

Teacher characteristics and ICT integration: a study in pre-service and in-service primary education teachers in China

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Foreword

Studying alone without friends results in a shallow and narrow mind. 独学而无友,则孤陋而寡闻 (Confucius, 551–479 BC)

Looking back four years since I came to this beautiful and peaceful city, what a great journey it has been for me. I will remember this experience forever because it was amazing and beneficial. The experience was great but I could not have accomplished this dissertation without the support and tremendous help of my promoters, colleagues, friends and family. With them, the journey of my four-year research is full of joys, happiness, and firmness. I am deeply grateful to have encountered the following people in my life.

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This is a closing moment of my PhD research. And this is a starting point of my new research journey.

Guoyuan Sang Ghent, July, 2010

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Chapter 1

General introduction*

Abstract

The educational potential of information and communication technology (ICT) can be observed in a variety of ways. ICT is influencing education by changing the way of teaching and learning. Schools (in most of the world and in China) are making efforts to benefit from the potential power of ICT. But, ICT integration may encounter a number of barriers. Ertmer (1999) mentions two sorts of barriers: external barriers related to access to ICT, environmental supports and teacher ICT literacy and internal barriers related to teacher cognitions. When the external barriers are resolved, the decision regarding whether and how to use ICT rests on the shoulders of teachers. In the Chinese context, most of the teachers are not willing to integrate ICT, even when external barriers do not exist in most of the primary schools (Yuan, 2006). In order to examine influencing factors of ICT integration in China, we have to take the internal barriers into consideration. Research in the field of ICT implementation is fast growing. From a theoretical point of view, this research presents a key problem. There is profound conceptual confusion in the "internal" teacher related variables and processes researched that describe and explain the process of ICT integration. This explains why - in this introductory chapter - we pay attention to the elaboration of a conceptual framework that brings together a large set of concepts currently being researched in the literature. In this context, we introduce the central concept of "teacher cognitions" as an umbrella term that embraces affective, motivational and cognitive antecedents of ICT adoption in education.

^{*} This chapter is partly based on (a) Valcke, M., Sang, G, Y., Rots, I., and Hermans, R. (2010). Taking prospective teachers' beliefs into account in teacher education. In: Penelope Peterson, Eva Baker, Barry McGaw (Eds), *International Encyclopedia of Education* (vol. 7, pp. 622-628). Oxford: Elsevier and (b) Sang, G. Y., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, 54(1), 103-112.

1. Introduction

The introduction of information and communication technology (ICT) into mainstream school has been widely accepted and now penetrates and transforms teaching and learning across the curriculum (Hennessy, Ruthven, & Brindley, 2005). ICT was assumed to offer a wide spectrum of benefits for the actual teaching and learning process. The term information and communication technology encompasses the range of hardware (desktop and portable computers, projection technology, calculators, data logging and digital recording equipment), software applications (generic software, multimedia resources) and information systems (Intranet, Internet) now available in schools (Hennessy et al., 2005). ICT is not only the backbone of the information society, but is also presented as an important catalyst for inducing educational reforms that change our students into productive knowledge workers (Pelgrum, 2001). The educational potential of ICT is stressed in a variety of ways (Becker, 2000; Godfrey, 2001). For instance, Godfrey (2001) stresses the potential of ICT to present rich learning environments, allowing learners to adopt multiple perspectives on complex phenomena, to foster flexible knowledge construction in complex learning domains, and to cater for individual differences.

Marcinkiewicz (1993) has pointed out that the "full integration of computers into the educational system is a distant goal unless there is reconciliation between teachers and computers. To understand how to achieve a sufficient level of ICT integration, we need to study teachers and what makes them use computers" (p. 234). Furthermore, Oliver (1993) also argues that beginning teachers who received formal training in the use of ICT hardly differ in their future use of computers for teaching from teachers not receiving such training. More seems to play a role that influences the educational adoption of ICT by teachers.

As Ertmer (2005) has documented, the decision regarding whether and how to use technologies for instruction rests on the shoulders of teachers. Despite the increased availability of ICT hardware (Ertmer, 1999), school related support for ICT integration (Baylor & Ritchie, 2002), and a larger consciousness of teachers about the importance of educational ICT use (Khine, 2001), relatively few teachers are willing to integrate ICT into their teaching activities (Becker, 2000; Wang, Ertmer, & Newby, 2004). Other factors, next to technical knowledge and skills seem to contribute to teachers' successful technology integration. For instance, Cuban already stressed in 1993 the importance of knowledge, beliefs, and attitudes of teachers, since they "shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time" (p. 256).

Ertmer (1999) has categorized two barriers hampering teachers' ICT implementation efforts: external (first-order) barriers and internal (second-order) barriers. External barriers include those that are often projected as the key obstacles, e.g., issues related to access to the technologies (hardware, software, Internet connectivity), ICT training, and local support. When these barriers are present, it is almost impossible to talk about technology integration. But, when these first-order (external) barriers are resolved, 'teachers do not automatically use technology to achieve advocated meaningful outcomes' (Ertmer 1999, p.51). For this reason, we have to consider the second-order (internal) barriers stalling ICT integration by teachers. Internal barriers are related to teacher related variables and processes that affect their teaching behavior and approaches towards learning. These are veiled and deeply rooted in daily practices (Ertmer 1999, 2005). Examples of these internal barriers are – among others – teacher beliefs, teacher self-efficacy and teacher attitudes.

In the context of research about the educational use of ICT, a vast number of studies have been published during the last decades that refer to specific internal barriers in teachers. As examples, we can point at studies about (1) educational beliefs to explain the frequency and successful use of ICT in education (Higgins & Moseley, 2001); (2) teaching self efficacy (Wang et al., 2004); and (3) computer attitudes (van Braak, Tondeur, & Valcke, 2004). Preston, Cox, and Cox (2000) also state that in order to integrate ICT, a teacher: (1) must believe that the use of the technology can more effectively meet learning objectives or reach a higher level goal than could otherwise have been achieved; and (2) must feel that he/she has the confidence, ability, and access to necessary resources to apply the technology to the learning and teaching process. Though these studies – and there are ample more studies focusing on this type of internal teacher variables and processes – present empirical evidence about the way these variables interact with educational

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ICT adoption, they also present an important theoretical problem. The multitude and the variety of concepts adopted to refer to the internal teacher variables and processes do not reflect an integrated picture. The same concepts are used with different meanings, different concepts are used that overlap in meaning, the interaction between the concepts is not always clear, and the path is not clear that explains or describes the direct, indirect and/or mediating impact of these variables/processes on the actual integration process of ICT in education. Therefore, a key part of this introductory chapter presents an attempt to bring together this variety in concepts being used. In this setting, we introduce the central concept of "teacher cognitions" as an umbrella term embracing the variety of concepts and variables that can be considered as relevant antecedents of ICT adoption.

Lastly, the research presented in this PhD dissertation is set up in the Chinese context. This introduces an additional critical dimension to our conceptual framework. Since all behavior is culturally defined, we have to consider the focus on teacher related variables and processes that help to understand the educational use of ICT from a cultural perspective. Though – and this important to be stressed – we don't aim at setting up a comparative cultural or a cross-cultural study, the present research has nevertheless a clear cross-cultural dimension. Since most research in the field of ICT integration has been set up in Western contexts, we will build in our studies mainly on a Western conceptual framework and on research instruments and instructional approaches that have been developed in Western contexts. This introduces automatically a question about the generalizability of this conceptual and instrumental approach for the Chinese context. Though the cultural context is not being manipulated and/or compared in the researches discussed in this dissertation, we will nevertheless have to present our reflections and conclusions about the feasibility and success in the adoption of this "Western" conceptual and instrumental framework.

Building on the former rationale, we can present our main research problem being tackled in this dissertation: What are and what is the impact of teacher cognitions in the process of educational ICT use in Chinese primary schools? We build on available research about teacher ICT integration and the way specific variables and processes have been operationalized via the research instruments being used in these studies. More specifically, we will center on the following list: teacher educational beliefs (constructivist and traditional beliefs), teacher self efficacy beliefs, teacher perceptions (about ICT/ICT policies), teacher attitudes toward ICT, teacher ICT motivation, teacher computer self-efficacy.

2. Theoretical background

Before starting a conceptual discussion, we also have to focus on how teacher cognition variables and background variables interact and explain ICT use in education. This requires the development of a theoretical perspective that brings together the concepts being used in our research. Our theoretical focus is eclectic. We integrate some mainstream theories that help to describe and explain ICT adoption. Four such theories are being discussed below. We will shortly describe each theory and will especially look at the way specific variables are positioned and interlinked. It has to be stressed that these theories will present a larger set of variables and processes than actually studied in this dissertation. This introduces immediately a key limitation of the studies, as will also be discussed in our concluding chapter: not all variables and processes that describe and explain ICT implementation are being tackled and studied. In fact, our selection is pragmatic in nature.

2.1. Theoretical bases

The Teacher Thoughts and Action Process model (TTAP)

The Teacher thoughts and action process model of Clark & Peterson (1986) builds on two areas that play a role in the teaching process (Figure 1): (a) unobservable *teacher thought* processes (teacher planning; teachers' interactive thoughts; and teachers' theories and beliefs) and (b) *teachers' actions* and their observable effects (teachers' classroom behavior; students' classroom behavior; and student achievement).





Figure 1 A model of Teacher Thoughts and Actions (Clark & Peterson, 1986).

The TTAP model helps to explain the mutual relationship between teacher thought processes and related teacher behavior. Building on this model, we take from this framework the importance of internal processes as precursors of specific teaching activities. In addition, we keep in mind that Clark and Peterson put a two-sided arrow between the two areas. The actual behavior (and its effect in the environment) will also affect teacher thoughts. From the model of Clark and Peterson, we also take the assumption that teacher thoughts are varied and the interplay between the different teacher thoughts has to be taken into consideration (Clark & Peterson, 1986).

The Theory of Planned Behavior (TPB)

The theory of planned behavior (TPB) of Ajzen (1991) serves as a second grounding theoretical framework of our study (Figure 2).



Figure 2 Theory of planed behavior (Ajzen, 1991).

The model clearly aims at explaining the antecedents of resulting behavior that builds on planned actions. A critical internal variable in this model is represented by the attitudes. "Attitude toward the behavior" refers to the degree to which a person has a favorable or unfavorable evaluation about the final behavior. Subjective norm refers to the perceived social pressure to perform or not to perform the behavior. Since this depends on external variables (social pressure), this concept will be of lesser importance in the context of the studies in the dissertation. On the other hand, perceived behavioral control can clearly be linked to the present studies. It refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles. We will link this variable to self-efficacy of teachers (educational self-efficacy (beliefs) and computer self efficacy). Lastly, a central factor in the theory of planned behavior is the individual's intention to perform a given behavior. Intentions are assumed to capture the motivational factors that influence a behavior. The subsequent separation of behavioral intention from behavior allows explaining the somewhat limited impact of attitudes on final behavior (Azjen, 1991). In other words, to predict the extent to which certain behavior will be adopted will be marred by the intentions of teachers to perform this behavior. The TPB has already been helpful to explain teachers' intentions

and behavior in the classroom or their intentions toward educational technology usage (e.g., Sugar, Crawley, & Fine, 2004).

The Expectancy-Value theory of Achievement Motivation (EVAM)

The expectancy-value theory of achievement motivation – as developed by Wigfield & Eccles (2000) – argues that an individuals' choice, persistence, and performance can be explained by their beliefs about how well they will perform an activity (expectancy) and the extent to which they value this activity (value). *Motivation* is the product of individuals' expectancy and the individual's value appraisal about a specific behavior. This explains why "task value" and "expectancy" are positioned as variables prior to the actual behavior (Figure 3).



Figure 3 A social cognitive expectancy-value model of achievement motivation (based on Wigfield & Eccles, 2000).

According to the EVAM, both expectancy and value are influenced by internal and external variables and processes (Pintrich & Schunk, 1996). In the context of the present PhD, the nature of and interplay between the internal variables and processes are of particular interest. The authors of the

model stress at the one hand internal cognitive processes related to their perceptions of the way the external context reacts to their (present and future) behavior. Secondly the cognitive processes include the attributions that explain – according to the teacher – their success and/or failure to perform a specific behavior. In the context of our study, we can link these cognitive processes to the perceptions teachers have about what their school puts forward as central issues in an ICT related policy. The authors of the model position - on the other hand - a connected set of motivational beliefs that determine the value and expectancies in relation to behavior; such as ICT adoption and use in school. These motivational beliefs comprise affective memory, goals, the self concept and perceptions about the task (e.g., difficulty level). In the context of this PhD, we will keep in mind the position and role that goals (goal orientations) play as driving internal forces to direct behavior. Next, self concept refers to a series of self efficacy beliefs and as such to the extent – teachers in our case – perceive themselves as being able to carry out certain task, to adopt new behavior, to be involved in innovations, etc. (Wozney, Venkatesh, & Abrami, 2006). The latter competency judgments have been - as will be explained below - intensively studied under the umbrella of studies related to general and specific teacher beliefs.

Next to the nature and position of the internal variables, we also retain from the Wigfield and Eccles model, the predictive nature of model to explain teacher adoption and integration of ICT in their instruction. In line with the model of Clark and Peterson (1986), the model of Wigfield and Eccles also stressed the reciprocal nature of their model. The motivational variables can both be considered as results and causes of behavior. This introduces again the fact that in our research we will have to be careful to speak about the causal nature of internal teacher variables. What is more, we will rather stress that we study associations between the internal variables and teachers' use of ICT.

The Technology Acceptance Model (TAM)

Technology acceptance model (TAM) (Davis, Bagozzi, & Warshaw, 1989) links the perceived usefulness and ease of use with attitudes toward using ICT and actual use (Figure 4).



Figure 4 Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989).

The Technology Acceptance Model (TAM) has explicitly been developed in view of describing and explaining technology adoption and use. The TAM theorizes that an individual's behavioral intention to use technology is basically determined by two beliefs: *perceived usefulness*, defined as the extent to which a person believes that using the system will enhance job performance, and *perceived ease of use*, defined as the extent to which a person believes that using the system will be free of effort (Davis et al., 1989). Perceived usefulness and perceived ease of use are two primary determinants of technology acceptance. Attitude towards technology use is jointly determined by perceived usefulness and perceived ease of use. The latter influences the behavioral intention to use the technology that – in turn – determines the actual adoption and use of technology (Venkatesh & Davis, 2000). External variables (e.g., system characteristics, development process, and training) on intention to use are mediated by the former internal processes (Venkatesh & Davis, 2000).

The TAM reconfirms the nature and role of specific internal variables that can be associated with the intention to use and the future use of technologies. In the context of this PhD, the model stresses again the critical role of these internal variables. In addition, the fact that perceptions are stressed about the technology use, and attitudes towards technology use, help to validate the selection and position of these specific variables in the context of our conceptual framework.

To sum up, all four theories postulate that teachers' behavior is predicted by – or stated more carefully, is associated with – behavioral intentions to adopt and use ICT and/or to actually use ICT. That is to say, teachers' decisions to (intend to) use ICT in their classroom teaching may be related to (a) teachers' cognitive processes (e.g., their perceptions); (b) teachers' attitudes toward ICT; (c) teachers' aims (e.g., goal orientations); (d) teacher's competency judgments as they are expressed via general and/or specific beliefs. In addition, the four models stress that this set of internal variables interacts in their impact on the adoption and use of ICT. Lastly, the recursive nature of two models, stresses the need to be careful about a too strong emphasis on causality. Lastly, teachers have - thus far - been written about in a very general way. As can be explicitly derived from the four models, teachers will differ widely in the way the processes and variables play a role in the adoption and use of ICT. In section 2.4 we will therefore return to this issue when discussing differences in teachers, building on a number of background variables.

2.2. Towards a conceptual framework

As stated earlier, the research field about ICT implementation by teachers presents a conceptual "marsh". Authors refer to a multitude of variables and processes; e.g., educational beliefs, self-efficacy beliefs, attitudes, motivation, perceptions.

From a theoretical point of view, it is – consequently – hardly possible to integrate this existing variety of conceptual orientations, choices, and boundaries into a single conceptual framework. Therefore, we prefer to reposition a number of these variables and processes into a new conceptual framework (Figure 5), that serves as a guide to integrate theoretical perspectives that interlink these variables and process and help to explain the actual adoption of ICT in education by teachers in the Chinese context. Especially the fact that we will reuse a number of research instruments that builds on this big variety in concepts, requires us to be clear how the original concepts are repositioned within the conceptual framework for our studies.



Figure 5 Conceptual framework, linking teacher cognitions, teacher background variables and teacher ICT use in education.

In this framework, a basic hypothesis is that pre-service teacher' intention and/or in-service teachers' *ICT use* can be linked to *teacher cognitions* and *teacher background variables*. The interplay between these variables is positioned within the *Chinese cultural context*.

2.3. Teacher cognitions

The present research about teacher use of ICT fits nicely in a strand of research about the processes and variables that "drive" actual teaching behaviour. The four theoretical models, presented in the former section illustrate how a variety of "internal" processes and variables help to describe and explain why teacher do or do not adopt ICT in their educational setting: beliefs, self-efficacy, motivation, attitudes, and perception. In the context of this PhD research, a variety of concepts will be used to bring these variables together, based on the related teacher education literature. As such "teacher cognitions", "teacher thinking processes" and "teacher thoughts" are used interchangeably. The concept "teacher thoughts" is used in Chapter 4. The

concept was introduced by Clark & Peterson (1986) to state that teacher behaviour is substantially influenced and even determined by teacher thoughts. Based on the term "teacher thinking" (Higgins & Moseley, 2001) in the teacher education context, we adopt the concept of "teacher thinking processes" in Chapter 5. Considering the broader meaning of "teacher cognitions" (Kagan, 1992; Kompf & Decicolo, 2003; Zwart, Wubbels, Bolhuis, & Bergen, 2008), the term is adopted as an umbrella concept in introductory and concluding chapters of the PhD to include the complex internal variables.

"Cognition" can be understood as the integrated whole of theoretical and practical insights, beliefs and orientations on the part of the individual (Zwart et al., 2008) and can also thus include personal goals, emotions, expectations, and attitudes. Teacher cognitions refer to the unobservable cognitive dimension of teaching, what teachers know, believe, and think (Borg, 1999). As reviewed by Borg (1999), teachers' cognitions consist of a set of personally-defined practically-oriented understandings of teaching and learning exerting a significant influence on instructional decisions (Clark and Peterson, 1986; Kagan, 1990). An understanding of the often implicit psychological bases of teachers' work is required if we are to go beyond a superficial behavioral conception of instructional processes (Borg, 1999).

As stated before, we build in the studies discussed in chapter 2 to chapter 6 on a variety of teacher cognitions as they have already been studied – separately – in the literature. In the next paragraphs, we will present an initial definition of this set of teacher cognitions. Step by step, the following concepts will be discussed: teacher beliefs (traditional teaching beliefs, constructivist teaching beliefs), self-efficacy beliefs, perceptions of school-level ICT policy, attitudes toward ICT in education, ICT motivation, and computer self-efficacy.

Teacher educational beliefs

A conceptual confusion for teacher beliefs can be observed since researchers easily adopt alternative terms. Researchers refer instead to teachers' "principles of practice", "personal epistemologies", "perspectives", "practical knowledge", or "orientations" (Kagan, 1992). It is therefore not surprising that Pajares (1992, p. 307) considered teacher beliefs being a "messy construct," noting that "the difficulty in studying teachers' beliefs has been caused by definition problems, poor conceptualizations, and differing understandings of beliefs and belief structures". Despite the conceptual confusion, researchers have made attempts to clarify the terminological discussion about teacher beliefs and to centre on profiles in teacher beliefs (Nespor, 1987; Richardson, 1996). Teacher beliefs have been defined by Kagan (1992) as "tacit, often unconsciously held assumptions about students, classrooms, and the academic material to be taught" (p. 65). Also, the nature of teacher beliefs has been characterized in terms of affective, evaluative, and episodic processes (Van Driel, Bulte, & Verloop, 2007). Researchers have made attempts to delineate prototypical teacher beliefs. In the literature, authors mainly distinguish between "traditional beliefs" and "constructivist beliefs".

The traditional teaching beliefs can be also labeled as teacher-centred, transmissive beliefs, or subject-matter oriented. A teacher adopting traditional beliefs will stress discipline, will put the subject matter first, and will emphasize moral standards, while a teacher adopting progressive beliefs concentrates on individual differences, social learning, and the interests of his/her pupil (Kerlinger & Kaya, 1959).

