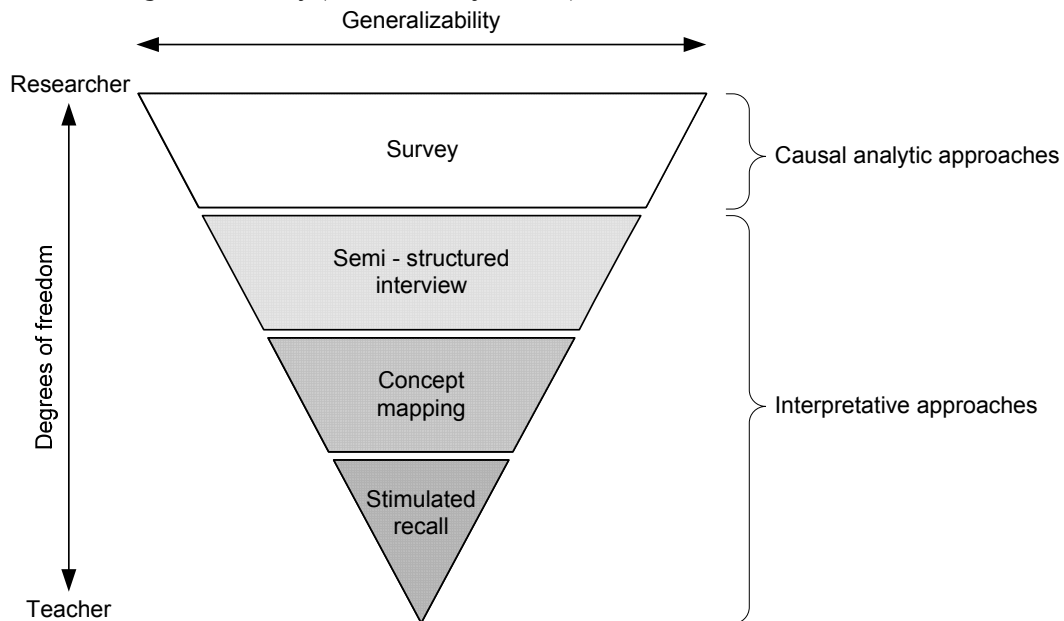
There are some limitations associated with the current study. These can further be explained by concentrate on the next elements: (1) constrains related to validity and reliability and (2) constrains related to the research design.

(1) Constrains related to validity and reliability

In this dissertation we used a combined design (Miles & Huberman, 1994) integrating both quantitative (survey studies) and qualitative approaches (interviews and open ended questionnaires). Following Meijer (1999), these analytical approaches can be rubricated by two main criteria, namely latitude and generalizability (see Figure 8). In terms of research into teachers' beliefs, the concept of latitude refers to the degree of freedom an individual teacher is given to make his/her individual beliefs explicit. The more latitude given to the individual teacher, the greater the chance a researcher has of capturing the idiosyncratic beliefs of this teacher. Generalizability refers to the possibility of making systematic comparisons between data gathered from different teachers and the ability to generalize the findings to a population or subpopulation. The more the generalizability increases, the more the latitude inclines to the researcher and, as a consequence, the more the researcher structures the set of instruments. Survey instruments can therefore be placed along the dimensions of high generalizability and low latitude. In terms of interviews, the dimension of generalizability decreases, but the latitude increases in favor of the individual teacher. The inclusion of interviews and open ended questionnaires was therefore appropriate for gathering background information as well as getting a rich understanding of both the educational context and the context of educational innovation. However, the main emphasis in the studies incorporated in this dissertation was on quantitative analyses by means of survey studies (Chapters 2 to 5). Exploration by interviews (Chapter 4) and open ended questionnaires (Chapter 5) were

also used in the conceptual development and instrumentation. Limitations in relation to the research design used in this dissertation concern problems with validity in survey research.

Figure 8
Latitude and generalizability (Based on Meijer, 1999)



In general, ‘validity’ concerns the extent to which ‘a variable measures what it is supposed to measure’ (Adcock & Collier, 2001). In the field of research on teachers’ beliefs the concept of validity is particularly complex. Since beliefs cannot be observed in a direct way and have to be inferred from peoples’ actions and speech (Pajares, 1992) it is difficult to assess this variable in a straightforward way. As teachers do not think and behave the same way in different situations, paper-and-pencil examinations are often criticized for ‘violating’ the complexity of the teaching activity (Beijaard & Verloop, 1996). Following Hofer and Pintrich (2002), a number on a continuum cannot capture the complexity of a teacher’s broader system of beliefs about primary education. Finally, numerous authors point to an inconsistency between (reported) beliefs and the practice of teaching (Bolhuis & Voeten, 2004; Fang, 1996). In this context, Bryan (2003) and Richardson (2003) recommend using longitudinal or mixed method designs when investigating teachers’ beliefs in order to capture the rich interplay between variables.

In future research a better ratio between generalizability and latitude could be achieved by extending survey research with stimulated recall research. This combined design could provide interesting insights into the (in)consistency between reported beliefs and actual teacher behavior. Stimulated recall is a verbal reporting technique in which the teacher is asked to verbalize his interactive thoughts while looking at his own behavior on video. The visual aids serve to elicit underlying beliefs in the explaining teacher's behavior (Fang, 1996). Consistencies and inconsistencies can be observed by comparing the results of both methods.

A similar remark can be made regarding the way in which classroom use of ICT was measured in this dissertation. Classroom use of computers (Chapter 3) and ICT (Chapter 5) was perceived as a time appraisal. As a consequence, it is possible that there is inconsistency between reported behavior and actual behavior. In future research on classroom use of ICT, the reliability could be improved by complementing the scales we used with other methods of data collection, for example, classroom observations including video registration of the teachers' actual use of ICT.

A second critical remark on the reliability of our findings concerns the construction and validation of the different scales used in this dissertation. In selecting participants for each of the different samples, representation of various subgroups in the population was taken into account. In deciding the strata, stratification variables were primarily related to location (region) and type of educational network. Furthermore, as we aimed to gather a large sample, our target number per school was the participation of at least one teacher at each grade level. Although the samples used in the different studies were relatively large future research should attempt to replicate our findings by administering the scales to other samples. This in order to further validate the scales constructed in this dissertation.

The contextual specificity of measurement validity should also be questioned. As the studies in this dissertation were restricted to the Flemish region of Belgium, it is not possible to generalize our findings to primary teachers from other cultures. Research indicates that as teachers' beliefs are shaped by culturally shared experiences and values, their educational beliefs are rooted in the culture in which they were raised (Correa, Perry, Sims, Miller, & Fang, 2008). A cross-cultural investigation of teachers' beliefs

could be particularly valuable as a comparison of two distinct culturally embedded belief systems and could make implicit beliefs and assumptions more transparent (Correa, et al., 2008). This could also lead to more explicit understanding of one's own culturally embedded beliefs. As ICT-use is culturally sensitive (Erumban & de Jong, 2006; Kozma & Anderson, 2002), future research should explore cultural differences in relation to ICT-use and attempt to validate our scales in different contexts. Such research could shed light on similarities and differences in primary teachers' educational beliefs and ICT use in different cultures.

(2) Constrains related to the research design

Each research design has its strengths and limitations. Naturally, the strengths and limitations of the method chosen will affect the conclusions that can be drawn. In this dissertation much attention was paid to the conceptualization of primary teachers' educational beliefs. We investigated the role of educational beliefs (as facilitators/constraints) in the process of integrating educational innovations and we examined the relationship between educational beliefs and classroom use of ICT. However, there were limitations to the number of variables included in the studies.

Future research should carry out further in depth analysis of primary teachers' educational belief structure. As mentioned above, one of the assumptions held in research on educational beliefs is that different beliefs are structured within a governing belief system (e.g. Green, 1971; Pajares, 1992). Within this system, both the place of a belief within the system and the mutual relations between beliefs within the system are important, as they determine the perceived importance of beliefs, their changeability, and the accessibility of beliefs for reflection (Richardson, 2003). Furthermore, the proposition that the mutual relationships between different beliefs within the structure can be characterized as 'quasi-logical' seems to be plausible. The term quasi-logical means that some beliefs are derived from others within the structure (Green, 1971). The results in this dissertation indicate that there is a clear relationship between educational beliefs about the purpose of primary education and beliefs about learning and instruction. However, an individual's belief system contains more than just the clusters of educational beliefs used in this study. Research in educational psychology emphasizes the importance of epistemological beliefs (e.g., beliefs about the importance of knowledge and processes

of knowledge acquisition, beliefs about innate ability and intelligence ...) and motivational beliefs about the self in terms of self-efficacy (e.g. Fives & Buehl, 2008; Hofer & Pintrich, 2002; Poulou, 2007). However, while psychological research proposes that these beliefs may facilitate or constrain pedagogical/didactical beliefs, the way in which these beliefs are related to each other is unclear. Further research focusing on these clusters of beliefs and their mutual relationships can provide more insight into this area.

Secondly, in this dissertation little attention was paid to the wider context of the learning environment. Roelofs et al. (2003) suggest that physical conditions (e.g. classroom, timetable, group size, textbooks, and media) and parental expectations may be impeding factors to the implementation of educational innovations. Meellissen and Drent (2008) indicate that contextual, structural, and cultural school characteristics have significance influence on the integration of ICT in the classroom. The extent to which these factors influence underlying teacher beliefs and behavior (i.e. use of computers and ICT) is less clear. Further research should investigate the extent to which the perceived context of the learning environment facilitates (in)consistency between reported beliefs and actual teacher behavior in the learning environment.