As reviewed by Sang et al., the "constructivist teaching beliefs" are also referred to as "supporting student learning", a "constructivist philosophy of learning", "progressive beliefs", or "student-centred approach". Teachers who believe in student-centered approaches to teaching and learning concentrate on harmonious development of students and integration of different subjects can be characterized into this "constructivist" dimension (Sang et al., 2010).

Teacher self-efficacy beliefs

Bandura (1997) defined self-efficacy as "People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses" (p. 391). Self-efficacy beliefs are characterized as major mediators of

behavior, and more importantly, behavioral change. Bandura stresses that self-efficacy is strongly related to particular types of action. Therefore, in the current context we focus on teacher self-efficacy. Consistent with the general definition, Tschannen-Moran and Woolfolk (2001) define teacher self-efficacy as "a teacher's judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (p. 783). Teacher self-efficacy has been identified as a crucial variable that accounts for individual differences in teaching effectiveness. Teachers with a strong sense of self-efficacy are open to new ideas and more willing to experiment with new strategies, seek improved teaching methods, and experiment with a variety of instructional materials (Allinder, 1994; Guskey, 1988).

Computer self-efficacy

Self-efficacy regarding computers refers to a person's perceptions of and capabilities to manipulate computers (Compeau & Higgins, 1995). Computer self-efficacy is positively correlated with an individual's willingness to choose and participate in computer-related activities, expectations of success in such activities, and persistence or effective coping behaviors when faced with computer-related difficulties (Compeau & Higgins, 1995). Teachers with higher levels of self-efficacy about computers, use computers more often and experience less computer-related anxiety. On the other hand, teachers with lower levels of self-efficacy about computers, become more frustrated and are more anxious, and hesitate to use computers when they encounter obstacles. Ropp (1999) uses the term 'computer self-efficacy' to claim that while many teachers have positive attitudes to the use of educational technologies, they do not necessarily believe in their own abilities to use technology in their classroom. Compeau, Higgins, and Huff (1999) conducted a longitudinal study to test the influence of computer self-efficacy beliefs, outcome expectations and anxiety on computer use. Their research findings point out that computer self-efficacy beliefs have a significant positive influence on computer use.

Teacher attitudes toward ICT in education

According to Fishbein and Ajzen (1975), attitudes refer to the ability to predict a person's behavior toward certain targets. Ajzen (1991) described an attitude as a predisposition to respond favorably or unfavorably to an object, person, or event. The strong relationship of computer related attitudes and computer use in education has been documented in many studies (e.g., Myers & Halpin, 2002; van Braak, 2001). For instance, Myers and Halpin (2002) argued that a major reason for studying teachers' attitudes is that it is a major predictor of classroom ICT use. Attitudes towards computers influence teachers' acceptance of the usefulness of technology, and also influence whether teachers integrate ICT into their classroom (Clark, 2001). Huang and Liaw (2005) also state that among the factors that affect the successful use of computers in the classroom, teachers' attitudes towards computers play a key role. Research of van Braak et al. (2004) also supported that class use of computers was strongly affected by attitudes toward computers in education. Taking the importance of attitudes toward computer into consideration, it is also important to understand what influences pre-service teachers' attitudes towards computers (Fisher, 2000).

Teacher ICT motivation

Though we already discussed internal motivations of teachers (teaching beliefs, self-efficacy beliefs), their motivation on ICT use is described here to specify teachers' goal setting and decision making related to ICT. Motivation encompasses a multitude of factors driving the selection, the persistence, and the engagement of particular activities to attain an objective (Dweck & Elliott, 1983). Motivation refers to the process whereby goal-directed behaviour is instigated and sustained (Schunk, 1990). Motivational factors are therefore considered to be part of one's goal structures and beliefs about what is important (Ames, 1992). Scholars agree that a key factor is the need for a teacher to be motivated to use technologies (Marcinkiewicz, 1996). Sufficient levels of motivation in teachers are seen to be related to the innovative role of technology. Empirical research has successfully linked motivation to teacher computer use (Marcinkiewicz, 1993). "Motivation is the catalyzing

ingredient for every successful innovation" (Christensen, Horn, & Johnson, 2008, p. 7).

Teacher perception of ICT policy

Perceptions are cognitive processes that build on internal and external experiences. As explained earlier in the model of Wigfield & Eccles (2000), perceptions are the personal translations of these experiences. As such, the opinions of colleagues or the school team will invoke perceptions in teachers. In the context of the present PhD, this is especially the case in relation to the role that defined of ICT in a school context by an ICT school policy. As ICT continues to drive changes in present and future society, school policies need to define upfront their organizational vision and actions in view of planned change (Senge, 2000). A number of studies (e.g., Tearle, 2003) present evidence that an increase in classroom use of ICT in classroom can be linked to a favorable policy environment. School-level policy produces the desirability to build a coherent and supportive community of practice associated with effective, regular, and consistent ICT use (Hennessy et al., 2005). An ICT policy itself does not automatically result in the adoption of innovations unless all actors involved are clearly aware of this policy. But, research of Fullan (1991) shows that the adoption of innovation in schools depends on the democratic process of planning change by involving all school related actors. Not only the fact that there is a school policy will be of importance. More in particular, the perceptions of teachers about this policy are crucial. If teachers share the values expressed within a school policy and understand the implications, this policy is more likely to influence practice (Kennewell, Parkinson, & Tanner, 2000).

2.4. Teacher background variables

In our conceptual framework, we added a group of variables labeled "teacher background variables". As will be explained below, teachers seem to adopt different cognitions and ICT integration, depending on their socioeconomic and regional position, their gender, their teaching experience, the subject domain they teach, and the levels of study years for pre-service teachers.

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Socioeconomic and regional position refers to socioeconomic status and geographical position of teachers' teaching area. The geographical teaching area (rural/urban) where teachers teach has been reported to be an important influencing factor on teachers' beliefs and ICT use in education. First of all, socioeconomic and regional position of teachers may have a strong effect on ICT use because of different availability, support, and literacy (Yuan, 2006). And the institutional context in which teachers work has effect on teacher beliefs (Lim & Torr, 2007).

Gender differences with regard to teacher beliefs, teacher self-efficacy and teacher attitudes toward computers represent an important research area. The literature on educational computing abounds with conflicting findings about the impact of gender (Teo, 2008). Since the introduction of computers, ICT related activities have been largely viewed and labeled as a "male domain" (Brosnan & Davidson, 1996).

The teaching subject a teacher is specialized in, is also expected to be an influencing factor on teachers' educational beliefs. Teacher beliefs are expected to be mediated by epistemological differences that are inherent to respective content areas or by the instructional materials (Wood & Floden, 1990). Teaching subject has also been associated with ICT integration (Hennessy et al., 2005). In this context, many refer to the close link between ICT use and mathematics.

Teaching experience of pre-service and in-service teachers seems to affect their beliefs about the role and position of learners in the instructional context; i.e., to what extent can we hand over responsibilities to learners (Brousseau, Book & Byers, 1988). The level of teaching experience also determines the extent to which teacher reflect on their own practices. Also, teacher beliefs appear to be heavily influenced by actual teaching practices (Zahorik, 1987).

The levels of *study years of pre-service teachers* also have been connected to teacher beliefs and then their intention to integrate ICT into their future teaching. For instance, Brousseau et al. (1988) state that the number of years of classroom experience "reduces" certain teacher beliefs: "experienced teachers were more likely to believe that classrooms should be teacher centered and that learning did not always need to be fun" (p.38). By referring to age and computer experience, study years of pre-service teachers may also influence ICT integration (Teo, 2008).

2.5. Teacher ICT use in education

Researchers have mapped a range of definitions, classifications and typologies about ICT use in education. For instance, Niederhauser and Stoddart (2001) distinguish mainly between two main types of educational ICT use: "skill-based transmission use" and "open-ended constructivist use". Educational computer use is also categorized as "computers as information resource tools", "computers as authoring tools" and "computers as knowledge construction tools" (Ainley, Banks, & Fleming, 2002). On the base of an empirical study, involving a large number of teachers, Tondeur, Hermans, van Braak, and Valcke (2008) have delineated two main categories of ICT use by teachers: supportive ICT use, classroom ICT use; these categories replicate in an empirical way typologies developed by e.g., Hogarty, Lang and Kromrey (2003), and van Braak et al. (2004). The first category, supportive ICT use, refers to the use of ICT for pro-active and administrative teaching tasks, such as student administration, preparing worksheets, developing evaluation activities, keeping track of pupils' learning progress, etc. The second, classroom ICT use, aims to support and enhance the actual teaching and learning process, such as the use of computers for demonstration purposes, drill and practice activities, modeling, representation of complex knowledge elements, discussions, collaboration, project work, etc. (Hogarty et al., 2003).

2.6. Cultural context

Conceptions of culture and the cultural context

Most studies that start the endeavor to explore the concept of culture, end in a feeling of getting and being lost (Hall, 1976). A major factor contributing to this feeling is the tremendous complexity of the concept of culture. Next to a large variety in of definitions as presented in the literature, we are confronted with shifts in foci towards the concept of culture. Several traditionally and historically accepted definitions are presented below. The shared components of these definitions will help to delineate a work definition for the dissertation.

- Tylor provides one of the earliest definitions of culture: "the complex whole which includes knowledge, belief, art, morals, custom and any other capabilities and habit acquired by man as a member of society" (Tylor, 1871, p.1).
- Franz Boas shattered the unitary conceptions of culture adopted thus far. He referred to the determining nature of geographical and historical dimensions. Cultural elements have to be explained with reference to local conditions. This anthropological view can be seen as a reaction to the current approaches overestimating the role of biology in determining human behaviour at the individual and racial level (Boas, 1940).
- Geertz (1973, p.89) writes as follows: culture is a "historically transmitted pattern of meanings embodied in symbolic form by means of which men communicate, perpetuate, and develop their knowledge about and attitudes toward life".
- Gordon (1991, p.101) extends Geertz's notion of culture to include "structured relationships, which are reflected in institutions, social status, and ways of doing things, and objects that are manufactured or created such as tools, clothing, architecture, and interpretative and representational art".
- Hofstede (1980, pp. 21-23) defines culture as "the collective programming of the mind which distinguishes the members of one group from another", which is passed from generation to generation, it is changing all the time because each generation adds something of its own before passing it on.
- "Culture...refers to a socially constructed and historically transmitted pattern of symbols, meanings, premises, and rules" (Philipsen, 1992, p.7).
- Culture is "a symbolic realm which arises within the frame of social structures...[and] a way of life of a group of people, the sphere of complex practical activity, or praxis" (Preston, 1997, p. 39).
- The concept of culture points at "the shared way of life of a group of people" (Berry, Poortinga, Segall, & Dasen, 2002), which influences people's behavior, perspectives, values and understanding.

The different definitions share a number of features. A crucial element is the contextual nature of culture. Therefore, we adopt - in the context of this PhD - the term "cultural context". This cultural context is composed of generations of people in coordination with each other, with some common and continuing organization, values, understanding, history, and events that transcend the particular individuals (Rogoff & Angelillo, 2002).

Cultural perspectives towards teacher cognitions

In this section, the emphasis on the cultural context is discussed in view of the central position of teacher cognitions in our conceptual framework. We mainly focus on teacher educational beliefs and self-efficacy beliefs as examples of culturally shared teacher cognitions.

Considering the nature of beliefs, teachers' educational beliefs may be largely shaped by culturally shared experiences and values. Teaching is a cultural activity and thinking about teaching and learning is informed by culturally shared ideas about teaching and learning (Correa, Perry, Sims et al., 2008; Stigler & Hiebert, 1999). Different cultures generate different educational beliefs. The latter reintroduces the importance of the external variables as mentioned in a number of the theoretical models discussed in a former section. Culturally shared educational beliefs of teachers may be so ubiquitous and familiar that they become difficult to recognize (Correa et al., 2008). Teacher beliefs about teaching and learning are as a result consistent with broader values within a culture, or shared as 'primordial values' such as individualist, community, or collectivist orientations (Alexander, 2001).

Researchers have questionned the appropriateness of transporting Western theories, constructs, and measuring instruments to be used in non-Western cultural contexts (Sinha, 1993; Lin & Gorrell, 2001). For instance, Lin and Gorrell (2001) explored pre-service teacher efficacy in Taiwan and clearly argued that teacher efficacy and beliefs are largely shaped by culturally and socially shared experiences and values. If we take teacher self-efficacy as an example, studies of Chinese teachers' personal efficacy might reflect the self-effacing tendency in personal (re)presentation in collectivistic societies as well as the strong emphasis on teacher responsibilities and teacher performance in the Chinese cultural context (Ho & Hau, 2004). Therefore, a

cultural examination is the first step to explore teacher beliefs in Chinese context rather than Western settings in which most theories and instruments about teacher beliefs mainly have been developed.

The Chinese pedagogical culture: it's meaning and effect on ICT

Instruction is increasingly seen as a culture or set of cultures reflecting different contexts and different teacher behaviors inside and outside classrooms (Thomas, 1997). Feiman-Nemser and Floden (1986) state in this context that, teaching is a complex and varied process and not just a uniform set of encounters and traits. Understanding how culture influences instructional behavior and thinking process is a key issue in the research about teacher education (Aguinis & Roth, 2003; Correa et al., 2008). Pedagogical culture is introduced as a concept to stress cultural differences of pedagogy and instruction in different contexts (e.g., Zhang, 2004). A fundamental assumption for a pedagogical culture is that there are skills, knowledge and processes required for teaching a subject that are related to, but distinguishable from, expertise in the subject itself. Thomas (1997) emphasizes the need to identify different pedagogical cultures and describes the impact they can have on improving educational quality. A "culture sensitive theory" was proposed by Thomas to distinct four essential components: epistemological, process component, contextual component, and a personalistic component. He discusses six main influencing factors (political factor, economic, societal factors, professionalism, research and innovation, and cultural factor) that affect, in varying ways, one or all of the four components (Thomas, 1997).

Chinese culture is regarded as being part of the Confucian-heritage and reflecting particularities of a collectivist society (Biggs, 1996). Confucianism emphasizes traditional values rather than the easy adoption of new notions. This traditionalism might affect in a(n) (in)direct way choices teachers make about instructional practices (e.g., individual versus group work), the extent to which responsibilities are taken over by learners, the nature of assessment, etc. Chinese culture also holds a view of collectivism, urging individuals to surrender their own genuine interests for the sake of the well-being of a collectivity, whether that is the family or the state (Huang, 2002). This

cultural tradition, combined with other factors such as the population pressure, economical and political systems, helps to shape a group-based, teacher-dominated, and highly structured Chinese pedagogical culture (Zhang, 2004).

Though the question about ICT integration in education is of global significance, cultural variables have to be taken into account. There is a clear consensus that culture must have a definite influence on the design and use of ICT (Chai, Hong, & Teo, 2009; Pelgrum, 2001). For instance, Chai et al. (2009) argue that culture plays a mediating factor that influences how teachers relate their beliefs to ICT use. "The social and cultural contexts in which ICT resources are perceived and used by teachers are key influences in the development of a range of personal and professional practices" (Loveless, 2003, p314). Cultural differences have been identified when comparing Chinese and Flemish teacher perspectives on the use of ICT in teaching and learning (Zhu, Valcke, Schellens, 2010). They state that - more in particular -Chinese teachers express more doubts about the constructivist principles underlying many ICT applications. It is also important to see the transformative influences that ICT may have to social and academic cultures by encouraging diverse thinking and undermining knowledge authority (Hyun & Gilder, 1998). According to Zhang (2004), the incorporation of ICT as cultural artifacts that school contexts triggers a dual cultural interaction process that involves "assimilation" and "accommodation". Educational practitioners assimilate ICT by trying, sometimes unconsciously, to select technologies that fit the existing pedagogical culture. Confronted with the new technological artifacts that embed alternative pedagogical cultures, teachers will have to deal with the inconsistencies and make necessary accommodations through a process of "reflective adaptation" (Zhang, 2004).

ICT integration in Chinese education

About three decades ago, Chairman Deng Xiaoping stated – when visiting a secondary school in Beijing – that: "Education should be oriented towards modernization, globalization and future construction" (c.f., Yang, 1996). A linear response to this statement was the "modernization movement of education" that centered mainly on the adoption and use of educational

technologies and the "informationization" of education which can fulfill great-leap-forward development of education (Li & Xie, 2009). In the Chinese context, technology in education (coined as "electrified education" before 1993) has a history of more than 70 years (Ministry of Education [MOE], 2008). The new term "educational technology" is already in use for about two decades (equivalent to duration of China opening-up policy). A brief historical overview related to the adoption of educational technology in the Chinese context is listed below (sources: MOE, 2008):

- In 1991, "Leading Group for Computer Education in Primary and Secondary Schools" was set up by the State Education Commission.
- In 1991, the China Audio-Visual Education Association was founded.
- In 1993, "Educational Technology" was defined as a teacher education specialization at teacher education universities.
- In 1999, "The Plan for the Revitalization of the 21st Century of Education" was developed by the Ministry of Education, and also implied the set up of the "Modern Distance Education Project" resulting in a first open education network and life-long learning system.
- In 1999, the State Council issued "The Decision on Deepening Reform, Promoting All-round Quality Education", defining the status of educational technology.
- In 2000, a first "Conference of Information Technology in Primary and Secondary Schools" was held by the Ministry of Education. It aimed at popularizing ICT use in primary and secondary education from 2001 on in the "school-to-school" project.
- In 2000, the "Standardization Committee for Modern Distance Education Technology" was founded by the Ministry of Education.
- In 2002, the name of the "China Audio-Visual educational Association" was formally changed into the "China Educational Technology Association".
- In 2003, the China Educational Technology Association published a first edition of the "the China Educational Technology Standards".
- In 2004, the State Council issued the "2003-2007 Action Plan for Development of Education". The promotion of educational information technology becomes one of the six major projects.

- In 2004, the Ministry of Education issued the "Standards of ICT Literacy for Primary and Secondary School Teachers (trial version)".
- In 2008, the first "China Educational Technology Association 2008 Annual Meeting" and the "Improving Teaching and Learning with ICT Forum" was held.

The integration of ICT into teaching and learning at all levels of education is – considering this historical overview – deemed essential. Liu (1997, 2004) analyzed the development of the relationship between ICT and education, and divided the whole process into four stages: (1) coexistence of computer literacy and CAI, (2) integration of ICT and curriculum, ICT-based curriculum transformation and ICT-based education reform. Currently, Chinese governmental and educational organizations are paying more and more attention to "informationization" of education (MOE, 2008). The government has paid additionally attention to prepare pre-service teachers and to educate in-service teachers to integrate ICT into their classroom teaching, by offering ICT literacy training programs at the teacher education institutes (Yuan, 2006). Nowadays, more and more teachers in China are getting possibilities to use ICT in their teaching. It is not exaggerated to state that access to ICT (the availability and basic skills levels related ICT) are no longer obstacles for teachers (MOE, 2008). As a result, ICT in education has made significant progress and achievements both in the developed areas and in Western rural areas of China (Zhao & Xu, 2010). The effectiveness of ICT in education has considerably improved, teachers' competence of ICT has been strengthened, and the traditional teaching and learning approach has been significantly refined (Zhang, 2007; Zhao, 2009). ICT has played a critical role in education, which serves as a fundamental means to realize educational modernization. Both teachers and students are familiar with ICT and would like to use it to support their teaching and learning (Zhao & Xu, 2010).

However – despite the positive picture that is reflected in many reports – relatively few teachers use ICT regularly in their teaching activities and the impact of ICT on existing curriculum is rather limited. As Yuan (2006) reviewed, school teachers are failing to use materials from the Internet and they mainly "use computers as TV sets". There is a serious contradiction in

the attempt to integrate ICT into education (Li, 2003). Xie (2006) argues that researchers should help teachers develop their beliefs about ICT in Chinese primary schools and secondary schools. A better understanding and developing of teachers' beliefs should be an important step in modern educational reform (Xie, 2006; Zhao & Xu, 2010). As mentioned above, researchers in Western settings state that internal factors of teachers may play important roles in ICT integration. This understanding is a rationale for the present research, but set up in the Chinese cultural context.