Furthermore, recent research on teacher learning of Meirink (2007), for example, pointed at the importance of collaboration between teachers while implementing new pedagogical approaches in their practice. A combination of exchanging ideas and experiences of experimentation, and a school culture aiming at shared problem solving appeared to relate positively with teacher learning. It further can be argued that this view on learning as a process of social construction related to individual sense-making requires more than only space to negotiate over the meaning of things (Geijsel, & Meijers, 2005). According to Geijsel and Meijers, personal sense-making need separate platforms which initiate and facilitate processes of learning and change and which pay attention to personal experiences and related emotions. The extent to what schools can create platforms for both collaboration and personal sense-making can be subjected to further investigation.

Due to the nested structure of the data (teachers within grades), multilevel structural equation modeling (Heck, 2001) should be performed to overcome limitations on the

individual level as well as the contextual level. In using this technique, the benefits of structural equation modeling (analyzing (in)direct effects on a dependent variable) and multilevel modeling (analyzing variance attributed to between and within-level differences) can be combined. However, finding a sample large enough for these analyses, as well as conducting this relatively new and highly complex method of analysis, will be challenging.

Finally, in terms of the research design used in this dissertation, there were limitations in relation to the cross-sectional nature of the studies. A common starting point of research into teachers' educational beliefs is the influence of beliefs on teachers' behavior in the learning environment. The related (in)consistency between teachers' beliefs and their actual behavior in the learning environment is sometimes characterized as a threshold in the implementation of educational innovations (Bryan, 2003). In this dissertation, we approached the relationship between teachers' educational beliefs and classroom use of ICT in a unidirectional way, from the former to the latter. However, Levin and Wadmany (2005) revealed changes in teachers' educational beliefs, knowledge and classroom practices elicited from performing information-rich tasks in a technology-based environment. Consequently, the relation between beliefs and classroom practices seems to be more reciprocal than expected (Haney et al., 2003; Levin & Wadmany, 2005). However, measuring teachers' educational beliefs only once gives little insight into this reciprocal relationship. Future research using a longitudinal design would be valuable in this context.

Practical implications

As indicated in the introduction, there has been much research on primary teachers' educational beliefs. However, the focus of that research has been predominantly on the beliefs of prospective teachers (e.g. Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003; Stuart & Thurlow, 2000). Research on the beliefs of in-service primary teachers often includes instruments (e.g. Smith, 1993; Woolley et al., 2004) that focus only on assessing teachers' beliefs about the practice of teaching and classroom processes. The present dissertation extends to this field of research in terms of its exploration of (1) primary teachers' educational beliefs and (2) the relationship between

primary teachers' educational beliefs and their class use of ICT. Alongside these scientific ambitions, the contributions of this dissertation regarding the development of empirically grounded theories can not be separated from some inherent practical implications. The example of the integration of ICT in the classroom can be used for clarification.

This dissertation has taken into account the limited integration of ICT in the classroom. The slow uptake of educational innovations prompts questions concerning the role of the teacher in innovation processes. Previous research indicates that educational reforms sometimes fail due to different interpretations of the innovation by those involved in the instructional process (van den Berg et al., 1999). The results of this dissertation demonstrate that the meaning attached to an innovation should not be limited to the subject of the innovation itself. Our findings indicate that there is a powerful relationship between teachers' beliefs about learning and instruction and the use of ICT. This implies that when ICT is seen as a tool to be integrated into learning and instruction environments (and not as a subject in its own right), teachers must also reflect on the position of ICT in relation to their beliefs about teaching and learning. Therefore, in order for this educational innovation to be successful teachers' beliefs should be addressed prior to implementing the innovation. However, while the findings in this dissertation indicate that a large percentage of the variability in teachers' use of ICT results from personal characteristics (especially in terms of the adoption of innovative ICT practices), our findings also indicate that there are significant differences between schools in terms of ICT use. The integration of ICT should not be solely the responsibility of the individual teacher, but should be a shared responsibility. Bridging the gap between the teacher and the school and having a technology plan which includes a shared vision could lead to greater success in the integration of ICT in the classroom (Hew & Brush, 2007; Vanderlinde et al., 2009).

Within the Flemish context, schools are encouraged to design a technology policy plan related the integration of the new technology curriculum, in which they outline their expectations, goals, content, and actions (Vanderlinde et al., 2008). In order to support and facilitate the development of this policy plan, an online tool for technology plan development (Planning for ICT on School: PICTOS), was developed for primary

education and the first grade of secondary education. The online policy environment pICTos is a combined project of the Department of Educational Studies of Ghent University, in service training coordination of the Flemish Community (REN), and a commercial company for educational software development (Playlane). This cooperation between an academia, government, and business is an example of the development and diffusion of empirically based educational materials. One of the cornerstones of this tool is the explication of teachers' and schools' vision on the nature of good education and the processes of learning and instruction (Vanderlinde et al., 2009). One of the rationales behind this tool is that without such a vision teachers will limit their thinking about technology to isolated computer skills (Vanderlinde et al., 2008). Another rationale behind this tool is that gaining insight into teachers' vision of education and involving teachers by encouraging them to reflect on their vision will encourage teachers to participate in the decision making process in the school.

With this online survey, participating teachers are asked to make explicit their educational beliefs. This survey is built on the BPES (Hermans, van Braak, & Van Keer, 2008) and the TBS (Woolley et al., 2004). The findings of the first two studies of this dissertation were used to make a general distinction between transmissive (teacher-centered) and developmental (student-centered) beliefs. After the participating teachers fill in the survey, the results are plotted on a graph which illustrates both the individual results and the collective results. Furthermore, in order to provoke discussion and achieve a shared vision on education, the graph serves as a basis for teachers to compare their own results with those of the other participating teachers. By doing so, the use of empirically validated scales is used to stimulate both to make the 'invisible visible' as well as a useful way to make underlying beliefs about the purpose and nature of primary education and beliefs about learning processes and instruction processes in primary education as a subject of discussion. A shared vision can be a starting point for teachers to decide upon their own technology goals and priorities (Vanderlinde et al., 2008). By this, the rationalization of teachers thought processes in general and addressing teachers' educational beliefs more specifically can form successful parameters in bringing about sustained changes.

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NEDERLANDSTALIGE SAMENVATTING

*‘De invloed van onderwijsopvattingen op het gebruik van ICT als
onderwijsvernieuwing in het lager onderwijs.’*

Theoretische achtergrond

Het onderzoek in dit proefschrift focust op de invloed van heersende onderwijsopvattingen van leraren lager onderwijs in Vlaanderen op het gebruik van ICT als voorbeeld van een onderwijsvernieuwing. Hierdoor worden in het proefschrift twee onderzoekslijnen centraal gesteld. Een eerste onderzoekslijn zoomt in op een conceptuele uitklaring van onderwijsopvattingen van leraren. In een tweede onderzoekslijn wordt het verband onderzocht tussen onderwijsopvattingen en het gebruik van Informatie en Communicatie Technologie (ICT). Een theoretische achtergrond van beide onderzoekslijnen wordt weergegeven in *hoofdstuk 1*.

Onderzoek naar de conceptuele uitklaring van onderwijsopvattingen van leraren

Vanuit een behavioristisch onderzoekskader werd in het verleden veel aandacht besteed aan observeerbaar lerarengedrag en de invloed hiervan op leerlingprestaties. Daarbij werd een eerder eenzijdige focus gelegd op het ‘ontcijferen’ van de causale relatie tussen beide componenten (zie onder meer Fang, 1996; Shulman, 1986). Vanaf het begin van de jaren ‘80 kan een paradigmatische verschuiving vastgesteld worden waarbij meer aandacht wordt besteed aan de cognitieve processen van leraren (zie onder meer Clark & Peterson, 1986; Shulman, 1986). Een verbijzondering van dit onderzoeksparadigma heeft geleid tot onderzoek naar opvattingen van leraren (zie onder meer Denessen, 1999; Richardson, 2003).

Deze opvattingen kunnen omschreven worden als idiosyncratische denkbeelden die als dynamische structuren filterend werken op de interpretatie van nieuwe kennis en ervaringen (Pajares, 1992). Wanneer deze opvattingen betrekking hebben op het domein van onderwijs wordt er gesproken van onderwijsopvattingen. In brede zin kunnen

onderwijsopvattingen omschreven worden als ideaaltypische persoonlijke denkbeelden over om het even wat met onderwijs te maken heeft. Deze denkbeelden drukken een subjectieve overtuiging uit; de waarschijnlijkheid dat kennis correct is, dat nieuwe informatie waar is, of dat een bepaalde gebeurtenis zal gebeuren (Wyer & Albarricín, 2005). Hierdoor kunnen opvattingen minder beoordeeld worden in termen van juist of onjuist, maar veeleer in termen van wenselijk of onwenselijk. Hoewel onderzoek naar opvattingen bij leraren sterke aandacht geniet in de internationale literatuur en recente empirische en theoretische bijdragen inzicht beginnen te leveren in zowel de conceptualisering van onderwijsopvattingen als in de rol van opvattingen als gedragsdisposities en de invloed van opvattingen in innovaties (e.g. Pajares, 1992, Richardson, 2003), zijn de resultaten van dit onderzoek niet volledig sluitend.