Research on teacher cognitions and ICT integration in Chinese cultural contexts

In the Chinese context, teachers' beliefs are understood and explained following a number of dimensions: beliefs about students, beliefs about teaching, beliefs about educational environment, and beliefs about classroom interaction (Chen, 2007; Xie, 2006; Yu & Xin, 2000). In addition, a variety of studies have already been set up to explore teacher beliefs and how they are related to other actors, variables, and processes. For instance, Chen (2007) claims that teacher beliefs have an impact on teaching style and strategy. Li and Xie (2009) suggest that three strategies need to be considered to reconstruct ICT teachers' beliefs: innovation of the school culture, innovation of teacher education programs, and finally promoting teaching reflection during practice. Researchers (see e.g., Chen, 2007; Xie and Ma, 2007; Zhang, 2008) suggest that many teachers still proceed on the base of their own ideas and thoughts, and thus are relying on personal learning and teaching experiences rather than on teaching policies and new rules. In the domain of beliefs, much attention is paid to English (as a foreign language) teachers' beliefs (Huang & Chen, 2008; Zhang, 2008).

Researchers in the Chinese context have clearly started to carry out studies on teachers' beliefs. They build – as such – on studies from the Western context and started to construct theories about the nature a structure in teacher beliefs (Xie & Ma, 2007; Xin & Shen, 1999; Zhang, 2008). Available empirical research about teacher beliefs focuses on the impact of teachers' beliefs on student development, teacher professional development, and curriculum innovation. Using "narrative research method", other researchers look at the link between beliefs and ego-role, classroom management, students' needs, curriculum design, and curriculum resources (Xie (2006). Zhu and Ye (2003) investigated the factors resulting in change of pre-service teachers' beliefs. They found that the pre-service teachers' beliefs, though comparatively stable, could be changed during their practice teaching period and that pre-service teachers' motivation in view of professional growth was an important predictor of their beliefs and changes in beliefs.

To sum up, compared to the large number of studies about teacher beliefs set up in western contexts, this research field is still relatively new and disparate in the Chinese context. Secondly, we observe that consistently Western frameworks, concepts and instruments are being used. Thirdly, Chinese studies tend to be more theoretical in nature and build to a lesser extent on empirical investigations. In the Chinese context, researchers still prefer to discuss teacher in relation to philosophical discussions about education, teaching and learning (Xin & Shen, 1999). Many Chinese researchers focus on exploring teachers' beliefs and studies about the consistency between teacher beliefs and their teaching practices (Zhu & Ye, 2003). Additionally there is related focus on differences in beliefs as they are related to different subject domains (Xie, 2006).

When it comes to Chinese research about the use of information technologies and teacher beliefs, most studies remain theoretical and refer to the importance of the linkage between beliefs, teaching methods, teaching management and teacher attitudes towards computers (Chen, 2007). A new research strand can be observed, but this is yet very new, small and certainly not centered on the Chinese primary education setting. For instance, Li (2003) discusses the relationship between teachers' beliefs and e-learning. He states that teachers' beliefs play crucial roles in teaching activities and strategies related to e-learning. Li & Xie (2009) argue that it is important to improve teachers' beliefs about, and attitudes towards information technology. Lü (2008) claims that the reason of lower level ICT integration can by explained by the low adoption of student-centered and constructivist teacher beliefs. According to He (2006), although teachers take positive attitudes toward educational technology, they are not confident in their usage abilities. They state that teacher education programs have not resulted in a sufficient proficiency level about technology use. If teachers hold underdeveloped

beliefs about teaching, learning and ICT, the innovation of teaching and the integration of information technology will continue to face difficulties. In this context, some authors stress that a key factor to influence teacher beliefs is the actual involvement of teachers with ICT in their own teaching and learning activities (Li, 2003). The latter fits into the reciprocal nature of the relationship between teacher cognitions and ICT use.

3. Research design and overview of the dissertation

3.1. Research objectives

Our review of the literature about ICT and teacher cognitions in the Chinese context, clearly points at the need to set up studies in Chinese educational settings. The nature of pre-service and in-service primary teacher cognitions and the relationship between teacher cognitions and ICT integration in the classroom need to be explored. The interest in beliefs of in-service teachers was clearly stressed in the former sections. Additionally, Richardson (1996) argues that being concerned about teacher beliefs is also critical for teacher education: on the one hand, beliefs can be associated with the adoption of specific teaching behavior. Learning to teach is expected to be linked to shifts in both skills and beliefs (Elliott & Calderhead, 1995). Therefore, next to in-service teachers, we must pay sufficient attention to our understanding of the nature of teacher beliefs. In the Chinese context, pre-service training of teachers is mainly set up in Normal Universities. This brings us to the first research objective:

Research objective 1: Exploration of the nature of teacher beliefs in China. This research objective is subdivided into the following two research questions:

Research question 1: What are the profiles of Chinese in-service primary school teachers' educational beliefs, considering teacher background variables?

Research question 2: What is the nature of pre-service primary teachers'
educational beliefs in Chinese Normal Universities?

Our research especially focuses on the relationship between specific teacher cognitions and the level of integrated ICT use. In China, scholars hardly pay attention to the specific educational use of ICT in education, and also hardly link this to the context of teacher education (Li & Xie, 2009). This brings us to the second research objective:

Research objective 2: Examination of teacher cognitions and ICT integration. It leads to the following research questions:

Research question 3: How are teacher cognitions of in-service teachers related to their teaching practices with and without ICT? *Research question 4*: How are teacher cognitions of pre-service teachers related to their prospective teaching practices with and without ICT?

Ertmer (1999) argues that teachers' individual beliefs should be challenged, and teachers should be inspired to adopt new teaching approaches. Researchers and teacher educators have found evidence to state that teacher beliefs can be challenged by some well-designed interventions (Korthagen, & Kessels, 1999; Luft, 2001; Wang et al., 2004). For instance, Luft (2001) found effects of an inquiry-based demonstration classroom in-service program on science teachers' beliefs. In China, most teachers have received a training that focuses on their ICT capacities and skills. But considering the conceptual framework presented above, training should also try to impact teacher beliefs. This brings us to the third research objective of the present research:

Research objective 3: Challenging teacher beliefs and related teaching practices in the use of ICT. This objective is explored by studying the following research question:

Research question 5: What is the effect of a video-based intervention on in-service teachers' cognitions and practices?

Figure 6 presents a more detailed overview of the studies by linking the research objectives to the research questions, the chapters, research variables, research methods and the resulting output of the research.



Figure 6 Detailed overview of the design and focus of the subsequent studies.

* Status of publications:

Chapter 2: Published in the Asia-Pacific Journal of Teacher Education.

Chapter 3: Submitted for publication in the Teaching and Teacher Education journal.

Chapter 4: Accepted for publication in the Journal of Computer Assisted Learning.

Chapter 5: Published in Computers & Education.

Chapter 6: Submitted for publication in the Journal of Science Education.

3.2. Overview of the dissertation

The dissertation builds on seven chapters. All chapters have been published, accepted for publication, or submitted for publication in ISI-indexed peer-reviewed journals, apart from Chapter 1 "General introduction" and Chapter 7 "General conclusion".

In this introductory chapter, the general overview of this dissertation is developed. The problem statement and the research context are presented first. Next, the conceptual framework is discussed and the theoretical background is clarified. In the next paragraphs, we present more information about the research design and the overall structure of the dissertation.

Chapter 2 explores the nature of and profiles of in-service teachers' educational beliefs, and links this to critical teacher background variables: the socioeconomic and geographical setting. A survey, involving 820 primary school teachers is used to study their traditional and constructivist beliefs about teaching and learning. This study also examines differences of teacher educational beliefs considering economic and geographical context variables. A cluster analysis helps to delineate four teacher belief profiles: a constructivist profile, a mixed constructivist/traditional profile, a traditional profile, and a mixed low constructivist/traditional profile.

In Chapter 3 we examine the profiles of pre-service teachers' educational beliefs. Participants include 727 Chinese pre-service teachers from four teacher education universities (Normal Universities). The first aim of this study is to check the reliability and validity of the Chinese version of "Teacher Beliefs Scale" that is originally developed and used in Western settings. Next, the study helps to clarify the nature of the pre-service teachers' beliefs and focuses on differences in educational beliefs that can be linked to gender, level of study year, and school subject.

Chapter 4 explores factors associated with the integration of ICT into Chinese primary school classrooms. It centers on the complex interplay of a number of internal teacher variables and the supportive use of ICT in view of explaining the integrated classroom use of ICT. Path modeling will help to explore the direct and indirect effects of the teacher cognitions and background variables on the level of classroom ICT integration. The results are expected to ground the hypothesis that classroom use of ICT depends on a complex set of teacher cognitions. The study will demonstrate the complex interplay between teacher related variables adds to our understanding of ICT integration in Chinese classroom teaching.

Chapter 5 addresses the relationship of pre-service teacher cognitions and ICT integration. It focuses on the impact of Chinese pre-service teachers' constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy, and computer attitudes on their prospective ICT use. Some teacher background variables are considered (e.g., gender). Building on the results of a path analysis model, the study will examine predictive factors related to teacher cognitions (constructivist teaching beliefs, teacher self-efficacy, computer self-efficacy and computer attitudes in education) of prospective ICT integration.

In Chapter 6, we present the set-up and results of an intervention study titled "challenging science teachers' beliefs and practices through a video case-based intervention in Chinese primary schools". This study aims at challenging primary science teachers' educational beliefs. Forty six in-service teachers were involved in this study (experimental group = 23, control group = 23). We administer pre- and post-questionnaire surveys to examine possible changes in participants' educational beliefs and science teaching efficacy beliefs. Video data is gathered through classroom observations of 9 participants from the experimental group and 9 participants from the control group. We predict that science teachers' beliefs and teaching practices can be influenced by the intervention program.

Chapter 7 provides a general conclusion. It integrates the findings of the subsequent chapters. This integrative discussion helps to consider the main findings from a broader perspective. Theoretical and practical implications are presented. Finally, it includes a discussion of the limitations of the studies and possible directions for future research.

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Chapter2

Investigating teachers' educational beliefs in Chinese primary schools: socioeconomic and geographical perspectives*

Abstract

This empirical study explores the nature of and profiles in primary teachers' educational beliefs in the Chinese educational settings. A survey of 820 primary school teachers was conducted using a questionnaire focusing on teachers' traditional and constructivist beliefs about teaching and learning. Analysis of variance and cluster analysis were applied. Results show that gender and subject domain affect traditional educational beliefs. Significant differences appear considering economic and geographical context variables. Cluster analysis helps to delineate four teacher belief profiles: a constructivist profile, a mixed constructivist/traditional profile. Interrelation between teacher belief profiles and school categories are discussed.

1. Introduction

A growing body of research suggests that teacher beliefs affect teaching practices, classroom judgments and classroom management (Clark & Peterson, 1986; Richardson, 1996; Shin & Koh, 2007; Thompson, 1992; Woolley, Benjamin & Woolley, 2004). For instance, Clark & Peterson (1986) state that "teacher behavior is substantially influenced and even determined by teachers' thought processes" (p.255), because teachers' beliefs represent

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the rich store of knowledge of teachers affecting their instructional planning and practices. Teacher beliefs present as such a window to look at teacher decision-making, practices, and in some cases, the efficacy of instructional practices (Nespor, 1987; Pajares, 1992). Hence, a better understanding of educational beliefs of teachers is essential to influence and improve teaching practices and the potential success of educational reforms.

In the Chinese context, research focusing on teacher beliefs started only recently. Especially as a response to dealing with the more complex demands of modern society, educationists and researchers stressed the need to adopt more progressive educational beliefs. They refer in particular to the importance of constructivist beliefs about teaching and learning (Lü, 2004; Xie, 2006). This goes together with a shift in the pedagogical paradigm from teaching practices as "transmission of knowledge" to teaching practices that "activate" the learner through approaches such as problem-based learning, inquiry learning, collaborative learning, etc. According to Pei (2004), teaching strategies of teachers are evolving towards this constructivist idea. However, many teachers do not embrace the constructivist paradigm in their daily classroom activities (Cao, 2006). The latter may be explained by inconsistencies between their teaching beliefs and the innovative practices they are expected to adopt (Clark & Peterson, 1986; Tobin & McRobbie, 1996). Differences in the adoption of educational reforms can also be related to contextual variables. Teng (2003) refers in the Chinese context to the large diversity in economic and cultural development between the western and eastern provinces and between urban and rural areas in China. Studying educational beliefs in the Chinese context should therefore consider these additional variables.

2. Theoretical background

2.1. Defining teacher beliefs

The term "beliefs" is used in an interchangeable way with concepts as conceptions (Erlwanger, 1975), a philosophy (Ernest, 1991), an ideology, a perception, and a world view (Schoenfeld, 1985). Other researchers refer to 'principles of practice', 'personal epistemologies', 'perspectives', 'practical

knowledge', or 'orientations' (Kagan, 1992). It is therefore not surprising that Pajares considered it to be a "messy concept" (1992, p. 307). Because beliefs can not be directly observed and have to be inferred from behavior or teacher statements, it is difficult to put forward a precise definition of beliefs (Leder & Forgasz, 2002). Pajares (1992) argues that the lack of a clear definition and the inconsistent adoption of terminology is a major impediment to progress in research on teacher beliefs.

A belief is a representation of the information someone holds about an object, or a "person's understanding of himself and his environment" (Fishbein & Ajzen, 1975. p 131). Beliefs and beliefs system serve as personal guides in helping individuals define and understand the world and themselves (Pajares, 1992). Also, the nature of teacher beliefs has been characterized in terms of affective, evaluative, and episodic processes (Van Driel, Bulte & Verloop, 2007).

Despite the conceptual confusion, researchers have made attempts to clarify the terminological discussion about teacher beliefs and to centre on profiles in teacher beliefs (Nespor, 1987; Richardson, 1996). Beliefs could be as varied as teaching itself and reflect issues related to learners (e.g., beliefs about inclusion, about diversity), knowledge (epistemological beliefs), teaching components (beliefs about the curriculum, beliefs about what learning content is important, beliefs about instructional media, teaching strategies, evaluation, etc.), parents, instructional context, and organisational dimensions (Tondeur, Devos, Van Houtte, van Braak, & Valcke, 2009). Hermans, van Braak and Van Keer (2008) consider these beliefs to centre on three educational issues: (a) the general goals of primary education, (b) the general nature of the educational content, and (c) ways of knowledge acquisition. Woolley et al. (2004) distinguish between "traditional teaching" beliefs versus "constructivist teaching" beliefs of elementary teachers that mirror student-centered approaches to teaching and learning.

2.2. Theoretical construct and the structure of teacher beliefs

Increasingly, improvement efforts in k-12 schools and teacher education programs are based on constructivist theories of learning (Richardson, 1996; Woolley et al., 2004). Many teacher educators believe that it is important for

teachers to experience constructivist teaching from a learner's perspective, and then to have opportunities to reconstruct their beliefs about teaching based on their reactions as students. However, as objects of reforming, traditional beliefs and methods still can not be abandoned by teachers and teacher educators. This bipolar structure of teacher educational beliefs has been discussed by researchers (e.g. Woolley et al., 2004; Tondeur, Hermans, van Braak, & Valcke, 2008).

Since educational beliefs are related to a variety of educational tenets (see above), researchers have made attempts to delineate prototypical teacher beliefs. In the literature, authors mainly distinguish between "traditional beliefs" and "constructivist beliefs" (Kerlinger & Kaya, 1959; Woolley et al., 2004). The traditional beliefs are also labeled as teacher-centred (Bramald, Hardman & Leat, 1995), transmissive beliefs (Hermans et al., 2008), or subject-matter oriented (Billig, Condor, Edwards et al., 1988). These beliefs are adopted by teachers who concentrate on knowledge transmission, devise well-organized teaching plans, and adopt step-by-step teaching methods. On the other hand, "constructivist beliefs" are also referred to as "supporting student learning" (Samuelowicz & Bain, 1992), a "constructivist philosophy of learning" (Bramald et al., 1995: 24), "progressive beliefs" (Kerlinger & Kaya, 1959; Hermans et al., 2008), or "student-centred approach" (Bramald et al., 1995). Teachers who believe in student-centred approaches to teaching and learning, concentrate on harmonious development of students and integration of different subjects can be characterized into this "constructivist" dimension.

But the bipolar approach to teacher beliefs profiles has - from the start - been criticized by researchers (see e.g., Kerlinger & Kaya, 1959). Their study provided support for the hypothesis that teachers hold both "traditionalistic" and "progressive" educational beliefs. Green (1971) suggests that people tend to order their beliefs in clusters, which are "more or less in isolation from other clusters and protected from any relationship with other sets of beliefs" (p.48). Consequently, people can hold conflicting beliefs, for instance about the need for competition and the importance of learner collaboration (see Van Driel et al., 2007). Recently, Tondeur et al. (2008) have also concluded that primary school teachers adopt concurrent educational beliefs and "specific beliefs profiles can be identified in teachers, based on the extent to which

they adopt traditional and constructivist teaching beliefs" (p. 84).

Those research on the structure of teachers' educational beliefs support as a theoretical construct of present study, considering that teachers are expected to adopt bipolar or concurrent educational beliefs.

2.3. Endogenous variables affecting educational beliefs: teacher characteristics

Teachers seem to adopt different educational beliefs, depending on their gender (Lin, 1992, Kalaian & Freeman, 1994), their teaching experience (Shaw & Cronin-Jones, 1989; Wood & Floden, 1990), or the subject domain they teach (Brown, 1985).

Earlier research points at clear gender differences in educational beliefs. For example, Kalaian and Freeman (1994) argue that gender differences in self-confidence and educational beliefs play a role in student-teacher persistence and program completion. Gender differences in the beliefs of Chinese primary school teachers are also reported by researchers (see Lin, 1992; Lü, 2004).

The variable teaching experience of pre-service and in-service teachers seems to affect beliefs about the role and position of learners in the instructional context; i.e., to what extent can we hand over responsibilities to learners (Brousseau, Book & Byers, 1988). The level of teaching experience reflects extent of teacher reflections on their own practices. Also, teacher beliefs appear to be heavily influenced by actual teaching practices (Zahorik, 1987). Furthermore, in the Chinese context, teaching experience of teachers is related to their professional qualifications. According to Xiong (2001), the lowest qualification required to become a primary teacher has been changed from "middle normal school diploma" to "college diploma". Thus, teaching experience is negatively correlated with teachers' level of qualification.

The teaching subject a teacher is expected to convey is also expected to be an influencing factor on teachers' educational beliefs (Wood & Floden, 1990). Teacher beliefs are expected to be mediated by epistemological differences that are inherent to respective content areas or by the instructional materials (Wood & Floden, 1990).

2.4. Exogenous variables affecting teacher beliefs: socioeconomic and geographical factors

Little research evidence is available as to macro-level contextual variables that are expected to affect teacher beliefs. The geographical teaching area (rural/urban) where teachers teach has been reported to be an important influencing factor on teachers' beliefs. The institutional context in which teachers work has effect on educational beliefs of teachers (Lim & Torr, 2007). Martin & Yin (1999) examined for instance differences in classroom management beliefs and found that rural teachers adopted to a significantly higher extent a teacher-induced interventionist instructional approach, while urban teachers adopted significantly more student-based interventionist approach. A hidden variable in the former study is whether schools are positioned in a developed or developing province. This returns in the study of Geng, Feng, Shen and Zhang (2006) who argue that school location and the related school size is expected to have an effect on primary teachers' educational beliefs, which are shaped and developed by teachers culturally and geographically.

The critical importance of school categories has been underpinned by earlier research that links school performance to the underdevelopment of certain Chinese provinces. The "Chinese Western Development Drive Policy" focuses in this context on 12 under-developed provinces. These provinces comprise 28.8% of the Chinese population, living in 71.4% of the Chinese land (CPG, 2000). Teachers are influenced by local educational policies that are expected to be heavily affected by these differences in developmental level (Teng, 2003). Diversities and differences between urban regions and rural regions, between developed regions and developing regions have been discussed in view of teacher opinion, which states that teachers in underdeveloped areas hold more traditional views (e.g., Pei, 2004); sub-cultures, which argues that western ethnic minority school teachers are net in their sub-cultures (e.g., Teng, 2003); and economic development, which indicates the big distance between western regions and eastern regions, between rural areas and urban areas (e.g., Zhu, 2003).