Onderzoek naar de link tussen onderwijsopvattingen en het gebruik van ICT

Het hoeft geen betoef dat ICT een belangrijke plaats heeft ingenomen in de hedendaagse kennissamenleving. De laatste vijftien jaar zijn er in het Vlaams onderwijs vanuit het beleid verschillende initiatieven genomen om de integratie van ICT in het onderwijs te stimuleren. Toch verloopt de integratie van ICT in de klaspraktijk niet van een leien dakje en wijst recent internationaal onderzoek op een lage integratiegraad (zie onder meer Kozma & Anderson, 2002). Deze vaststelling gaat evenzeer op voor het Vlaams lager onderwijs (zie onder meer Tondeur et al., 2007; van Braak, Tondeur, Valcke, 2004). Deze vaststellingen doen vragen stellen naar hindernissen die onderwijskundige innovaties in de weg staan in het algemeen, en naar de integratie van ICT in het onderwijs in het bijzonder.

In het onderzoek naar de implementatie van onderwijsinnovaties is een paradigmatische wending merkbaar van een rationeel-functioneel naar een cultureel-innovatief perspectief (van den Berg, 2004). Hierbij wordt afgestapt van een eerder instrumentele invulling van de innovatie waarbij centrale sturing, controle en effectiviteit hoog in het vaandel gedragen worden en de rol van de leraar gereduceerd wordt tot een uitvoerende professional (van den Berg, 2004). Vanuit een cultureel-innovatief kader

komt de lokale situatie op de voorgrond te staan. Centraal in dit veranderingsperspectief staat de gedachte dat de school moet aansluiten bij de praktische kennis, werkervaring en persoonlijke biografie van haar leraren (van den Berg, 2004). Onderwijsveranderingen worden immers geïnterpreteerd en aangepast vanuit en aan de lokale situatie (Kelchtermans & Labbe, 2005). Vanuit dit denken is het duidelijk dat de persoon van de leraar een belangrijke rol krijgt bij de invoering van onderwijsvernieuwingen (zie onder meer Gess-Newsomme et al., 2003; Harris, 2003). Vanuit deze probleemstelling staat het onderzoek in dit proefschrift stil bij de invloed van onderwijsopvattingen op de aanvaarding en toepassing van vernieuwingen in het onderwijs. Meer specifiek wordt de relatie onderzocht tussen onderwijsopvattingen van leraren in het lager onderwijs en de integratie van ICT in de klaspraktijk.

Resultaten

In een eerste onderzoekslijn in dit proefschrift staat een conceptuele uitklaring van onderwijsopvattingen van leraren lager onderwijs in Vlaanderen centraal. Hoewel de laatste decennia veel onderzoek werd uitgevoerd naar onderwijsopvattingen, bestaat er in de onderzoeksliteratuur nog steeds grote onduidelijkheid over hoe onderwijsopvattingen kunnen worden omschreven en gemeten (zie onder meer Pajares, 1992; Southerland, Sinatra, & Matthews, 2001). Meer concreet heerst er onduidelijkheid over het aantal dimensies dat het construct onderwijsopvattingen kan bevatten. Kerlinger & Kaya (1959a, 1959b) conceptualiseren bijvoorbeeld onderwijsopvattingen vanuit een klassieke tweedeling tussen traditionalisme en progressivisme. Silvernail (1992) voegt aan deze structuur romantische onderwijsopvattingen toe. In het Nederlandse taalgebied peilt het werk van Denessen (1999) naar opvattingen over onderwijs, maar wanneer deze opvattingen op het niveau van het lager onderwijs bekeken worden, is er een leemte. Een eerste betrachting van het onderzoek ligt dan ook in de constructie van een meetinstrument waarmee een valide en betrouwbaar beeld kan worden gegeven van opvattingen van leraren in het lager onderwijs.

De initiële doelstelling van *hoofdstuk 2* is het ontwikkelen en valideren van een onderzoeksinstrument dat opvattingen meet over de aard van ‘goed’ onderwijs; met name

de 'Beliefs about Primary Education Scale' (BPES). Met 'goed' onderwijs wordt hier verwezen naar algemene opvattingen over de doelen van het onderwijs, de finaliteit van het onderwijs, en processen van kennisverwerving. Het onderzoek resulteert in een itempool van 18 items waarmee deze ideaaltypische denkbeelden nagegaan kunnen worden. Verder onderzoek naar de latente structuur van deze items door middel van een exploratieve en confirmatorische factoranalyse wijst een twee-dimensioneel model uit. Hiermee wordt verwezen naar twee samenhangende patronen van algemene opvattingen die onderkend kunnen worden: overdrachtsgerichte opvattingen en ontwikkelingsgerichte opvattingen. Overdrachtsgerichte opvattingen verwijzen naar opvattingen die zich kenmerken door een eerdere technische visie op de onderwijstaak. Hierbij moet onderwijs gericht zijn op het bereiken van externe doelen en worden de beroeps- en maatschappijvoorbereidende rol van het onderwijs sterk beklemtoond. Op het gebied van kennisoverdracht kenmerken deze onderwijsopvattingen zich door een sterk voorgestructureerd curriculum. Ontwikkelingsgerichte opvattingen vertrekken vanuit een vormingsideaal waarbij de leerling centraal staat en kansen krijgt om mee vorm te geven aan het bepalen van de onderwijsinhoud en leerprocessen. Een brede en individuele ontwikkeling wordt binnen deze onderwijsopvattingen centraal gesteld.

Verder wordt in hoofdstuk 2 de relatie bestudeerd tussen de BPES en een nauw verwante onderzoeksinstrument, de 'Teacher Beliefs Survey' (TBS, Woolley et al., 2004) om zo de BPES verder te valideren. Hoewel beide instrumenten fundamenteel van elkaar verschillen, wordt een substantiële overlap tussen beide onderzoeksinstrumenten geconstateerd op het gebied van processen van kennisverwerving. Deze vaststelling ligt aan de basis om beide onderzoeksinstrumenten van een grondige revisie te voorzien.

De resultaten van deze revisie worden gepresenteerd in *hoofdstuk 4* en wijzen uit dat twee substantiële clusters van opvattingen onderscheiden kunnen worden. Vooreerst houden leraren lager onderwijs er algemene opvattingen over de aard en finaliteit van het onderwijs op na. Daarnaast treffen we ook meer specifieke opvattingen aan die zich beperken tot de praktische organisatie van leer- en onderwijsprocessen. Waar algemene opvattingen een uitspraak doen over de finale opdracht van het onderwijs, beperken deze

specifieke opvattingen zich tot de praktijk van het lesgeven en processen van leren en kennisverwerking.

Verder tonen de resultaten met betrekking tot de latente structuur een tweedimensionele oplossing voor zowel de algemene opvattingen over de aard en finaliteit van het onderwijs als de specifieke opvattingen over de praktische organisatie van leren en onderwijzen. Dit resulteert in vier meetschalen:

1. Met betrekking tot de aard en de finaliteit van het onderwijs:
 - *Developmental Oriented Beliefs (DOB)*: Binnen deze ontwikkelingsgerichte opvattingen staat de individuele leerling centraal. Om de uniciteit van elke leerling te garanderen, wordt een context gecreëerd waarbinnen hij of zij zich harmonieus kan ontwikkelen. Deze leef- en leeromgeving wordt gekenmerkt door een nadruk op een brede en individuele ontwikkeling.
 - *Economic Oriented Beliefs (EOB)*: Binnen deze economisch georiënteerde opvattingen staat onderwijs ten dienste van externe doelen. De leraar is eerder een uitvoerder van een opgelegd curriculum en zijn belangrijkste taak bestaat in het voorbereiden van leerlingen op de latere arbeidsmarkt of het secundair onderwijs.
2. Met betrekking tot de praktische organisatie van leren en onderwijzen:
 - *Constructivist Oriented Beliefs about Learning and Instruction (COBLI)*: Constructivistisch georiënteerde opvattingen vertrekken vanuit een leerlinggestuurde visie op de praktische organisatie van leren en onderwijzen. Hierbij tekent de leraar nog wel de klijtlijnen van het programma uit, maar de leerling wordt mede-verantwoordelijk voor het bepalen van zijn leertraject. Didactische werkvormen die binnen deze opvattingen de voorkeur genieten stellen samenwerking centraal en sluiten aan bij de individuele ervaringen en ideeën van de leerlingen.
 - *Transmissive Oriented Beliefs about Learning and Instruction (TOBLI)*: Transmissief georiënteerde opvattingen kunnen vergeleken worden met het stereotiepe beeld van de leraar die enkel vooraan in de klas les staat te geven.

Deze leraar bepaalt wat er geleerd wordt, hoe geleerd wordt en wanneer er geleerd wordt. Leren wordt hierbij sterk opgevat vanuit het assimileren van feiten en inzichten.

Een belangrijke vaststelling van het onderzoek is dat de verschillende dimensies relatief onafhankelijk van elkaar voorkomen. Hiermee wordt ingegaan tegen het idee dat constructivistische en transmissieve opvattingen uiteinden zijn op eenzelfde dimensie.

In een volgende stap wordt onderzocht in welke mate algemene onderwijsopvattingen specifieke onderwijsopvattingen over de inrichting van de onderwijsleeromgeving voorafgaan. Uit de analyses blijkt een sterke positieve invloed aanwezig te zijn van ontwikkelingsgerichte opvattingen op constructivistisch georiënteerde opvattingen over leren en onderwijs. Eveneens wordt een positieve invloed gevonden van economisch georiënteerde opvattingen op transmissief georiënteerde opvattingen over leren en onderwijs.