2.5. Cultural perspectives on educational beliefs

Though the present study does not focus on cross-cultural differences in teachers' educational beliefs, culture is an important variable in discussions about beliefs. Considering the nature of beliefs, teachers' educational beliefs may be largely shaped by culturally shared experiences and values. Teaching is a cultural activity and thinking about teaching and learning is informed by culturally shared ideas about teaching and learning (Correa, Perry, Sims et al., 2008; Stigler & Hiebert, 1999). Culturally shared educational beliefs of teachers may be so ubiquitous and familiar that they become difficult to recognize (Correa et al., 2008). Correa et al. (2008) explored the differences and similarities in mathematics beliefs of primary teachers in China and the United States. They state that Chinese and American teachers have distinct beliefs about teaching and learning. Furthermore, teacher beliefs about teaching and learning are consistent with broader values within a culture, or shared as 'primordial values' such as individualist, community, or collectivist orientations (Alexander, 2001). For instance, the Chinese social values have been essentially influenced by Confucianism philosophy. Confucianism emphasizes traditional values rather than new notions. This tradition might affect in an (in)direct way choices teachers make about instructional practices (e.g., individual versus group work), the extent to which responsibilities are taken over by learners, the nature of assessment, etc. Building on this rationale, it will be interesting to analyze the results of the present study in order to see whether the beliefs and belief profiles in Chinese teachers reflects what has been found in Western teachers.

3. Research questions

Teachers hold implicit theories (beliefs) about students, the subjects they teach and their teaching responsibilities, and that these implicit theories influence teachers' reactions to teacher education and to their teaching practices (Ashton, 1990). Furthermore, development of students and success of educational reforms also rely on understanding and changing of teachers' educational beliefs (Pei, 2004). The ultimate objective of the present study is to construct a portrayal of the nature in and structure of Chinese teachers'

educational beliefs for use by educational researchers, policymakers, teacher educators and school administrators, and to explore the differences in teachers' educational beliefs and profiles between urban and rural primary schools in developed and developing areas in China, and between the four school categories (teachers from urban schools in developed areas; teachers from rural schools in developed areas; teachers from urban schools in developing areas; and teachers from rural schools in developing areas). The following research questions guide the present study:

- 1. What is the nature of teachers' educational beliefs and to what extent are these beliefs affected by endogenous teacher related variables (gender, teaching subject, teaching experience)?
- 2. To what extent are teachers' educational beliefs related to exogenous variables (i.e., urban versus rural schools; developed versus developing provinces; and the four school categories)?
- 3. What profiles can be delineated in Chinese teachers' educational beliefs?
- 4. To what extent do those profiles link to the four school categories?

4. Method

We adopted a quantitative approach to develop a first understanding of the nature of and structure in educational beliefs currently adopted by Chinese teachers. In this context, we adopted a survey methodology, based on the administration of questionnaires.

4.1. Instruments

In order to determine the educational beliefs of Chinese teachers, the "Teacher Educational Beliefs" scale (TEB) was administered. The TEB is based on two available instruments developed in Western educational settings: the "Beliefs about Primary Education Scale (BPES)" (Hermans et al., 2007) and the "Teacher Beliefs Survey (TBS)" (Woolley et al., 2004). The recommended translation procedure "back-translation" was applied to the development of the instrument (Hambleton, 1992). In total, 18 items from the BPES (15 of original 18 items) and the TBS (3 of original 21 items) were selected, after discussions about the interpretation of the test items with 6

Chinese educationalists and 10 Chinese primary school teachers on the two translated instruments.

TEB items request teachers to indicate on a Likert scale the extent the expression is applicable to them. Typical constructivist belief (CB) items: "The learning process always has to start from the learning needs of the pupils"; "Learners must get the opportunity to build up their own knowledge in a collaborative way or together with the teacher". Typical traditional belief items (TB) are: "The content of a lesson has to be completely in line with the curriculum"; "Lecturing by teacher is more efficient than students' inquiry".

Though the TEB was developed after a careful translation process and a screening of the items in view of an adequate interpretation, further quality control was necessary because of the Chinese translation and differences in the number of items as compared to the original instruments. Three ambiguous items that loaded inconsistently on one of the both factors were removed from the scale. For example, the constructivist item "The emphasis on cross-curricular goals is important in primary education" loaded on the factor representing the traditional dimension. Three other items were discarded due too low communalities. Adaptations resulted in adequate validity of the final version of the instrument. In addition, the final TEB version reflects a high internal consistency level for both the subscale "CB" ($\alpha = .81$), and the subscale "TB" ($\alpha = .70$).

4.2. Research sample

A total of 1000 teachers in Chinese primary schools were invited to participate in the study. A high response rate was achieved (82%). All 820 participants of this study are primary school teachers from 11 different provinces throughout China. The sampling procedure took initially into account the teaching context of teachers (urban versus rural), the level of economic development of the provinces (developed versus developing), and the four school categories.

Additional criteria played a role, but did not define the further stratification strategy of the sample. Sample characteristics are summarized in Table 1.

Item	Options	Number (%)	$M\left(\sigma\right) CB$	<i>F</i> values (<i>p</i>)	$M\left(\sigma\right) TB$	F values (p)
All sample		820 (100)	3.06 (.76)		2.17 (.92)	
Gender	Male	245 (29.9)	3.11 (.75)	1.908	2.32 (.97)	10.221
	Female	575 (70.1)	3.03 (.76)	(.168)	2.10 (.88)	(.001)
Teaching	< 5 years	102 (12.4)	3.04 (.72)	0.585	2.13 (.90)	0.676
experience	6 - 15 years	379 (46.2)	3.09 (.76)	(.557)	2.14 (.92)	(.509)
	> 16 years	339 (41.3)	3.03 (.78)		2.21 (.92)	
School	Academic	519 (63.3)	3.04 (.76)	1.921	2.11 (.90)	6.587
subjects	Non-academic	163 (19.9)	3.17 (.69)	(.125)	2.30 (.92)	(.000)
	Mixed subjects	111 (13.5)	2.94 (.86)		2.10 (.94)	
	No response	27 (3.3)	3.10 (.76)		2.80 (.80)	
School	Urban	430 (52.4)	3.12 (.70)	7.191	2.10 (.87)	5.086
setting	Rural	390 (47.6)	2.98 (.82)	(.007)	2.24 (.96)	(.024)
Development	Developed areas	418 (51.0)	2.98 (.77)	7.987	2.08 (.91)	7.121
level	Developing areas	402 (49.0)	3.13 (.74)	(.005)	2.25 (.91)	(.008)
School	Urban davalanad	200 (25 5)	2.08(68)	בדד ד	2 02 (83)	4 220
School	Orban, developed	209 (23.3)	2.98 (.08)	1.115	2.02 (.85)	4.329
categories	Rural, developed	209 (25.5)	2.99 (.85)	(.000)	2.15 (.99)	(.005)
	Urban, developing	221 (27.0)	3.26 (.69)		2.18 (.91)	
	Rural, developing	181 (22.1)	2.97 (.77)		2.35 (.91)	

Table 1. Characteristics, mean score (SD), ANOVA results (n = 820)

Of all respondents, 70.1 % teachers were female. Respondents were grouped into 3 categories depending their years of teaching experience: teachers with less than 5 years of teaching experience (12.4%); teachers with 6-15 years of teaching experience (46.2%); and teachers with more than 16 years of teaching experience (41.3%). Moreover, respondents were also categorized into four groups, depending upon their teaching subject, since subject curriculum and instruction are still preferable to integrated curriculum and instruction in Chinese educational context: 63.3% of the teachers teach an academic (main) subject (i.e. Chinese, English, mathematics, science); 19.9% teach non-academic (subsidiary) subject (i.e. fine arts, music, physical education, information technology); 13.5% teach more than one subjects; 27 teachers (3.3%) did not give answer to the subject-related question. As to the school setting, 430 (52.4%) teachers work in urban schools, and 390 (47.6%) teachers work in rural schools. Furthermore, schools of 418 (51%) teachers are located in developed areas, and 402 (49%) are located in developing areas. Respondents can be located in one of the four different geographical school identified by types that can be combing urban/rural and developed/developing regions. Sample distributions of the four school

categories are: teachers from urban schools in developed areas (N = 209; 25.5%); teachers from rural schools in developed areas (N = 209; 25.5%); teachers from urban schools in developing areas (N = 221; 27%); teachers from rural schools in developing areas (N = 181; 22.1%).

4.3. Data analysis

Data analysis is based on: (1) analysis of descriptive statistics; (2) ANOVA tests to analyze differences in teachers' educational beliefs considering endogenous and exogenous variables (see Table 1); (3) hierarchical cluster analysis and K-mean cluster analysis to delineate teacher profiles of educational beliefs; and (4) cross-tabulation to interpret the direction of differences for school categories and teacher profiles was interpreted.

5. Results

5.1. The nature of teacher beliefs

Table 1 also includes a clear overview of the extent to which teachers hold constructivist and traditional educational beliefs. In addition, the scores are split up according to endogenous and exogenous teacher characteristics. At a general level, the means of educational beliefs reflect that teachers report higher scores in relation to constructivist beliefs (M = 3.06) as compared to traditional beliefs (M = 2.17).

5.2. Teacher beliefs and endogenous teacher characteristics

Result of ANOVA analysis shows that male and female teachers do not differ in their adoption of constructivist beliefs (F(1,818)= 1.908, p > .05, η^2 = .001). In contrast, significant differences are found in relation to traditional beliefs (F(1,818)= 10.221, p = .001, $\eta^2 = .000$). Male teachers adopt to significantly higher extent traditional beliefs.

The number of years of teaching experience has no effect on adopting either constructivist beliefs (F(2,817) = 0.585, p > .05, $\eta^2 = .002$) or traditional beliefs (F(2,817) = 0.676, p > .05, $\eta^2 = .002$).

When studying the potential relationship between teachers' beliefs and the school subject they teach, we observe a significant difference in the extent these teachers adhere traditional beliefs (F(3,816) = 6.587, p < .001, $\eta^2 = .008$). On the base of a Post Hoc Test (Scheffe), teachers who did not answer the subject-related question, adopt to a higher extent traditional beliefs (p < .01). No significant difference in the adoption of constructivist beliefs is observed (F(3,816) = 1.921, p = > .05, $\eta^2 = .002$).

5.3. Teacher beliefs and exogenous variables

We observe in teachers from urban areas significantly higher scores in relation to constructivist beliefs (F(1,818) = 7.191, p < .01, $\eta^2 = .007$) and significantly lower scores on traditional beliefs (F(1,818) = 5.086, p < .05, $\eta^2 = .003$) as compared with teachers from rural areas.

We find in teachers from developed areas significantly lower scores in relation to constructivist beliefs (F(1,818) = 7.987, p < .01, $\eta^2 = .007$) and traditional beliefs (F(1,818) = 7.121, p < .01, $\eta^2 = .007$) as compared with teachers working in developing regions.

ANOVA analysis with the factor of the four school categories results in a significant effect of the variable school categories. This is true for both traditional beliefs (F(3,816) = 7.773, p < .001, $\eta^2 = .011$) and constructivist belief (F(3,816) = 4.329, p < .01, $\eta^2 = .014$).

On the base of a Post Hoc Test (Scheffe), we see that teachers from urban schools in developing areas hold significantly higher constructivist beliefs than teachers from the other areas (p < .001). Teachers from rural schools in developing areas hold significantly higher traditional beliefs than teachers from urban schools and rural schools in developed areas (p < .001). No significant differences were observed between teachers from rural schools in developed areas and teachers from urban schools in developed areas or developing areas, and teachers from urban schools in developed areas areas and teachers from urban schools in developed areas ar

5.4. Identifying profiles in teachers' educational beliefs

To explore whether teachers can be clustered into homogenous subgroups, a hierarchical cluster analysis was conducted, using constructivist beliefs and traditional beliefs as variables. Ward's method, which is designed to optimize the minimum variance within clusters, was used as a clustering method (Aldenderfer & Blashfield, 1984). The results suggest a four-cluster solution. Based on this solution, K-mean cluster analysis was applied to delineate clear teacher profiles. Out of sample of 820 respondents, 235 (28.7%) are classified as belonging to Cluster 1 that is labeled "constructivist profile"; 242 (29.5%) are grouped in Cluster 2, labeled "mixed constructivist and traditional profile"; and the remaining 83 teachers (10.1%) model Cluster 4, labeled "mixed low constructivist and traditional profile".

Table 2. Profiles in teachers' constructivist beliefs (CB) and traditional beliefs (TB)

Cluster no.	N (%)	CB	TB
		z-score	z-score
1. Constructivist profile	235 (28.7%)	2.83	-2.82
2. Constructivist/traditional profile	242 (29.5%)	3.45	3.49
3. Traditional profile	260 (31.7%)	-2.35	.30
4. Low constructivist/traditional profile	83 (10.1%)	-10.70	-3.12

5.5. Linking teacher profiles and school categories

The direction of differences for school categories and teacher profiles was interpreted using cross-tabs. Figure 1 shows the distribution of teachers from the four school categories on four clusters. Teachers from urban schools in developed areas mostly adopt a *traditional profile* (N = 88, 42%) and *constructivist profile* (N = 71, 34%). Most of the teachers (N = 72, 35%) from rural schools in developed areas adopt a *mixed constructivist/traditional profile*. Teachers from urban schools in developing areas reflect the highest proportion of the *mixed constructivist/traditional profile* (81, 4%) and

constructivist profile (77, 3%). As to teachers from rural schools in developing areas, they mostly mirror a *traditional beliefs profile* (72, 4%).



Figure 1 Distribution of teachers from the four school categories on four Clusters.

6. Discussion

The findings of the present study present an extensive profile of teachers' educational beliefs in Chinese primary schools.

6.1. Teacher beliefs and endogenous variables: teacher characteristics

In earlier studies, researchers found gender differences in the adoption of specific teachers' educational beliefs (e.g., Kalaian & Freeman, 1994). The findings of the present study are in line with these earlier findings. Chinese male teachers hold significantly higher traditional beliefs, and slightly higher – but not in a significant way – constructivist beliefs as compared to Chinese female teachers.

Prior teaching experiences are expected to influence teachers' educational beliefs (Richardson, 1996). Previous studies in Chinese setting indicate that teachers differ in their educational beliefs, depending their years of teaching experience (Xie & Ma, 2007). Lü (2004) states in this context that primary and secondary teachers with less than 6 years of teaching experience tend to hold more progressive educational beliefs. This could not be confirmed in the present study. Considering their teaching experience, teachers did not differ in the adoption of traditional or constructivist beliefs.

The relationship between curriculum subjects and teacher beliefs is confirmed when compared to the results of earlier studies. Researchers explored teachers' beliefs about mathematics (e.g., Renne, 1992), about science (e.g., Posner, Strike, Hewson & Gertzog, 1982), and about language learning and teaching (e.g., Yang, 2000). Lü (2004) pointed already at significant differences in general educational beliefs of teachers teaching different school subjects. In the present study, this is partly confirmed. Teachers teaching non-academic subjects mirror to a statistically higher extent traditional beliefs. Teaching academic or non-academic school subjects does – in the Chinese context – not yet result in differences in the adoption of constructivist beliefs.

6.2. Teacher beliefs and exogenous variables: socioeconomic and geographical factors

As mentioned earlier, due to historical and economic reasons, there are large differences in educational levels between urban areas and rural areas, between eastern, central and western Chinese provinces. The present findings mirror these differences. Chinese teachers from urban primary schools hold higher constructivist beliefs and mirror to a less extent traditional beliefs as compared to teachers from rural primary schools. This is in contrast to the findings of Lü who did not find significant difference between teachers from urban schools and rural schools in China (Lü, 2004). This can be partly explained by the more diverse sample that was involved in the present study (11 provinces). Surprisingly, we observe that teachers working in developing areas hold higher constructivist beliefs than those working in developed areas. This inconsistent result can be partly explained as "disenchanted"

(Vandenberghe & Huberman, 1999). Teachers in basic education system of China have been provided a large amount of training in view of the implementation of the new curriculum reform in China. Teachers working in developed areas participated in the reform earlier than those in developing areas. However, after a vigorous period of reform implementation, former teachers have encountered "education reform fatigue" (Li, 2008) and are suspicious of new educational theories.

6.3. Teacher profiles of educational beliefs

Four different beliefs-based profiles could be identified. Two relatively small subgroups of teachers take up an extreme position; they adopt dominantly constructivist beliefs (28.7%) or mixed constructivist/traditional beliefs (29.5%) respectively. The profile of mixed constructivist/traditional beliefs is a new finding in the Chinese context. However, in Western settings, researchers already observed that some teachers hold both high constructivist and traditional beliefs (e.g., Tondeur et al., 2008). As stated earlier, the teacher-centred "traditionalistic" bipolar distinction between and student-centred "progressive" beliefs has therefore been challenged (Kerlinger & Kaya, 1959). Members of the largest subgroup (31.7%) adopt traditional beliefs. Based on this finding, we may argue that most of the Chinese teachers still hold traditional beliefs. Finally, teachers in the smallest subgroup (10.1%) adopt a mixed low constructivist/traditional profile. The latter profile is comparable to the one found in a recent study, set up in the Belgian context, and was labeled as an "undefined profile" (Tondeur et al., 2008). Of importance is the fact that many teachers are able to hold opposing beliefs within their belief system. This finding is consistent with studies about conceptions of teaching (e.g., Pratt, 1992) and teachers' educational beliefs (Van Driel et al., 2007). These sets of opposing beliefs are considered to be "functional paradigms" (Lantz & Kass, 1987), that are helpful to cater for very different situations in the learning and training settings.

6.4. Linking teacher profiles and school categories

The underlying influence of socioeconomic and geographical factors on teacher profiles was also examined by linking teacher profiles and school categories. A large number of teachers (42%) from urban schools in developed areas are recognized into extremely *traditional profile*. As mentioned above, we may explain this by "disenchanted" (Vandenberghe & Huberman, 1999) and "education reform fatigue" (Li, 2008). The largest number of teachers (35%) from rural schools in developed areas is linked to mixed constructivist/traditional profile. According to Tondeur et al. (2008), this profile is positive to teachers' educational practice. Teachers from urban schools in developing areas possess the largest proportion on *constructivist* profile (35%) and mixed constructivist/traditional profile (37%). This finding is supported by earlier Post Hoc Test result: teachers from urban schools in developing areas hold significantly higher constructivist beliefs. The largest number of teachers (40%) from rural schools in developing areas can be linked to traditional profile. A large body of evidence can be found for this finding (see e.g., Pei, 2004; Teng, 2003). For instance, Pei (2004) states that for primary school teachers in western regions of China, traditional instructional beliefs are still dominant.

6.5. Limitations

The design of the present study reflects some limitations. First, it did only build on self-reports. Qualitative methods (such as video analysis, classroom observation) should substantiate the present findings. A mixed research method of qualitative and quantitative should therefore be adopted for further studies. Secondly, the research instrument was originally developed by Western researchers in Western settings. Though much time and energy was put in the translation and adaptation of a new version, this version might still be less fit for Chinese respondents; e.g., in the way questions were stated, or the way it reflects the Chinese context. This calls for the development of an instrument that is completely based on the Chinese educational setting. Thirdly, the overall number of test items to determine particular teacher educational beliefs was restricted. This can have affected the validity and reliability of the scale (Field, 2005). Finally, it should be noticed that a large number of primary teachers in China hold strong traditional beliefs, although policy-makers and teacher educators have been making efforts to promote progressive approaches of teachers (Pei, 2004). In future research, it might be interesting to know why traditional beliefs are so important for in Chinese setting, and thus to explain this contradictory.

6.6. Implications for policy development and teacher development

The findings of the study are important in view of educational policy development, teacher education, and teacher professional development.

Firstly, educational policy makers should consider the gender differences of teachers and the differences in the developmental level of particular Chinese regions, since differences in school categories and gender differences of teachers go together with differences in teachers' educational beliefs. Secondly, since teachers involved in the teaching of non-academic subjects mirror to a higher extent traditional beliefs, these teachers should be involved in professional development projects in view of developing a richer belief system that embraces both traditional and constructivist beliefs. Thirdly, teachers' individual beliefs should be challenged since there is a clear connection between teachers' educational beliefs and their instructional practices (Richardson, 1996). Nespor (1987) suggests that instructional change is not a matter of abandoning beliefs, but of gradually replacing or enriching them with belief systems that are relevant in view of the instructional context. In addition, it is stressed that these beliefs can best be influenced through concrete experiences in a supportive environment (Nespor, 1987). This introduces a dramatic change in the way professional development is to be set up: towards a case-based teacher education model.