Naast de onderzoekslijn met een sterke focus op de het conceptualiseren en operationaliseren van het opvattingenconstruct bij leraren lager onderwijs, wordt in het proefschrift verder ingegaan op de invloed van onderwijsopvattingen op de aanvaarding en toepassing van vernieuwingen in het lager onderwijs. Exemplarisch wordt hierbij de integratie van ICT in het lager onderwijs naar voor geschoven. Onderzoek naar de implementatie van ICT in het onderwijs richt zich vaak op de invloed van ondersteunende maatregelen en persoonsgebonden kenmerken van leraren (zie onder meer Becta, 2004; Demetriadis et al., 2003; van Braak, Tondeur, & Valcke, 2004). Niettemin wijst recent onderzoek naar de integratie van computers in het onderwijs uit dat onderwijsopvattingen een sterke invloed hebben op zowel het computergebruik als op de gebruiksmogelijkheden in de klaspraktijk (Becker, 2001; Riel & Becker, 2000). Vanuit deze optiek werd de relatie tussen onderwijsopvattingen en klasgebruik van ICT nauwer bestudeerd in hoofdstukken 3 en 5.

Centraal in *hoofdstuk 3* wordt de invloed van onderwijsopvattingen op het klasgebruik van computers nagegaan bij leraren lager onderwijs (van Braak, Tondeur, & Valcke, 2004). Deze invloed wordt gecontroleerd voor demografische variabelen (geslacht, leeftijd) en computergerelateerde variabelen (computerervaring, attitudes ten aanzien computergebruik). Omwille van de geneste structuur van leraren in scholen wordt multilevel modeling gehanteerd. De resultaten van deze analyse ondersteunen de hypothese dat onderwijsopvattingen een significante invloed uitoefenen op het klasgebruik van computers. Hierbij blijkt duidelijk dat constructivistische opvattingen over de inrichting van de leeromgeving een positieve invloed hebben op het klasgebruik van computers, terwijl traditionele opvattingen een negatieve invloed uitoefenen op het klasgebruik van computers. In het nagaan van opvattingen van leraren lager onderwijs wordt gebruik gemaakt van de TBS (Woolley et al., 2004). Door een stapsgewijze opbouw van het model toe te passen, blijkt eveneens uit de resultaten dat de bijdrage van opvattingen in het verklaren van de totale variantie van klasgebruik van computers even groot is als de bijdrage van variabelen die technologiegerelateerd zijn, zoals computerattitudes en -ervaring. De resultaten van deze studie bevestigen de stelling dat onderwijsopvattingen een belangrijke rol spelen om de integratie van computers in de dagelijkse klaspraktijk te begrijpen en te verklaren.

Waar in het derde hoofdstuk het modale gebruik van computers in de klas als afhankelijke variabele naar voren werd geschoven, wordt in het *vijfde hoofdstuk* de invloed van onderwijsopvattingen op innovatief ICT-gebruik getoetst. Daartoe werd in eerste instantie een eigen schaal geconstrueerd en gevalideerd om innovatieve ICT-toepassingen door leraren te kunnen meten. Door het raadplegen van experts met betrekking tot technologiegebruik in het lager onderwijs wordt een itempool gecreëerd van items die peilen naar praktijken die als nieuw gepercipieerd worden, en waarin ICT een belangrijke rol heeft in het nastreven van onderwijskundige doelstellingen. Onderzoek naar de latente structuur van deze itempool resulteert in een één-dimensionele schaal met een sterke focus op onderwijskundig gebruik van web 2.0 applicaties enerzijds, en een sterke focus op het gebruik van elektronica en ICT om samenwerking en communicatie in het onderwijs te ondersteunen anderzijds. Hierdoor

differentieert deze schaal zich van modaal computer- en ICT-gebruik waarbij de klemtoon nog vaak ligt op het aanleren en inoefenen van ICT-basisvaardigheden, of waarbij ICT ondersteunend is aan het inoefenen van leerstof (Tondeur et al., 2007).

Om een zo breed mogelijk inzicht te krijgen op de invloed van onderwijsopvattingen op klasgebruik van ICT worden beide modi van klasgebruik van ICT - met name innovatief en modaal gebruik - opgenomen in een multivariate analyse. Gezien de geneste structuur van de data (leraren in scholen) wordt geopteerd om een multilevel analyse te hanteren. Onderwijsopvattingen worden nagegaan door middel van de TOBLI en COBLI die in een eerdere onderzoeksfase werden ontwikkeld. De invloed van deze opvattingen wordt gecontroleerd voor het effect van geslacht, onderwijsservaring en computerervaring. De resultaten laten zien dat specifieke opvattingen van leraren lager onderwijs een sterke invloed uitoefenen op het klasgebruik van ICT. Hierbij zijn het vooral de constructivistisch georiënteerde opvattingen over leren en instructie die een positieve invloed blijken te hebben op zowel het modaal als het innovatief gebruik van ICT in de klas. Wanneer gekeken wordt naar verschilpunten in invloed van de verschillende variabelen op beide modi van ICT-gebruik, blijkt dat persoonsgebonden karakteristieken enkel van invloed zijn op innovatief klasgebruik van ICT. Deze resultaten suggereren dat naarmate ICT-gebruik meer geïnstitutionaliseerd wordt, persoonsgebonden eigenschappen zoals geslacht en leeftijd minder van belang zijn dan de onderwijsopvattingen.