7. Conclusions

In this article, we explored the nature and structure of educational beliefs of Chinese teachers. Based on an adaptation of available instruments, an in-depth picture could be developed of the educational beliefs that are reported by teachers to play a role in their teaching practices. Comparable teacher characteristics help to explain differences between teachers. In contrast, we also see clear differences that build on regional differences in China. Teachers from developed versus developing, and urban versus rural areas report differences in their educational beliefs. This could have been expected, considering the heterogeneous nature and status of school policy development between the different regions. Theoretically, our findings reinforce theories about teacher thinking processes, teacher education and curriculum reform in Chinese educational settings. Furthermore, based on research instruments developed in Western contexts, our empirical findings verify research findings about teachers' educational beliefs in Western contexts (Tondeur et al., 2008).

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Chapter 3

Exploring the educational beliefs of primary education student teachers in the Chinese context^{*}

Abstract

Teacher educational beliefs may be largely shaped by culturally shared experiences and values. The first purpose of this study is to explore educational beliefs of Chinese student teachers. An adapted version of the Teacher Beliefs Scale (TBS) - developed in a Western context (Woolley, Benjamin, & Woolley, 2004) - was validated in this study and the profiles of student teacher educational beliefs were analyzed. The research group consisted of 727 Chinese student teachers from four different teacher education universities. A factor analysis of the Chinese version of the TBS (CTBS) supported the dimensions of the original instrument but some items had to be discarded to less consistent factor loading. The ANOVA results showed that there were significant differences in constructivist teaching beliefs with respect to gender, grade level, and majoring subjects. But no significant differences in the adherence to traditional teaching beliefs were observed. The results also show that the first year student teachers hold stronger constructivist beliefs as compared to senior student teachers. This can be linked to the latter larger teaching and learning experiences in real classroom settings. Implications are drawn for further research in teacher education contexts.

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1. Introduction

A large body of research asserts that teacher beliefs affect teaching practices (Ashton, 1984; Clark & Peterson, 1986; Fang, 1996; Morin & Welsh, 1991; Richardson, 1996; Shin & Koh, 2007). For instance, Clark & Peterson (1986) state that 'teacher behavior is substantially influenced and even determined by teachers' thought processes' (p.255), because they represent the rich system of knowledge of teachers affecting their instructional planning and practices. Teacher beliefs therefore present a window to study teacher decision-making practices (Nespor, 1987; Pajares, 1992). It is widely agreed that student teachers begin their professional education with deeply grounded beliefs about teaching and learning and that these are hard to influence (Kagan, 1992; Pajares, 1992).

The importance of studying student teacher beliefs has regularly been emphasized by researchers. For instance, student teacher beliefs seem to play a pivotal role in the acquisition and interpretation of teacher training (Clark & Peterson, 1986; Holt-Reynolds, 1992) and subsequent teaching behaviour (Goodman, 1988). The unsubstantiated beliefs that pre-service teachers bring with them have been shown to affect what and how they learn from teacher education (Borko & Putnam, 1996; Calderhead & Robson, 1991). Having undergone a long term school career themselves, pre-service teachers enter their teacher education with a set of educational beliefs which may or may not be congruent with the way teacher educators hope their students will evolve (Floro-Ruane & Lensmire, 1990). Pre-existing beliefs are so influential that attempts to change teaching styles are ineffective, unless these beliefs are directly questioned (O'Loughlin & Campbell, 1988). Whitbeck (2000) suggests that pre-service teachers possess narrow beliefs about teaching and the profession. Therefore, researchers suggest that teacher educators must take into account the beliefs they incorporated ring prior to the teacher education program and how they evolve during their training years (Ashton, 1984; Nespor, 1987; Pajares, 1992). An important goal of teacher education programs should consequently be to help pre-service teachers developing beliefs that are consistent with the needs of the current or new educational system (Hart, 2002; Thompson, 1992).

Considering the importance of teacher beliefs, it is easy to argue that

exploring teacher beliefs is of extreme importance to promote teacher professional preparation and educational practices. But, teacher beliefs about teaching and learning are influenced by broader values within a culture (Alexander, 2001). Although prolific research about student teacher' beliefs has been conducted in Western countries, limited attempts can be observed in the Chinese context (e.g., Chan & Elliott, 2002). This introduces the key objective of the present article in which we aim at developing a better understanding of Chinese student teachers' educational beliefs. This can be related to the improvement of teaching practices and the potential success of current educational reforms in China.

The article is organized as follows. The next section presents the research rationale and theoretical base for this study. The third section discusses the research aims and questions as derived from our literature review. The design of our study with a description of research instruments and data analysis methods is presented in the next section, followed by the results section. We conclude with a discussion of the findings from a theoretical point of view, the implications of these findings and the limitations of the present study.

2. Theoretical background

2.1. Educational beliefs of student teachers

The term "beliefs" is used in an interchangeable way with terms such as conceptions (Erlwanger, 1975), philosophy (Ernest, 1989), ideology, perception, world view (Schoenfeld, 1985), personal epistemology, and orientation (Kagan, 1992). A belief is a representation of the information someone holds about an object, or a person's understanding of himself and his environment' (Fishbein & Ajzen, 1975. p 131). Beliefs and beliefs system serve as personal guides in helping individuals define and understand the world and themselves (Pajares, 1992).

Despite a persisting conceptual confusion, researchers have made attempts to clarify the terminological discussion about teacher beliefs and to centre on profiles in teacher beliefs (Nespor, 1987; Richardson, 1996). Teacher beliefs have been defined by Kagan (1992) as "tacit, often unconsciously held assumptions about students, classrooms, and the academic material to be taught" (p. 65). Also, the nature of teacher beliefs has been characterized in terms of affective, evaluative, and episodic processes (Van Driel, Bulte, & Verloop, 2007).

In respect to student teachers, it is widely agreed that they begin their education with a wide range of different educational experiences, resulting in varying opinions, beliefs and conceptions about teaching and learning (Booth, Abdulla, Lingham et al., 1998). Pre-service teachers' beliefs about teaching are well established and developed during what Lortie (1975) terms as the apprenticeship of observation (Fang, 1996; Richardson, 2003). Some authors state that most pre-service teachers already possess a well-developed and established set of beliefs upon entering teacher education programmes (Kagan, 1992; Nespor, 1987; Pajares, 1992). For instance, it is suggested that pre-service teachers who have been taught in a directive didactic learning environment are likely to hold on to traditional beliefs about teaching and learning and continue to adopt instructional practices supporting these beliefs (Applefield, Huber, & Moallem, 2001; Holt-Reynolds, 1992). Kagan (1992) confirms that pre-service teachers enter teacher education programmes with personal beliefs about what a good teacher is, images about themselves as future teachers, and memories of themselves as students. According to Kagan, pre-service teachers' beliefs act as filters through which others' teaching performance is interpreted. Thus, information from teacher education courses and even classroom observations are filtered, translated and absorbed into students' own pedagogy, making the experience potentially miseducative (Kagan, 1992). Nevertheless, some authors also stress that the teacher education experience can affect the educational beliefs of student teachers (Dart, Bouton-Lewis, Brownlee et al., 1998).

2.2. Dimensions of teacher beliefs: measurement issues

More than two decades ago, Clark and Peterson (1986) discussed methodological difficulties in studying teacher beliefs. A series of researchers have contributed to the development of teacher beliefs instruments. Kerlinger and Kaya (1959) conducted the first robust instrument assessing "traditional beliefs" and "progressive beliefs" about education. They defined a teacher adopting traditional beliefs as stressing discipline, puts the subject matter first,

and emphasizes moral standards, while a teacher adopting progressive beliefs concentrates on individual differences, social learning, and the interests of the pupil. The two-dimensional construct was supported by subsequent research. For instance, Bunting (1985) distinguished teacher educational beliefs with a "student-centred" orientation and with a "directive" orientation. In the study of Smith (1993), a two-dimension Primary Teacher Questionnaire was used to assess teacher beliefs about "traditional" and "developmental appropriate practices". Hermans et al. distinguished a "developmental" and "transmissive" dimension (Hermans, van Braak, & Van Keer, 2006). By adding a "romantic" orientation, emphasizing the importance of schools as sources of new ideas and self-awareness, other authors presented a three dimensional structure of educational beliefs (Silvernail, 1992). Woolley, Benjamin and Woolley (2004) also developed a three-dimensional instrument to measure primary teachers' "traditional" teaching beliefs, "traditional management" beliefs, and "constructivist" teaching beliefs.

Based on previous reviews, a two-dimensional structure seems to be a better way to explore teacher beliefs about teaching and learning. Teachers with traditional educational beliefs are more likely to employ didactic instructional practices (Niederhauser, Salem, & Fields, 1999; Stofflett & Stoddart, 1994). They tend to perceive teaching as a directive and didactic way of disseminating information to students and consider learning as a passive activity, with students doing minimal task management or holding little responsibility for their own learning (Duffy & Jonassen, 1992). Teachers with constructivist pedagogical beliefs perceive learning as an active construction and reconstruction of knowledge, and approach teaching as a process of guiding and facilitating learners in the process of knowledge construction. Constructivism represents a paradigm shift from education mainly based on traditional behaviorist assumptions to education based on social cognitive and socio-cultural theory (Gagnon & Collay, 2006; Prawat, 1992). Based on such a more learner-centered educational context, constructivism re-defines the role of the teacher. A constructivist teacher is not anymore the transmitter of knowledge, but he/she is a guide supporting students' learning (Brooks & Brooks, 1999).

Initial conceptions about belief dimensions stressed the dichotomy and opposing nature of teacher beliefs. Klein (1996) argues that student teachers'

may hold both transmissive as well as constructivist beliefs depending on the context and that these beliefs may reflect, at the same time, a constructivist and transmissive philosophy. Klein explains this finding by claiming that beliefs "are not organized into a coherent body of knowledge" or that the pre-service teachers in some way reconcile different approaches, themes or philosophies (Klein, 1996, p.370). Inconsistent or combined beliefs of student teachers have been regularly discussed in the literature (Raymond, 1997; Seaman, Szydlik, Szydlik, & Beam, 2005).

2.3. Cultural perspectives on teacher beliefs

Research associated with psychological constructs, such as self-concept and study approaches, has illustrated the impact of cultural values and contexts, e.g., individualism in the Western culture and collectivism in the Asian or Chinese culture (Bond, 1996). From an anthropological point of view, culture is understood as "a symbolic realm which arises within the frame of social structures" (Preston, 1997, p. 38) and is "a way of life of a group of people, the sphere of complex practical activity, or praxis" (p. 39). Considering the nature of beliefs, teachers' educational beliefs may therefore be largely shaped by culturally shared experiences and values. Because teaching is a cultural activity, thinking about teaching and learning is informed by culturally shared ideas about teaching and learning (Correa, Perry, Sims et al., 2008; Stigler & Hiebert, 1999). Teachers develop culturally shared beliefs about what good teaching and learning should be, even before they enter into their teaching careers (Wilson, 1990). Culturally shared educational beliefs of teachers may be so ubiquitous and familiar that they become difficult to recognize (Correa et al., 2008). For this reason, some cross-cultural studies about teacher beliefs have been set up by both Western and Eastern researchers, partly as a response to the queries about the appropriateness of transporting Western teaching models, theoretical frameworks, and measuring instruments to non-Western cultures (e.g., Correa et al., 2008; Shin & Koh, 2007; Yang, 2000). For example, Correa et al. (2008) explored the differences and similarities in teacher beliefs in China and the United States. They state that Chinese and American teachers reflect distinctive beliefs about teaching and learning. Chinese teachers talk about developing students'

interest in learning and relating the content of curriculum to real-life situations. US teachers talk about students' learning styles and using "hands-on approaches to learning" (Correa et al., p.140). Furthermore, teacher beliefs about teaching and learning are related to the broader values within a culture, or shared as "primordial values" such as individualist, community, or collectivist orientations (Alexander, 2001). For instance, the Chinese social values have been essentially influenced by Confucianism philosophy (Reagan, 2000). Confucianism emphasizes traditional values rather than new notions. This tradition might affect in an (in)direct way the choices teachers make about instructional practices (e.g., individual versus group work), the extent to which responsibilities are taken over by learners, the nature of assessment, etc. Therefore, "the comparison of two distinct culturally embedded belief systems can be helpful to make implicit beliefs and assumptions more transparent" (Correa et al., 2008, p.141).

2.4. Demographics and teacher beliefs

In previous studies about teacher beliefs - especially in Western educational settings - student teachers' gender, grade level and subject domain have been identified as critical independent variables to study differences in teacher beliefs. Researchers found gender differences in specific teacher educational beliefs (Beck, Czerniak, & Lumpe, 2000; Cornelius-White, 2007; Kalaian & Freeman, 1994). For instance, Beck et al. (2000) found a significant relationship between teachers' gender and their constructivist beliefs in favor of female teachers. Kalaian and Freeman (1994) argue that gender differences in self-confidence and educational beliefs play a role in student-teacher persistence and program completion. Grade levels of student teachers also have been connected to teacher beliefs. For instance, Brousseau, Book and Byers (1988) also state that the number of years of classroom experience "reduces" certain teacher beliefs. Shulman (1986) started research about the relationship with subject matter knowledge and argued that the way teachers understand the subject matter and their subject matter mastery, is "the missing paradigm" in many belief studies. The teaching subject a teacher is expected to convey is also expected to be an influencing factor on teachers' educational beliefs (Wood & Floden, 1990). Teacher beliefs are expected to be mediated by epistemological differences that are inherent to respective content areas or by the instructional materials (Wood & Floden, 1990). Also Freeman (1991) argued that teachers can adopt different beliefs in connection to different subject matters.

2.5. Research objectives

The central objective of the present study is to explore the nature of Chinese student teachers' educational beliefs in China. The present article is divided into two parts. Firstly, a Chinese version of the existing Teacher Belief Scale (Woolley et al., 2004) was administered to explore the factor structure of the instrument in the Chinese educational setting. Secondly, we examine the relationship between the student teachers' educational beliefs and background variables, such as gender, grade level and subject matter specialization.

3. Methodology

3.1. Participants

Participants in the study comprised of 727 pre-service primary teachers from four teacher education universities positioned in three large Chinese cities (Beijing, Changsha and Hangzhou). The universities were selected based on a structural collaboration with a Belgian university. The study was set up at the end of the first semester, academic year 2008-2009. With permissions of faculty leaders, a paper and pencil questionnaire was distributed among the student teachers. Informed consent was obtained from individual participants. All participants were asked to fill in this questionnaire after attending a regular classroom course.

Looking at the gender characteristics of the sample, 93.5% of the respondents were female. This mirrors the predominance of female student teachers (81.1%) in the Chinese student teacher population (Ministry of Education, MOE, 2009). Additionally, 128 (17.6%) of respondents were freshmen. A further 154 (21.2%) were sophomores, 246 (33.8) were juniors and the remainder 199 (27.4%) were seniors. In terms of their subject matter

specialization, most 441 (61%) of the primary school student teachers were majoring in a specific subject such as Chinese education, mathematics education, English education. Next, 286 (39%) of them were enrolled in "primary education" teacher education, without subject specialization. This distribution in our samples is consistent with the distribution in the pre-service (primary) teacher population in Chinese universities (MOE, 2009).

3.2. Instruments

The questionnaire contained two parts. The first part solicited demographic data such as gender, grade level, subject domain and family location. The second part represented the Chinese version of the "Teacher Beliefs Scales (TBS)" (Woolley et al., 2004). In order to examine the translation's validity, linguistic parallelism was checked by the recommended "back-translation" procedure (Brislin, 1970; Hambleton, 1992).

The items of the Teacher Beliefs Scales (TBS) were assessed along a 6-point continuum ranging from strongly disagree to strongly agree. In our study, the participants were asked to rate their level of agreement with a specific statement (from 1- strongly disagree to 5- strongly agree). The original TBS consists of three scales and 21 items. Considering our research objective, we selected two sub-scales: "constructivist teaching beliefs (CTB)" and "traditional teaching beliefs (TTB)". The CTB scale includes 10 items such as "I believe that expanding on students' ideas is an effective way to build my curriculum" or "I involve students in evaluating their own work and setting their own goals". The original TTB scale contains 7 items such as, "I base student grades primarily on homework, quizzes, and tests" or "I teach subjects separately, although I am aware of the overlap of content and skills".

3.3. Data analysis

The data were analyzed using SPSS 17.0. Firstly, exploratory factor analyses were carried out on the data from a first stratified randomly selected sub-sample of respondents (N = 366). Secondly, confirmatory factor analyses

were performed for instrument validity, on the data from the second stratified randomly selected sub-sample (N = 361). Furthermore, univariate ANOVA tests were conducted to explore differences in educational beliefs with participants' background variables (gender, grade, and study major) used as factors. To study effect sizes, Partial eta squared (η^2) was calculated. Guidelines for values of partial eta squared are from Cohen (1988) where .01 = a small effect, .06 = a moderate effect, and .14 = a large effect.

4. Results

The findings presented below are in two parts: (1) a study of the reliability and validity of the Chinese version Teacher Beliefs Scale and (2) a study of the relations between teacher beliefs and teacher background variables.

4.1. Reliability and validity of the instrument

Though the CTBS was developed after a careful translation process and a screening of the items in view of an adequate interpretation, further quality control was necessary because of the Chinese translation and some basic

adaptations of the original instrument. In order to explore the underlying structure of the 17 items, a principal component analysis, based on a varimax rotation was conducted on the data resulting from a first stratified random sub-sample (N = 366). On the base of this exploratory factor analysis, 2 ambiguous items loading inconsistently on both beliefs dimension were removed from the instrument: "*To be sure that I teach students all necessary content and skills, I follow a textbook or workbook*" and "*For assessment purposes, I am interested in what students can do independently*".

A second exploratory factor analysis was conducted on the basis of the remaining scale items. A two-factor structure was imposed, derived from the original scale. The two-factor solution accounted for the 39.694% of the variance (CTB = 26.715%, TTB = 12.979%) (see Table 1). The final CTBS reflects an acceptable internal consistency level for both the subscale constructivist teaching beliefs 'CTB' (α = .81) and traditional teaching beliefs 'TTB' (α = .57). The reliability of the original scales is.73 for CTB and .78 for TTB (Woolley et al., 2004).

Items	Constructivist teaching beliefs (CTB)	Traditional teaching beliefs (TTB)
CT6	.777	.044
CT5	.766	.036
CT7	.697	.058
CT8	.642	.140
CT4	.630	.090
CT10	.604	020
CT9	.547	.039
CT1	.534	.282
CT2	.509	.174
CT3	.473	.251
TT2	088	.722
TT7	.006	.666
TT6	.160	.634
TT1	.097	.434
TT4	.223	.428
Eigenvalue	4.278	1.676
% of variance explained	26.715%	12.979%

Table 1. Structure coefficients for constructivist teaching and traditional teaching scale

A confirmatory factor analysis (CFA) was carried out on the basis of the data from the second sub-sample (N = 361). Again a two-factor model was imposed on the data to investigate the structural stability of the CTB and TTB dimension. AMOS 7.0 (Arbuckle 2006) was used to test how well the data fit the hypothesized structure. The following goodness-of-fit indices were calculated to study the adequacy of the fitted model: the χ^2 and p-value, the comparative fit index (CFI), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA) (Hu & Bentler, 1999). The results reflect a good fit between the theoretical model and the data model (df = 89, χ^2 = 184.236, χ^2/df = 2.07. The goodness of fit estimates were GFI = .935, AGFI = .912, CFI = .894, TLI = .875. RMSEA of .055, with a 90% interval of .043 and .066, indicates that the two-factor solution explains an acceptable good approximation. These results are largely in line with the indices reported by the authors of the original TBS (df = 186, $\chi^2 = 43.79$, RMSEA= .066, NFI = .76, NNFI = .78, CFI = .81, GFI = .91, AGFI = .88), obtained in a study involving 896 pre-service teachers (Woolley et. al., 2004).

4.2. Teacher beliefs and background characteristics

In order to facilitate data analysis, standardized sum scores for the two educational belief scales were calculated (minimum 0 - maximum 100). The average sum scores for CTB was 76.62 (SD = 13.29) and 55.80 (SD = 16.29) for TTB. The descriptive results are summarized in Table 2.

Prior to conducting the ANOVA, homogeneity of variances was tested because of unequal sample sizes when considering the variable gender. Levene's test revealed that the equal variances assumption of the ANOVA was met (p > .05).

The ANOVA test results show that female student teachers reflect to a significantly higher extent constructivist teaching beliefs as compared to their counterparts (F(1,725) = 9.939, p < .01, Partial $\eta^2 = .014$). But the results show that male and female teachers do not differ in their adoption of traditional teaching beliefs (F(1,725) = 0.313, p > .05).

When studying the potential relationship between student teacher beliefs and the study grade, we observe a significant difference in the adherence to constructivist beliefs (F(1,725) = 11.681, p < .001, Partial $\eta^2 = .046$). No significant differences are observed in the adoption of traditional beliefs (F(1,725) = 2.381, p > .05). On the base of a Post Hoc Test (Scheffe), we find that freshmen (year 1) reflect significantly higher constructivist teaching beliefs than those in the other training years (p < .01). Seniors hold significantly lower constructivist teaching beliefs as compared to students of other training years, but this difference seems to be only significantly when compared to year 1 students (p < .001) and year 3 students (p < .05).

	Constructivist teaching beliefs		Traditional teaching beliefs	
Variable	MEAN(σ)	F	$MEAN(\sigma)$	F
Gender		9.939**		0.313
Male	70.64(13.91)		54.47(16.36)	
Female	76.92(13.17)		55.84(16.24)	
Grade		11.681**		2.381
1 st Grade	82.01(9.51)		54.65(16.09)	
2 nd Grade	75.39(12.39)		58.34(16.79)	
3 rd Grade	76.83(14.71)		54.19(17.56)	
4 th Grade	73.47(13.20)		56.38(13.84)	
Major		6.468**		0.784
Subjects	75.51(13.91)		56.18(16.36)	
Primary education	78.07(12.15)		55.09(16.05)	

Table 2. Teacher background variables and the adoption of educational beliefs (N = 727): descriptives and ANOVA results

**. Significant at the 0.01 level (2-tailed).

It can be derived from Table 2 that student teachers who majored in general primary education reported higher constructivist beliefs than those who majored in individual subject domains (F(1,725) = 6.468, p < .05, Partial $\eta^2 = .009$). No significant differences can be observed in the adoption of traditional beliefs (F(1,725) = 0.784, p > .05).

5. Discussion

The current study attempted to explore a first picture of educational beliefs of student teachers from four Chinese universities. The exploratory nature of the study was based on the empirical data and evidence about teacher educational beliefs in the Chinese context. Though the discussion presented below, builds on significant statistical findings, we caution the reader since not all effect sizes are large and the fact that part of the CBTS should be further refined in view of attaining a higher reliability level.

5.1. Cultural perspectives on teacher beliefs

In general, the two educational belief dimensions that were identified in the Chinese context seem to be largely in line with the two key dimensions reported by Woolley at al. (2004). However, the specific instruments used in Western settings (e.g., Tondeur, Hermans, van Braak, Valcke, 2008; Woolley et al., 2004) have not been able to be entirely replicated into Chinese context. This becomes clearer when studying the nature and impact of specific individual items in the survey instruments. Chinese student teachers hold to a larger extent constructivist views about the textbook, in order to teach students all necessary content and skills. This phenomenon could be explained by the exam-driven educational system, with a majority of schools constantly organizing tests (Xie, Seefeldt, & Tam, 1996). Maley (1983) also argued that for many Chinese teachers, "books are thought of as an embodiment of knowledge, wisdom and truth. Knowledge is 'in' the book and can be taken out and put inside students' heads" (p101).

It is impossible to talk about traditional Chinese educational thinking without making reference to Confucianism (Reagan, 2000). As Lee (1996) argues, the Confucian value of collectivism and conformity is only part of the story. This would suggest a strong emphasis on traditional educational beliefs. But, Confucius also had much to say about individuality in learning. Education is only meaningful if it leads to the perfection of the self: "the purpose of learning is to cultivate oneself as an intelligent, creative, independent, autonomous being" (Lee, 1996, p34). Based on this view, it is easy to understand that Chinese student teachers also hold high constructivist beliefs related to students' independent work. This suggests that though student teachers might hold dominant constructivist beliefs, their understanding may be more focused on the individual cognitive processing, and to a lesser extent on the social-constructivist view that dominates in Western settings. As stated above, high constructivist beliefs and low traditional beliefs were found in pre-service teachers in Western settings (Klein, 1996; Raymond, 1997). Following traditional Chinese philosophy, Chinese teachers are perceived as the sole custodians of knowledge and a pedagogical top-down approach is extolled (Biggs, 1996; Kennedy, 2002). However, our research findings show that constructivist teaching beliefs

dominate the adoption of traditional teaching beliefs. This finding is consistent with Ma's review about Chinese student teachers' teaching beliefs, claiming that - under the influences of modern educational theories and innovations - constructivism has become a trend in both teacher education programs. This is clearly reflected in the educational beliefs of student teachers (Ma, 2009). But, this can also be attributed to the growing exposure of the Chinese educational system to Western cultures and philosophies (Zhang & Sun, 2006). A second clear finding is that, despite of the clear adoption of constructivist teaching beliefs, student teachers still reflect the belief that traditional teaching approaches cannot be rejected. This finding is supported by other Asian context research in Singapore (Chai & Khine, 2008). They explain that contextual factors such as time constraints and an over-emphasis on test results could explain this concurrent adoption of specific educational beliefs.

5.2. Background characteristics and educational beliefs

As mentioned in section 2.1, gender differences of teacher beliefs have been documented in a variety of studies. For instance, Beck et al. (2000) found a significant predominance in the adoption of constructivist beliefs by female teachers. The current findings are in line with these earlier studies. Chinese female teachers hold significantly higher constructivist beliefs, and slightly higher - but not in a significant way - traditional beliefs as compared to their counterparts. This is in contrast to other Asian research that there are no significant differences between male and female pre-service teachers' adoption of constructivist and traditional beliefs (Chan, Tan, & Khoo, 2007).

Student teachers are often reported to state that the problems faced by their classroom teachers will not be faced by them, and they predict they will be better teachers (Pajares, 1992). Our research findings show that first year student teachers adopt to a larger extent constructivist beliefs as compared to senior year students. This can be explained by the latter increased learning and teaching experience and the confrontation with traditional classroom practices they have to learn to fit in. Novice student teachers hold therefore to larger extent constructivist teaching beliefs. This finding is in line with findings in the Taiwan setting (Lin & Gorrell, 2001). They state that

pre-service teachers' efficacy beliefs are clearly shaped by their experiences with classroom practices. Enter the "real" world of teaching, the dominant school culture or/and the pressures of fitting in as a novice practicing teacher may nurture or destroy their adherence to constructivist beliefs (Lim & Chan, 2007). As mentioned above, Brousseau et al (1988) state that the number of years of classroom experience "reduces" certain teacher beliefs. However, contradictory findings were found in a US setting: pre-service teachers' efficacy beliefs seemed to evolve and widen due to the training context, their increased in competences and increased experience (Lin, Gorrell, & Taylor, 2002). The latter authors explain these conflicting results by pointing at uncontrolled effects of the cultural adaptation of the research instruments being used.

The hypothetical relationship between curriculum subjects and the adoption of specific teacher beliefs has been confirmed and is in line with the results of earlier studies. Researchers explored teachers' beliefs about mathematics (e.g., Renne, 1992), about science (e.g., Posner, Strike, Hewson & Gertzog, 1982), and about language learning and teaching (e.g., Yang, 2000) etc. Lü and Wang (2004) pointed in this context to significant differences in the adoption of general educational beliefs by teachers responsible for different school subjects. In the present study, this is partly confirmed. Student teachers majoring in "primary education" mirror to a statistically higher extent of constructivist beliefs than those majoring in specific subjects. The both major groups do not yet result in differences in the adoption of traditional beliefs.

6. Conclusions, implications and limitations

Given the mainly exploratory nature of the present study, we can conclude that a first clear picture is now available about student teacher beliefs in a Chinese setting. The fact that findings of studies involving Western pre-service teachers (e.g., Woolley et al., 2004) cannot be completely replicated (e.g., beliefs about textbooks) in this study, suggests that culture can play an important role in teacher beliefs. Too general and "global" judgments about teacher beliefs can therefore be criticized. The present study therefore contributes to the research literature by adding further evidence about cultural and contextual differences in educational beliefs. In addition, the current study identified a first structure in Chinese student teachers' educational beliefs, considering the combined adherence to constructivist and traditional beliefs. A better understanding of these student teacher beliefs can help to improve the efficiency of teacher education programs (Richardson, 2003). In these programs, explicit reference can be made to instructional practices that underpin particular or both belief dimensions. In addition, student should get in touch with a variety of practices, examples, which can be linked to varying teacher beliefs. The literature points in this context to the important impact of peers and teachers they meet during practice sessions and internships (Valcke, Sang, Rots, & Hermans, 2010). Additionally, the CTBS could be used as an instrument to guide self-reflection. In the literature it is emphasized that student teachers should become more aware of their knowledge basis and beliefs about teaching and learning (Freese, 1999).

Of course, also some limitations have to be stressed in relation to the current study. In future studies, larger numbers of student teachers have to be involved to study the differences in subgroups (see the low % of male student teachers). Next, a survey approach is only one way to study teacher beliefs. Self report questionnaires present clear limitations. In view of corroborating the present findings, qualitative studies have to be set up, next to a study of actual teaching and learning practices of Chinese student teachers; e.g., based on interviews, focus groups, and observations of real classroom behavior. Thirdly, the particular impact of the teacher education setting has been neglected in the present study. Especially when replicating this study with a larger group of student teachers from a larger number of teacher education institutions, a multilevel analysis approach could be adopted to consider the particular differences in teacher beliefs that could be attributed to differences related to the particular teacher training institution. In this context, it also has to be mentioned that participants in the present study were not randomly selected because they were enrolled in institutions involved in an international cooperation. Longitudinal studies of student teachers' educational beliefs could help to address questions about the stability of educational beliefs in particular institutions, thus also detecting the key impact of a teacher education program. Fourthly, beliefs are but one key

dimension when studying the professional identity of teachers. The interaction between student teachers' mission, beliefs, knowledge and skills and their teaching behavior should be considered in later research. Lastly, a cross-cultural study needs to be set up to explore the similarities and differences between Western and Chinese teachers' educational beliefs.

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Chapter 4

Factors associated with the integration of ICT into Chinese primary school classrooms: an interplay of teacher-related variables*

Abstract

Available research has explored a wide variety of factors influencing ICT adoption and integration in classroom teaching. But, existing seldom centers on the combined impact of these variables. In addition, little research is available set up in the Chinese context. The latter is important given the different cultural context in which the interplay between teacher beliefs and educational practices has yet been little documented. The present study centers on the complex interplay of a number of internal teacher variables to explain ICT classroom integration. These variables comprise "teachers' constructivist teaching beliefs", "teacher attitudes towards computers in education", "teachers' computer motivation", "teacher perception of ICT-related policy". A survey was set up, involving 820 Chinese primary school teachers. Path modeling was used to explore the direct and indirect effects of the teacher related variables on their level of ICT classroom integration. Firstly, two distinctive types of ICT use can be distinguished in the Chinese context: (a) Teacher supportive use of ICT that refers to the use of ICT for e.g., student administration, preparing worksheets, developing evaluation activities, (b) Classroom use of ICT to support and enhance the actual teaching and learning process. The results show that classroom use of ICT directly depends on teachers' computer motivation and the supportive use of ICT. Teachers' constructivist beliefs, their attitudes towards computers in education and perceptions about the ICT-related school policy influence ICT integration in an indirect way. The results demonstrate how the complex

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interplay between teacher related variables and ICT integration in the classroom is partly in line with findings in non-Asian contexts. A number of differences can be explained by the particular Chinese context. In particular an indirect relationship was found between teachers' constructivist beliefs and their level of ICT integration.

1. Introduction

Among other factors, teacher related variables are the most powerful predictors of technology integration (Becker, 2000). Teachers should therefore be at the core of ICT integration projects. As early as 17 years ago, Marcinkiewicz (1993) stressed that the full integration of computers into the education remains a distant goal unless there is reconciliation between teachers and computers. Studies have produced an extensive overview of teacher related factors (Ely, 1999; Mumtaz, 2000; Tondeur, Hermans, van Braak, Valcke, 2008a). Some of these factors cannot be influenced or changed, such as age, teaching experience, etc. Others can be influenced, such as teacher attitudes towards ICT, ICT related knowledge and skills, and motivation to use ICT (Afshari, Bakaer, Su Luan et al., 2009).

In the literature, two types of barriers are described currently hampering the integrated use of ICT by teachers: external (first-order) barriers and internal (second-order) barriers (Ertmer, 1999). External barriers comprise variables that are perceived as key obstacles, e.g., adequate access to the technology, Internet access, bandwidth, technology related training (e.g., Galanouli, Murphy, & Gardner, 2004). However, as observed by Ertmer (1999), even when first-order (external) barriers are resolved, "teachers would not automatically use technology to achieve the kind of meaningful outcomes advocated" (p.51). ICT integration seems to remain limited when there is no focus on teachers' own theories and beliefs about teaching and learning (Mumtaz, 2000). This introduces the need to consider internal barriers stalling ICT integration by teachers. Internal barriers are - among others - related to a teacher's philosophy about teaching and learning, their conception of knowledge, etc. A critical issue is that these are veiled and deeply rooted in daily practices of teachers (Ertmer, 1999, 2005). The study presents a relational model embracing a wide variety of internal teacher variables related to ICT integration. Building on available research, this list comprises: teachers' constructivist beliefs (Higgins & Moseley, 2001, Sang, Valcke, van Braak, & Tondeur, 2010), teachers' computer motivation (e.g., Marcinkiewicz, 1996), teachers' attitudes toward computers in education (e.g., van Braak, 2001), and teachers' perceptions on ICT-related policy (e.g., Barron, Kemker, Harmes, & Kalaydjian, 2003). Few studies have explored how these factors influence in a direct and/or indirect way the level of ICT integration in classrooms. This introduces the key research question for the present study.

Though the question about ICT integration in education is of global significance, also cultural variables have to be taken into account. The concept of culture points in this context to "the shared way of life of a group of people" (Berry, Poortinga, Segall, & Dasen, 2002), which influences people's behaviour, perspectives, values and understanding. It is widely accepted that culture shapes individuals' perceptions of innovations that bear directly on their lives (Chen, Mashhadi, Ang, & Harkrider, 1999; Williams-Green, Holmes, & Sherman, 1997). For instance, Chen et al. (1999) claim that the pervasive influence of culture should be considered as a significant concern in the development of technology-enhanced learning systems. The research of Zhu et al. pointed at cultural differences in the educational use of ICT (Zhu, Valcke, & Schellens, 2009). Cultural perceptions need to be considered as an important element in the implementation of ICT (Albirina, 2006) and culture may play an important role influencing how teachers relate their beliefs to ICT use (Chai, Hong, Teo, 2009). Cultural differences have been identified when comparing Chinese and Flemish teacher perspectives on the use of ICT in teaching and learning (Zhu, Valcke, & Schellens, 2010). According to their findings, more in particular Chinese teachers express more doubts about the constructivist principles underlying many ICT applications (e.g., collaboration, independent learning, self-directed learning). Differences are identified in ideas of Chinese teachers - as compared to Flemish teachers - about teacher-student and student-student interactions. This is linked to differences in the cultural dimensions: power distance, collaboration and competition. Chinese teachers put a larger emphasis on those dimensions.

"The social and cultural contexts in which ICT resources are perceived and used by teachers are key influences in the development of a range of personal and professional practices" (Loveless, 2003, p314). In this respect, the present study enriches previous studies and tests the interplay between teacher variables and the ICT integration into classroom teaching in the Chinese context. As will be discussed in the theoretical setting, we especially centre on teacher beliefs, perceptions, attitudes and motivation to study teachers' adoption of ICT.

2. Theoretical background

In this background section, we first review the available research about the internal teacher variables and ICT use in education. Based on the review, an integrated model is presented bringing together these variables to explain and predict the educational use of ICT.

2.1. Internal teacher related variables and ICT integration

2.1.1. Constructivist beliefs

Constructivist beliefs about teaching and learning have gained acceptance as a viable framework to understand learning processes and to develop effective teaching models. Teachers adopting constructivist educational beliefs, seem to be more willing to adopt student-centered approaches and other innovative instructional approaches (Higgins & Moseley, 2001), while teachers adopting traditional beliefs are more likely to adopt teacher centered instructional practices (Isikoglu, Basturk, & Karaca, 2009).

The way teachers integrate computers into their classroom instruction seems to be strongly mediated by their belief systems (Windschitl & Sahl, 2002). Researchers have explored the particular impact of constructivist educational beliefs on ICT integration (Higgins & Moseley, 2001; Riel & Becker, 2000; Tondeur et al., 2008a). For instance, Tondeur et al. (2008a) argue that teachers adopting high constructivist beliefs are more active ICT users compared to teachers with low constructivist beliefs.

2.1.2. ICT motivation

Motivation encompasses a multitude of factors driving the selection, the persistence, and the engagement of particular activities to attain an objective (Dweck & Elliott, 1983). Motivation refers to the process whereby goal-directed behaviour is instigated and sustained (Schunk, 1990). Motivational factors are therefore considered to be part of one's goal structures and beliefs about what is important (Ames, 1992). Sufficient levels of motivation in teachers are seen to be related to the innovative role of technology. Empirical research has successfully linked motivation to teacher computer use (Marcinkiewicz, 1996; Sheingold & Hadley, 1990).

2.1.3. Attitudes towards ICT in education

Ajzen (1988) describes "attitude" as a predisposition to respond favorably or unfavorably to an object, person, or event. The strong relationship between computer related attitudes and computer use in education has been emphasized in many studies (e.g., Sang et al., 2010; van Braak, Tondeur, & Valcke, 2004). Attitudes toward computers influence teachers' acceptance of the usefulness of technology, and also influence whether teachers integrate ICT into their classroom (Akbaba & Kurubacak, 1998; Clark, 2001; Huang & Liaw, 2005). According to Mumtaz (2000), schools can go only so far to encourage educational technology use without taking teacher attitudes into consideration.

2.1.4. Perceptions of ICT-related school policy

As ICT continues to drive changes in society, school policies need to define upfront their organizational vision and actions in view of planned change (Senge, 2000). A number of studies (e.g., Barron et al., 2003; Tearle, 2003) present evidence that an increase in classroom use of ICT in classroom can be linked to a favorable policy environment. School-level policy produces the desirability to build a coherent and supportive community of practice associated with effective, regular, and consistent ICT use (Dawes, 2001).

Since the Chinese educational system is highly centralized, ICT-related

school policies are linked to national policies as developed by the Ministry of Education (MOE). The Ministry promotes ICT use, but links this explicitly to the prescribed national curriculum, the central examination system and teacher-led didactical strategies. This does not invite a thorough reflection on school-based policies (Zhang, 2007). The question arises to what extent the definition and implementation of these ICT policies is sufficiently linked to the educational practices in the school and the classroom. An ICT policy itself does not automatically result in the adoption of innovations unless all actors involved are clearly aware of this policy. Research of Fullan (1991) shows that the adoption of innovation in schools depends on the democratic process of planning change by involving all school related actors. If teachers share the values expressed within a school policy and understand the implications, this policy is more likely to influence practice (Kennewell, Parkinson, & Tanner, 2000). Recent research of Tondeur et al. (2008a) shows that successful ICT integration is much more likely when teachers share the values expressed within the school policy and understand their implications.

2.2. Teacher ICT use in education

Researchers have mapped a range of definitions, classifications and typologies about educational computer use. For instance, Niederhauser and Stoddart (2001) distinguished between two main types of educational ICT use: "skill-based transmission use" and "open-ended constructivist use". Educational computer use is also categorized as "computers as information resource tools", "computers as authoring tools" and "computers as knowledge construction tools" (Ainley, Banks, & Fleming, 2002). On the base of an empirical study, involving a large number of teachers, Tondeur, van Braak and Valcke (2007) have delineated two main categories of ICT use by teachers: supportive ICT use, classroom ICT use; these categories replicate in an empirical way typologies developed by e.g., Hogarty, Lang and Kromrey (2003), and van Braak et al. (2004). The first category, supportive ICT use, refers to the use of ICT for pro-active and administrative teaching tasks, such as student administration, preparing worksheets, developing evaluation activities, keeping track of pupils' learning progress, etc. The second, classroom ICT use, aims to support and enhance the actual

teaching and learning process, such as the use of computers for demonstration purposes, drill and practice activities, modeling, representation of complex knowledge elements, discussions, collaboration, project work, etc. (Hogarty et al., 2003). To study the relationship between both categories, it is interesting to build on the study of Wozney, Venkatesh and Abrami (2006). They found that supportive use of ICT was the most significant predictor of ICT class use.