Hoewel het niet tot de initiële doelstelling van het proefschrift behoorde, leveren de resultaten in hoofdstuk 3 en 5 bijzondere inzichten met betrekking tot de schoolspecifieke verschillen op het gebied van het klasgebruik van respectievelijk computers en ICT. De resultaten in hoofdstuk 3 tonen namelijk aan dat er een intrinsiek verschil is in het klasgebruik van computers tussen de verschillende scholen die aan het onderzoek deelnamen. Deze bevindingen werden bevestigd in hoofdstuk 5. Doordat in dit laatste hoofdstuk twee modi van klasgebruik van ICT in de analyses werden opgenomen, leveren de resultaten bovendien inzicht in het verband op schoolniveau tussen beide modi. Uit de resultaten blijkt duidelijk een positieve en sterke samenhang tussen beide modi. Dit

betekent dat scholen die een hoog modaal ICT-gebruik rapporteerden ook een hoog innovatief ICT gebruik rapporteerden.

Conclusies

Ten slotte worden in *hoofdstuk 6* de resultaten uit de vorige hoofdstukken samengevat en met elkaar in verband gebracht. Afsluitend kan gesteld worden dat de primaire bijdrage van het proefschrift bestaat uit een bijdrage tot fundamentele kennisontwikkeling op het gebied van onderzoek naar onderwijsopvattingen van leraren lager onderwijs en onderzoek naar de invloed van onderwijsopvattingen op het klasgebruik van ICT. Het onderzoek in dit proefschrift, gebaseerd op alle bovenstaande resultaten, leidt tot volgende conclusies:

1. De resultaten in het proefschrift inzake onderzoek naar de conceptualisering van onderwijsopvattingen van leraren lager onderwijs wijzen duidelijk op twee afzonderlijke clusters van onderwijsopvattingen: (1) algemene onderwijsopvattingen met betrekking tot de doelstellingen en de aard van het onderwijs; en (2) meer specifieke opvattingen met betrekking tot de praktische organisatie van leren en onderwijzen in het lager onderwijs.
2. De resultaten in het proefschrift inzake onderzoek naar de dimensionele structuur van beide clusters van onderwijsopvattingen zet de assumptie kracht bij dat onderwijsopvattingen moeten benaderd worden als een gelaagd construct. Dit houdt in dat leraren lager onderwijs volgende opvattingen er gelijktijdig op nahouden:
 - a. Zowel ontwikkelingsgerichte als economisch gerichte opvattingen over de doelen en de aard van het lager onderwijs;
 - b. Zowel constructivistisch georiënteerde als transmissief georiënteerde opvattingen over de praktische organisatie van leren en onderwijzen.
3. De resultaten in het proefschrift inzake de samenhang tussen de verschillende dimensies suggereren een relationele structuur waarbij opvattingen over de praktische organisatie van leren en onderwijzen worden voorafgegaan door opvattingen over de doelen en aard van het lager onderwijs.

4. De resultaten in het proefschrift met betrekking tot de invloed van onderwijsopvattingen op de integratie van ICT in het lager onderwijs leveren empirische evidentie voor de hypothese dat onderwijsopvattingen over de praktische organisatie van leren en onderwijzen een betekenisvolle invloed uitoefenen op het klasgebruik van ICT. Hierbij zijn het voornamelijk de constructivistisch georiënteerde opvattingen die een positieve invloed uitoefenen op klasgebruik van ICT.
5. De resultaten in het proefschrift met betrekking tot onderzoek naar de invloed van onderwijsopvattingen op de integratie van ICT tonen eveneens dat een relatief aandeel van de verklaarde variantie gezocht moet worden bij schoolgebonden kenmerken; ook scholen maken een verschil.

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- **Awards and Honors:**

- R.W. "Buddy" Burniske Memorial Award awarded by the TechTrends liaison of the International Division for the article: Vanderlinde, R., van Braak, J., De Windt, V., Tondeur, J., Hermans, R., & Sinnaeve, I. (2008). Technology curriculum and planning for technology in schools: The Flemish case. *TechTrends*, 52, 23-26.