2.3. Towards an integrated model

As mentioned in the previous section, teachers' classroom use of ICT depends on a variety of internal teacher variables. Considering the available research evidence, we can develop an integrated model that interlinks these internal variables to explain and predict classroom use of ICT (Figure 1).



Figure 1 Integrated model of the impact of teacher variables on ICT use in the classroom.

Note: Straight line indicates a relationship studied in the literature.

Dashed line indicates a suggested relationship in this study.

For ease of interpretation, linkages between variables are identified between brackets. The hypothetical relationships between the variables build on a variety of theoretical and empirical data:

- a. An interrelationship between teacher beliefs and perceptions has been documented by arguing that teacher beliefs influence their perceptions and judgments (Johnson, 1990; Pajares, 1992).
- b. As mentioned in section 2.1.1, teacher beliefs tend to be associated with their ICT integration the classroom teaching (Becker, 2001; Hermans, Tondeur, van Braak, & Valcke, 2008; Windschitl & Sahl, 2002). For instance, Hermans et al. (2008) found a positive effect of constructivist beliefs on the classroom use of computers. Becker (2001) also states that constructivist teachers are more likely to use ICT in more challenging ways.
- c. On the base of the model of Fishbein and Ajzen (1975) we position beliefs as precursors of attitudes towards ICT in education. Hew and Brush (2007) state that although attitudes and beliefs are two separate constructs that are inextricably intertwined, beliefs mainly determine a person's attitude (see also Bodur, Brinberg, & Coupey, 2000). A series of studies did already examine and support the impact of teachers' educational beliefs on educational computer attitudes (e.g., Chai et al., 2009; Ertmer, 2005). Becker and Ravitz (1999) also state that teachers who hold constructivist beliefs are more likely to engage their students to use ICT.
- d. The direct impact of beliefs on supportive ICT use has also been documented by researchers (Becker, 2001; Scrimshaw, 2004; Tondeur et al., 2007; Webb & Cox, 2004). For instance, Becker (2001) argues that constructivist beliefs foster ICT use in education.
- e. Davis, Bagozzi, & Warshaw (1989) focus on computer motivation. They claimed that a primary motivation for computer adoption is the adopter's belief regarding the usage outcome or his perceptions of the usefulness of the technology. The interrelation between beliefs and motivation is confirmed by Czubaj (1996) by defining internal motivation as a state of beliefs influencing one's decision making.
- f. The influence of teachers' perceptions of school ICT policy on ICT integration has been confirmed in the research of Tondeur, Van Keer, van Braak and Valcke (2008b). They argue that it is the actual level of teachers' awareness about an ICT-policy determines the integration of

educational ICT use.

- g. Researchers point at the impact of teacher motivation on the promotion of excellence in teaching with ICT (Abdullah, Abidin, Su Luan, & Atan, 2006; Hadley & Sheingold, 1993). Highly motivated teachers reflect higher levels of ICT use in their classroom (Karsenti, Villeneuve, & Goyer, 2006).
- h. The interrelationship between teacher attitudes toward computer and ICT classroom integration was discussed in section 2.1.3.
- i. An indirect interrelationship between teacher attitudes toward computers and supportive ICT use was reported by van Braak et al. (2004). Positive attitudes toward computers are also important since they lead to increased computer competency (Chai et al., 2009; Ertmer 2005).
- j. Supportive use of ICT can be considered as a significant predictor of classroom use of ICT (Cox, Preston, & Cox, 1999; Wozney et al., 2006). The former argues that teachers who are already regular users of ICT have confidence in using ICT in their teaching.

Although, clear theoretical and empirical grounding is available to develop the model, the existing research remains limited in two ways. First, what is missing is an overall study of the interplay between this set of internal teacher variables and how this affects the educational use of ICT. Secondly, a number of relationships have yet not been studied (dashed lines in the model): the interrelationship between the mediating variables perception of the ICT policy, attitudes toward ICT in education, and ICT motivation and the subsequent impact of types of computer use. From a theoretical point of view, these links can be drawn when we consider the interaction between cognitive processes (e.g., ICT policy perceptions) and motivational beliefs (ICT attitudes, ICT motivation) in e.g., the Expectancy-Value motivation model of Wigfield and Eccles (2000). Building on this model, perceptions and attitudes are considered to influence teacher motivation to use ICT. Both in a direct and indirect way these teacher variables are expected to affect both types of ICT use (supportive use and classroom use). Furthermore, the relationships between the variables are not studies in the context of Chinese primary education.

3. Method

A survey was set up to gather data about the internal teacher variables discussed above, and information about the actual ICT use in education. Participation was organized after obtaining consent from the school principal. A sample of 27 primary school principals was contacted, resulting in a total of 1000 questionnaires being sent to the individual teachers. In total, 820 teachers returned the questionnaire, reflecting an 82% response rate.

3.1. Characteristics of the participants

The 820 respondents taught in 11 different provinces throughout China. About 70% of the respondents were female. Average teacher age was 41.7 years (range 18-70 years), average years of teaching experience was 14.6 (range 0-51 years). As to the school setting, 430 (52.4%) teachers worked in urban schools, and 390 (47.6%) teachers worked in rural schools.

To control for potential impact of background variables, respondents were grouped into 3 categories depending on their years of teaching experience: teachers with less than 5 years of teaching experience (12.4%); teachers with 6-15 years of teaching experience (46.2%); and teachers with more than 16 years of teaching experience (41.3%). Considering the varying classroom size in Chinese primary schools, and the fact that this affects the adoption of specific teaching and learning approaches (see e.g., He, 2001), class size data was controlled for. Three class size categories were considered: small classes (< 30), medium classes (31-50), and large classes (51 >). 7% of the participants reported teaching small classes; 47% of them reported teaching medium classes; 40% of them reported teaching large classes. In addition, respondents were also categorized into groups depending on the subjects they teach. It is to be stressed, that in Chinese primary education and in clear contrast to many other countries, teaching responsibilities differ depending on the school subject: 63.3% of the teachers teach an academic (main) subject (i.e. Chinese, English, mathematics, science); 19.9% teach non-academic (subsidiary) subject (i.e. fine arts, music, physical education, information technology); 13.5% teach more than one subject; 27 teachers (3.3%) did not answer the subject-related question.

3.2. Research instruments

Several existing scales were reused in this study to obtain measures in relation to the large set of internal teacher variables and ICT use variables. In view of adaptation and translation, the recommended translation procedure "back-translation" was applied to develop Chinese instrument versions (Hambleton, 1992).

3.2.1. Teacher constructivist beliefs

Teachers' constructivist teaching beliefs were measured through the "Constructivist Teaching Beliefs" (CTB, 8 items) scale adapted from Woolley, Benjamin and Woolley (2004). The participants were asked to rate their level of agreement with a specific statement (from 1-strongly disagree to 5-strongly agree). Item example: "*Learners must get the opportunity to build up their own knowledge in a collaborative way or together with the teacher*". Internal consistency was determined by calculating Cronbach's alpha (α = .82). The single-factor solution is validated when carrying out a confirmatory factor analysis (CFA), resulting in a good model fit [χ^2 = 44.931 (df = 18; p < .001), *CFI* = .985, *GFI* = .987, *AGFI* = .973, *TLI* = .977, *RMSEA* = .043].

3.2.2. Perceptions of ICT-related school policy

Considering the potential role of teacher perceptions of an ICT school policy, the ICT School Policy Survey (ICTP) was developed. Six items focusing on policies, strategies and plans at school level in relation to ICT infrastructure, ICT use, and ICT teacher training and evaluation are presented to the teachers. Respondents were asked to rate the extent to which a particular item was – in their perception – available in their school. Item example: "*I am aware that the school has a policy about ICT literacy for teacher evaluation*". Exploratory factor analysis reflected a single factor solution, accounting for 55.7% of the variance. Cronbach's α coefficient of the ICTP was .89. The one-factor model was verified on the base of a confirmatory factor analysis (CFA), reflecting a good model fit [$\chi^2 = 20.897$ (df = 6; p < .01), CFI = .992,

GFI = .992, *AGFI* = .971, *TLI* = .981, *RMSEA* = .055].

3.2.3. Computer motivation

The Computer Motivation Scale (CMS) was newly developed and builds on eight items. Respondents were asked to rate each statement on a 5-point scale (from 1-strongly disagree to 5-strongly agree). Item example: "*I use ICT to prepare children for the information society*". Exploratory factor analysis confirmed a one factor solution accounting for 50.3% of the variance. Cronbach's α coefficient of "CMS" was .89. A CFA test of the one-factor model, resulted in optimal goodness-of-fit indexes [$\chi^2 = 35.999$ (df = 16; p < .01), CFI = .992, GFI = .989, AGFI = .975, TLI = .986, RMSEA = .039].

3.2.4. Computer attitudes

The 10-item Attitudes towards Computers in Education Scale (ACE), designed by van Braak (2001), was used in the present study. The ACE measures teachers' attitudes towards the effects of computer adoption in the classroom. The scale adopts a 5-point Likert scale (from 1-strongly disagree to 5-strongly agree). An example item is *"The efficiency of the learning process is increased through the use of ICT"*. The internal consistency of the scale was good ($\alpha = .85$). A CFA test resulted in a one-factor model solution, reflecting good goodness-of-fit indexes [$\chi^2 = 81.755$ (df = 30; p < .001), *CFI* = .982, *GFI* = .980, *AGFI* = .963, *TLI* = .973, *RMSEA* = .046].

3.2.5. Supportive ICT use

The Supportive ICT Use Scale (SIUS) was adapted from van Braak *et al.* (2004). Scale items build on eight 5-point Likert items (never, every term, monthly, weekly, daily). An example item is "*I use the computer for administration, e.g. reports, curriculum planning etc*". Internal consistency of the scale was .92. The one-factor solution was corroborated by a confirmatory factor analysis (CFA), reflecting a good model fit [$\chi^2 = 50.388$ (df = 18; p < .001), CFI = .988, GFI = .985, AGFI = .970, TLI = .972, *RMSEA* = .047].
3.2.6. Classroom ICT use

The ICT Class Use Scale was developed by van Braak *et al.* (2004). It consists of six 5-point Likert items (never, every term, monthly, weekly, daily). An example item is "*I use ICT for independent work/ individual learning*". Calculation of Cronbach's alpha reflected a high level of internal consistency ($\alpha = .92$). The one-factor model test resulted in optimal goodness-of-fit indexes [$\chi^2 = 14.199$ (df = 6; p < .05), CFI = .997, GFI = .994, AGFI = .980, TLI = .994, RMSEA = .041].

3.3. Data analysis

Next to descriptive data analysis, initially a correlation analysis procedure was adopted to study the nature of the associations between the different research variables. Subsequently, structural equation modelling (AMOS 7.0) (Arbuckle, 2006) was used to test the complex relationships among the variables. Building on the recommendations of Hu and Bentler (1999), the following goodness-of-fit indices will be reported: the comparative fit index (CFI), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA).

4. Results

4.1. Correlation analysis

A first picture of the nature of the relationships between the research variables can be derived from the results of the bivariate correlation analysis (Table 1). For the purpose of this study, the correlations of all variables with classroom use of ICT are of primary interest. The results suggest positive and significant interrelationships between classroom use of ICT and the other internal teacher variables. Also, significant correlations can be observed between the different internal teacher variables. None of the correlation values reflect problematic collinearity between the different constructs.

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	{1}	{2}	{3}	{4}	{5}
{1} ICT class use	-	-	-	-	-
{2} constructivist beliefs	.08*				
{3} perception on policies	.16**	.22**			
{4} ICT motivation	.31**	.34**	.19**		
{5} ICT attitudes in education	.19**	.40**	.14**	.54**	
<pre>{6} supportive ICT use</pre>	.51**	.13**	.19**	.19**	.16**

Table 1. Results of the bivariate correlation analysis (N= 820)

**Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The results suggest a strong interrelation between ICT classroom use and the internal teacher variables. ICT class use is strongly correlated with ICT motivation (r = .31, p < .01). Other important correlations are found between constructivist beliefs and ICT attitudes (r = .40, p < .01), between constructivist beliefs and ICT motivation (r = .34, p < .01), and between ICT motivation and ICT attitudes (r = .54, p < .01). In addition, ICT class use is strongly correlated with supportive ICT use (r = .51, p < .01).

4.2. Path modeling

In order to test the theoretical model - presented in Figure 1 - path analysis was applied to test the hypothetical links between internal teacher variables and the dependent variable. Of interest is the predictive power of these variables to explain the implementation of classroom use of ICT (adjusted R^2 coefficient). Secondly, we are interested in the direct and indirect effects of the predictor variables on the dependent variable. Direct effects on endogenous variables were calculated as standardized beta-weight (path coefficients or β 's). All the goodness-of-fit indices are in line with recommended benchmarks for acceptable fit [$\chi^2 = 11.670$ (df = 6; p > .05), CFI = .994, GFI = .995, AGFI = .983, TLI = .984, RMSEA = .034]. The total proportion of explained variance in computer use amounts to 35% ($\mathbb{R}^2 = .35$). Figure 2 shows the resulting path coefficients in the research model.



Figure 2 Results of the path analysis: estimates of direct and indirect effects on 'Classroom use of ICT''.

The figure includes estimates of both direct and indirect effects on ICT use in the classroom. In view of parsimony, only significant effects have been retained in the model. ICT classroom use is directly predicted by the supportive use of ICT ($\beta = .52$, p < .001) and ICT motivation ($\beta = .20$, p < .001). All other relationships in the model seem to be of an indirect nature, considering the role played by the mediating variables: perception of ICT policy, attitudes towards ICT in education, and ICT motivation.

The mediating role of the attitudes towards ICT in education is clear when we consider the relationship between constructivist beliefs and the attitudes towards ICT in education ($\beta = .40$, p < .001) and its consecutive impact on ICT motivation ($\beta = .47$, p < .001). The attitudes towards ICT in education play a comparable role in linking constructivist beliefs and ICT motivation to the supportive use of ICT ($\beta = .18$, p < .001). The mediating role of ICT motivation is clear when we see the path from constructivist beliefs via ICT motivation to classroom use of ICT ($\beta = .20$, p < .001). In a comparable, weaker, and somewhat complex way, does the perception of ICT policy mediate in the relationship between constructivist teaching beliefs and supportive ICT use ($\beta = .14$, p < .001). The perception of ICT policy also has an indirect effect on ICT classroom use mediating by ICT motivation ($\beta = .09$, p < .01).

5. Discussion

The key point of the theoretical base is that internal teacher variables are important to explain the adoption of particular teaching activities (Veen, 1993). Actual integration depends largely on teachers' personal feelings, skills and attitudes to technology in general (Mumtaz, 2000). The results of this study confirm that at the teacher level, there are many factors influencing the educational use of ICT. Before proceeding with a discussion of these results, we have to stress that in the context of this study, not all measures and indicators – though presenting a clear pattern – are very strong. As will be discussed in the limitation section, future research should replicate the present study to reach results that can be generalized, especially considering the specific cultural setting focused upon in the present article.

The relationships between the teacher related variables and the use of ICT, as reflected in the structural equation model, are largely confirmed in the present study. Our findings underpin the direct and indirect relationship between internal teacher variables and ICT use into classroom teaching in the context of Chinese education. ICT integration in the class also seems to be strongly related to and depend on the use of ICT as a supportive tool.

The findings demonstrate that classroom use of ICT in primary education is clearly linked to the degree of ICT use as a supportive tool. Stated in a different way, when a teacher is a regular ICT user to prepare his/her teaching and to develop a student management approach, he/she is more willing to integrate ICT in classroom activities. This finding is in accordance with the literature (Galanouli et al., 2004; Tan, Hu, Wong, & Wettasinghe, 2003; van Braak et al., 2004). We claim - in addition - that supportive ICT use can be enhanced by high ICT training, and as such enhance ICT integration into classroom teaching. This claim is supported by research of Cox et al. (1999) in which they found that the teachers who are already regular users of ICT have confidence in using ICT in classroom, perceiving it to be useful for their personal work and for their teaching and plan to extend ICT use further in the future. Because of the use for personal issues, ICT has become an evident part of the personal set of tools, instruments and solutions to deal with their work. From a theoretical point of view, we could even hypothesize that ICT has become part of teachers' professional identity as theorized by Rasku-Puttonen, Eteläpelto, Lehtonen, Nummila and Häkkinen (2004).

Our finding that internal teacher variables affect - either directly or indirectly - the types of ICT use in primary education, is consistent with earlier research. A body of research - in Western settings - has found a direct relationship between teachers' constructivist beliefs and ICT adoption (Becker & Ravitz, 1999; Higgins & Moseley, 2001; Mumtaz, 2004). Becker (2000) claims that teachers with a strong constructivist thinking are eager to adopt ICT in educational settings. However, in our results, only an indirect relationship was confirmed between teachers' constructivist beliefs and their ICT classroom integration. This can partly be explained by the Chinese educational tradition, based on the Confucius philosophy emphasizing "a group-based, teacher-dominated, and centrally organized pedagogical culture" (Zhang, 2007, p. 302). The finding of Chai et al. (2009) in Singaporean and Taiwanese settings also supports our results. They claim that the pre-service teachers' attitude towards ICT use is not associated with their epistemological and pedagogical beliefs.

Attitudes towards ICT in education also indirectly influence ICT classroom integration through mediation of ICT motivation and ICT supportive use. The added value of this finding is that the mediating role of these teacher attitudes is confirmed within a larger complex of other variables and processes that influence ICT use in Chinese primary education. This implies that if primary teachers adopt favorable attitudes towards ICT in education, they are more eager to integrate ICT into their teaching. This finding is in accordance with the findings of previous studies (e.g., van Braak et al. 2004). For instance, van Braak et al. (2004) observed that a favorable attitude towards computers did positively and directly affect the degree of computer use in class. Moseley & Higgins (1999) also stated that teachers who efficiently use technology in classroom teaching adopt positive attitudes towards ICT.

According to Hadley & Sheingold (1993) and Karsenti et al. (2006), teachers who are motivated and have a strong commitment to foster learning processes integrate technology more easily in their teaching. This is consistent with our findings that among the internal teacher variables, ICT

motivation seems to be the strongest predictor of ICT classroom use. In addition, teacher attitudes toward ICT use in education are strongly related to their ICT motivation being a predictor of ICT classroom use.

In our theoretical base, we also centered on the critical role of teacher perception of ICT school policies. Repeatedly, authors stress that an appropriate level of school planning is needed to enhance the successful integration of ICT in the classroom (Baylor & Ritchie, 2002; Tearle, 2003). Teachers are more willing to adopt new modes of ICT when the school aims underpin these modes of teaching and learning. Although a direct effect of these perceptions of the ICT school policy is not supported in our data model, evidence is found to consider teacher perception of an ICT school policy as a mediating variable in view of classroom use of ICT. This reiterates the findings of earlier studies set up in the Flemish (Belgium) educational context (Tondeur et al., 2008b). It also is in line with the conclusions of Hughes and Zachariah (2001) stating a successful ICT integration depends upon the development of a shared vision. It appears that teachers engaged in school ICT planning and policy will be more likely to apply ICT in an innovative way (Kozma, 2003). The development of ICT school plan and policy aiming at setting clear goals and defining the means to realize these goals is a crucial step towards ICT integration (Bryderup & Kowalski, 2002). The proposed interrelation between perceptions of ICT school policies and attitudes toward ICT use in education is not supported by the results.

As could be derived from Figure 2, classroom use of ICT is strongly influenced by the interrelated impact of internal teacher variables. Constructivist beliefs are linked to the perception of ICT policy, attitudes towards ICT in education, and ICT motivation. These findings confirm the theoretical statements of Bodur et al. (2000) and Davis et al. (1989). Although their position is not explicitly related to technology adoption, it is easy to understand that teacher beliefs are central to the complex of internal teacher variables (Ertmer, 2005; Pajares, 1992). Teachers' perception of the ICT policy is correlated to ICT motivation. This is in line with the finding of Hughes and Zachariah (2001) claiming that efficient ICT use relies on the development of a shared vision. Furthermore, the research confirms a strong interrelation between attitudes towards ICT in education and ICT motivation, which is supported by studies of Abdullah et al. (2006).

6. Conclusions

The present study did focus on the interrelated nature of internal teacher variables and ICT use in primary education. It is important to stress that the study was set up in the Chinese context. Our findings suggest that successful ICT integration is related to the direct and indirect effects of a number of internal teacher variables. The results underpin the importance to consider complex models to explain and predict educational ICT adoption and implementation.

A number of limitations have to be stressed. First, though a large sample from 11 different Chinese provinces was involved in the study, the sample was still too small to reflect the Chinese teacher population in a representatitive way. This affects the generalizability of the current findings. In this respect, the results cannot simply be generalized to other educational levels and other countries. Some variables were specifically measured in the context of primary education. We have to assume that ICT integration in education can be different outside the Chinese educational context. Secondly, the data in this study were obtained via survey instruments gathering self-report measures. Future studies could build on classroom observations and/or interviews with teachers. A next limitation of the study is the assumed independence of individuals as units of analysis (van Braak et al., 2004). School level factors (leadership, school culture, infrastructure etc.), social background factors (economic status, social culture etc.) and national level factors (national policy, curriculum innovation etc.) may also influence teachers' ICT integration. A multilevel analysis would be helpful to integrate the above levels. Lastly, the adoption of a longitudinal approach could be recommended to track changes in thinking processes and related teaching practices about educational ICT integration.

Despite the limitations, the current study contributes to the literature about ICT integration in a number of ways. Firstly, from a theoretical perspective, more insight has been obtained in the complex interplay of teacher variables affecting their adoption and implementation of educational ICT use. Secondly, ICT policy-makers need to realize that teachers shouldn't be excluded from school policy planning when considering future educational ICT use. Thus, teachers should be involved and be familiar with school level

policies. Lastly, considering the influence of the internal teacher variables on classroom use of ICT, teacher professional development should be aware of the direct and mediating impact of these variables. Especially, the essential role of teacher ICT motivation should be recognized.

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Chapter 5

Student teachers' thinking processes and ICT integration: predictors of prospective teaching behaviors with educational technology*

Abstract

Student teachers should be prepared to integrate information and communication technology (ICT) into their future teaching and learning practices. Despite the increased availability and support for ICT integration, relatively few teachers intend to integrate ICT into their teaching activities (e.g., Ertmer, 2005). The available research has thus far mainly focused on isolated teacher related variables to explain the weak level of ICT integration. Also, most of this research was set up in Western settings. The present study centers on the impact of Chinese student teachers' gender, constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy, and computer attitudes on their prospective ICT use. For this purpose, a survey was set up involving student teachers from four Normal Universities in China (N = 727). Results show that prospective ICT integration significantly correlates with all teacher related variables, except for gender. Building on the results of a path analysis model, prospective ICT integration could be directly predicted on the base of teacher thinking variables (constructivist teaching beliefs, teacher self-efficacy, computer self-efficacy and computer attitudes in education), and indirectly by the gender of the student teachers. Implications for teacher education and further research are discussed.

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1. Introduction and problem statement

The educational potential of ICT is stressed in a variety of ways (Godfrey, 2001; Becker, 2000; Cooper & Brna, 2002). For instance, Godfrey (2001) stresses the potential of ICT to present rich learning environments, allowing learners to adopt multiple perspectives on complex phenomena, to foster flexible knowledge construction in complex learning domains, and to cater for individual differences.

Since the introduction of educational technologies into classroom settings, teacher education has faced the challenge of improving in-service teacher education and preparing pre-service teachers for successful integration of educational technologies into their teaching and learning practices. In recent years, teacher education institutes have made efforts preparing pre-service teachers to integrate technology into their future teaching practices (e.g., Krueger, Hansen, & Smaldino, 2000). The related review of Kay (2006) summarizes key strategies to introduce technology to pre-service teachers: delivering a single technology course; offering mini-workshops; integrating technology in all courses; modeling how to use technology, etc. In the case of China, the government has also paid much attention to prepare student teachers to proficiently integrate ICT into their future teaching practice, by offering ICT courses at the teacher education institutes (Yuan, 2006). However, Marcinkiewicz (1993) has pointed out that 'full integration of computers into the educational system is a distant goal unless there is reconciliation between teachers and computers. To understand how to achieve integration, we need to study teachers and what makes them use computers' (p. 234). Furthermore, Oliver (1993) also argues that beginning teachers who received formal training in the use of ICT did not differ in their future use of computers for teaching from teachers not receiving such training. As Ertmer (2005) has documented, the decision regarding whether and how to use technologies for instruction rests on the shoulders of teachers. Despite the increased availability of ICT hardware (e.g., Ertmer, 1999), school related support for ICT integration (e.g., Baylor & Ritchie, 2002), and a larger consciousness of teachers about the importance of educational ICT use (e.g., Khine, 2001), relatively few teachers are willing to integrate ICT into their teaching activities (e.g., Becker, 2000; Hermans, Tondeur, van Braak, &

Valcke, 2008; Wang, Ertmer, & Newby, 2004). Other factors, next to technical knowledge and skills seem to contribute to teachers' successful technology integration. For instance, knowledge, beliefs, and attitudes of teachers were stressed by Cuban (1993), since they 'shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time.' (p. 256).

Ertmer (1999) has categorized two barriers hampering teachers' ICT implementation efforts: external (first-order) barriers and internal (second-order) barriers. External barriers include those that are often seen as the key obstacles, e.g., issues related to access to the technologies, training, and local support. When these barriers are present, it is almost impossible to talk about technology integration. Ertmer (1999) has documented that even if the first-order (external) barriers were resolved, "teachers do not automatically use technology to achieve advocated meaningful outcomes" (p.51). For this reason, we have to consider the second-order (internal barriers) stalling ICT integration by teachers. Internal barriers are related to a teacher's philosophy about teaching and learning; they are veiled and deeply rooted in daily practices (Ertmer 1999, 2005). Examples of these internal barriers are teacher beliefs, teacher self-efficacy and teacher attitudes. Empirical studies underpin the particular impact of (1) educational beliefs on the frequency and successful use of ICT in education (e.g., Higgins & Moseley, 2001; Hermans et al., 2008; Tondeur, van Keer, van Braak & Valcke, 2008); (2) teaching self efficacy (e.g., Wang et al., 2004); and (3) computer attitudes (e.g., van Braak, 2001). However, little is known about the combined effect of these processes and variables and about the direct and indirect impact of the complex interplay of teacher thinking processes (i.e., teacher beliefs, teacher efficacy, teacher attitudes toward ICT) on ICT integration.

2. Theoretical background

2.1. Cultural issues of research on teacher thinking and ICT use

Brennan, McFadden and Law (2001) emphasize that cultural differences need to be taken into account when studying instructional interventions. Understanding how culture influences instructional behavior and thinking processes is a key issue in the research about teacher education (Aguinis & Roth, 2003; Correa, Perry, Sims, Miller, & Fang, 2008). Different cultures generate different educational philosophies and beliefs. Based on this consensus, researchers have studied the appropriateness of transporting Western theories, constructs, and measuring instruments to be used in non-Western cultural contexts (Sinha, 1993; Lin & Gorrell, 2001). For instance, Lin and Gorrell (2001) explored pre-service teacher efficacy in Taiwan and clearly argued that teacher efficacy and beliefs are largely shaped by culturally and socially shared experiences and values. Chinese culture is regarded as part of Confucian-heritage and reflecting particularities of a collectivist society (Biggs, 1996; Ho, 1993). If we take teacher self-efficacy as an example, studies of Chinese teachers' personal efficacy might reflect the self-effacing tendency in personal (re)presentation in collectivistic societies as well as the strong emphasis on teacher responsibilities and teacher performance in the Chinese cultural context (Ho & Hau, 2004). Culture and context have also repeatedly been reported as obstacles to the integration of ICT in education (Chai, Hong, & Teo, 2009; Pelgrum, 2001; Tearle, 2003). For instance, Chai et al. (2009) argue that culture plays a mediating factor that influences how teachers relate their beliefs to ICT use.

2.2. Gender issues of research on teacher thinking and ICT use

Gender differences with regard to teacher beliefs, teacher self-efficacy and teacher attitudes toward computers represent an important research area. The literature on educational computing abounds with conflicting findings about the impact of gender (Teo, 2008). Since the introduction of computers, ICT related activities have been viewed as a "male domain" (Brosnan & Davidson, 1996; Panteli, Stack, & Ramsay, 1999). There is a significant body of

evidence supporting the notion that gender plays a role in actual computer integration. For instance, already more than twenty years ago, Loyd and Gressard (1986) found male teachers to be more confident and less anxious toward computers compared to their female counterparts. A study of Blackmore, Stanley, Coles, Hodgkinson, Taylor and Vaughan (1992) found similar findings-- males appear to be more positive in their attitudes toward computers than females. As predicted, a study of Liao (1998) in Chinese Taiwan showed that male teachers scored significantly higher than females. Significant differences between males and females were observed for technical ICT capabilities, and situational and longitudinal sustainability (Markauskaite, 2006). Since technologies have become a normal part of the workplace setting, a number of researchers argue that computing should no longer be regarded as a male domain (King, Bond, & Blandford, 2002; North & Noyes, 2002). This emphasizes the need to reconsider the potential impact of gender in the context of educational ICT use.

2.3. Teacher thinking processes

2.3.1. Teacher constructivist beliefs

Studying of constructivist beliefs in a Chinese cultural context, recent studies reported a strong emphasis on constructivist teaching and learning approaches and this both in-service teachers (Sang, Valcke, van Braak, Tondeur, 2009) and pre-service teachers (Yuan, 2006). This can be related to the strong emphasis on the adoption of constructivist teaching and learning approaches in Chinese teacher education, when considering the recent New Curriculum Reform (Yuan, 2006). This particular observation makes it more interesting to explore the influence of student teacher beliefs on their prospective ICT use in the Chinese setting.

A definition of Taylor, Fraser, and White (1994) about constructivist teaching refers to five critical components: scientific uncertainty, student negotiation, shared control, critical voice, and personal relevance. The theoretical and actual influences of teachers' constructivist educational beliefs on classroom activities with or without ICT integration have also been explored by a variety of researchers (Higgins & Moseley, 2001; Riel &

Becker, 2000; Tondeur, 2008). When considering the interrelationship between teacher beliefs and ICT integration, there is evidence that, teachers' constructivist beliefs about teaching and learning are a significant factor in determining patterns of classroom computer use by in-service teachers (Higgins & Moseley, 2001) and pre-service teachers (Wang et al., 2004). Honey and Moeller (1990) found that teachers with student-centered beliefs were successful at integrating technology, except in cases where anxiety about computers prevented them from appropriating the technology.

2.3.2. Teacher self-efficacy

Bandura (1997) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Self-efficacy beliefs were characterized as major mediators of behavior, and more importantly, behavioral change. Bandura stresses that self-efficacy is strongly related to particular types of action. Therefore, in the current context we focus on teacher self-efficacy.

Consistent with the general definition, Tschannen-Moran and Woolfolk Hoy (2001) defined teacher self-efficacy as 'a teacher's judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated' (p. 783). Teacher efficacy is related to teacher classroom behaviors. Teacher self-efficacy has been identified as a crucial variable that accounts for individual differences in teaching effectiveness. Teachers with a strong sense of self-efficacy are open to new ideas and more willing to experiment with new strategies, seek improved teaching methods, and experiment with instructional materials (Allinder, 1994; Guskey, 1988).

2.3.3. Teacher efficacy about computers

Self-efficacy regarding computers refers to a person's perceptions of and capabilities to apply computers (Compeau & Higgins, 1995). The latter authors state that computer self-efficacy is positively correlated with an individual's willingness to choose and participate in computer-related activities, expectations of success in such activities, and persistence or

effective coping behaviors when faced with computer-related difficulties. Teachers with higher levels of self-efficacy about computers used computers more often and experienced less computer-related anxiety. On the other hand, teachers with lower levels of self-efficacy about computers become more frustrated and more anxious, and hesitate to use computers when they encounter obstacles. Ropp (1999) uses the term "computer self-efficacy" to claim that while many teachers have positive attitudes to the use of educational technologies, they do not necessarily believe in their own abilities to use technology in a classroom. Compeau et al. (1999) conducted a longitudinal study to test the influence of computer self-efficacy beliefs, outcome expectations and anxiety on computer use. Their research findings point out that computer self-efficacy beliefs have a significant positive influence on computer use.

2.3.4. Computer attitudes

According to Ajzen and Fishbein (1977), attitudes refer to the ability to predict a person's behavior toward certain targets. An attitude is a predisposition to respond favorably or unfavorably to an object, person, or event (Ajzen, 1988).

The strong relationship of computer related attitudes and computer use in education has been emphasized in many studies (e.g., van Braak, 2001). Attitudes towards computers influence teachers' acceptance of the usefulness of technology, and also influence whether teachers integrate ICT into their classroom (Akbaba & Kurubacak, 1998; Clark, 2001). According to Myers and Halpin (2002), a major reason for studying teachers' attitudes is that it is a major predictor of future classroom computer use. Huang and Liaw (2005) also state that among the factors that affect the successful use of computers in the classroom, teachers' attitudes towards computers play a key role. Research of van Braak, Tondeur and Valcke (2004) also supported that class use of computers was strongly affected by attitudes toward computers in education. Khine (2001) studied 184 pre-service teachers and found a significant relationship between computer attitudes and its use in the institution. Taking the importance of attitudes toward computers into consideration, it is also important to understand what influences pre-service

teachers' attitudes towards computers (Fisher, 2000). These attitudes are related to other internal and external variables.

2.4. Towards an integrated theoretical perspective

Adopting a holistic perspective, Mueller, Wood, Willoughby, Ross and Specht (2008) conclude that seven interacting variables influence computer technology integration among primary school teachers: positive experiences with computers; teachers' comfort with computers; specific beliefs related to the use of computers as an instructional tool; number of workshops attended; the challenge subscale of the work preference inventory; assistance from others; and teaching efficacy. Using the Technology Acceptance Model (TAM) as a research framework, a similar research has been carried out with pre-service teachers in an Asian setting (Teo, Lee, Chai and Wong, in press). The study found that the interaction between the key determinants, perceived usefulness and perceived ease of use, and attitudes toward computer use influenced behavioral intention. The latter studies clearly exemplify the need to adopt a more holistic approach to describe and explain ICT integration in the context of the present study. Therefore, figure 1 represents in a graphical way the integration of the theoretical and empirical base into one model. A number of additional arrows have been added that are explained below.



Figure 1 integrated model of the impact of gender and student teacher thinking processes on prospective classroom ICT use.

There is evidence that gender is related to computer attitudes (Wu & Mogan, 1989), computer self-efficacy (Potosky, 2002), and the adoption of constructivist beliefs of teachers (e.g., Beck, Czerniak, & Lumpe, 2000; Cornelius-White, 2007). For instance, Beck et al. (2000) found a significant relationship between teachers' gender and their constructivist beliefs in favor of female teachers. It is suggests that females may have a stronger sense of efficacy than males due to the fact that the teaching profession predominantly is a female profession (Kalaian & Freeman, 1994). Nevetheless, considering the dynamic approach suggested above by North & Noyes (2002). We have to reconsider the potential impact and whether gender differences still play a role in a workplace setting where ICT has become a common provision.

It is argued that student teachers' constructivist beliefs and pedagogical philosophy influence their teaching efficacy (Sung, 2007) and self-efficacy on computers (Potosky, 2002). In the literature, different authors point at the impact of constructivist beliefs on educational computer attitudes (Ertmer, 2005; Chai et al., 2009). Ertmer (2005) has documented that teachers adopting strong constructivist educational beliefs are more likely to use ICT in their classroom practice. However, as mentioned by Chai et al. (2009), how pedagogical beliefs are related to the teachers' attitudes toward computers is a less researched area. Therefore, the relationship between constructivist beliefs and teachers' attitudes toward computers needs to be examined. Furthermore, teachers' teaching efficacy also is related to their attitudes toward efficacy on computers (Olivier & Shapiro, 1993; Wang et al., 2004).

3. Purpose of the study

Most previous studies have centered on the influence of one single or two internal/external teacher thinking process variables. Therefore, little is known about direct and indirect impact of the variables and processes discussed above, when we focus on their complex interplay to explain classroom ICT integration. Earlier studies tend to ignore the systemic nature of ICT integration. The main objective of the present study is as a consequence to examine the effect of student teachers' gender and their thinking processes (constructivist teaching beliefs, teacher self-efficacy, computer self-efficacy, attitudes toward computers in education) on prospective ICT integration in education. This guiding research question can be stated as follows: To what extent do student teachers' thinking processes (constructivist teaching beliefs, teaching efficacy, computer self-efficacy, attitudes toward computer in education) and/or gender influence their interests to integrate ICT into future teaching practices?

4. Method

In view of the purpose of the study, a survey instrument was designed to gather information from student teachers about the large set of variables. Next to general background questions, five existing scales were used as subsection of the research instrument.

4.1. Sample Characteristics

A survey was carried out at the end of the first semester, school year 2008-2009. A total number of 727 respondents, representing a response rate of 97%, completed the survey. Participants were university students majoring in primary education from four teacher education universities in three cities of China (Beijing, Changsha, and Hangzhou). The universities were selected based on the international corporation with a Belgian university. Most of the respondents were juniors (246, 34%). 128 (18%) of respondents were freshmen. A further 154 (21%) were sophomores; the remainder 199 (27%) were senior students. 123 (17%) of them were majoring in Chinese, 80 (11%) in mathematics, 55 (8%) in English, 100 (14%) in science, 51 (7%) in educational technology, 33 (3%) in arts and 286 (40%) in "other" (187 of them responded 'primary education' or elementary education). Most (351, 48%) of the respondents had 1-5 years of personal computer experience. 326 (45%) of them had more than 6 years of computer experience. 50 (7%) of the respondents reported that they had less than 1 year of computer experience. Looking at the gender characteristics of the sample, 93.5% of the respondents were female. This mirrors the predominance of female student teachers (81.1%) in the Chinese student teacher population (Ministry of Education,

2008). Consequently, we have to study the impact of the gender variable on our object of study: prospective ICT use.

With permissions of faculty leaders, a paper and pencil questionnaire was distributed among the student teachers. All participants were asked to fill in this questionnaire after they attended a regular course in their class.

4.2. Instruments

Five existing scales were utilized in our study. The recommended translation procedure "back-translation" (Brislin, 1986) was applied to the development of the instrument. The instruments were translated from English into Chinese; a different translator translated that version back into English, and then an English speaker compared the original instruments with the back-translation (see Behling and Law, 2000). Considering the fact that original scales were translated and applied in a very different educational context, we studied in detail the reliability and validity of each individual instrument.

4.2.1. Constructivist teaching beliefs

Student teachers' constructivist teaching beliefs were measured through the "constructivist teaching beliefs" (CTB) scale (see Appendix A) of Woolley, Benjamin and Woolley (2004). The participants were asked to rate their level of agreement with a specific statement (from 1- strongly disagree to 5-strongly agree). Internal consistency was measured with Cronbach's alpha ($\alpha = .81$). A one-factor model was confirmed after carrying out a confirmatory factor analysis (CFA), reflecting a good model fit (χ 2/df < 3, AGFI = .967, RMSEA = .052).

4.2.2. Teacher self-efficacy

Student teachers' teaching self-efficacy was determined on the base of the "Ohio State teacher efficacy scale" (OSTES, see Appendix B) Tschannen-Moran & Woolfolk Hoy, 2001). The OSTES contains 12 items. The OSTES is a 5-point Likert scale (from 1- strongly disagree to 5- strongly agree). For student teachers, only one construct was suggested by the authors,

since "subscale scores may have little meaning for prospective teachers who have yet to assume real teaching responsibilities" (Tschannen-Moran & Woolfolk Hoy, 2001). Principal-axis factoring revealed one factor, using the response of the student teachers. The reliability of α = .84 was acceptable compared to the original instrument (α = .90). A CFA test of a one-factor model resulted in acceptable goodness-of-fit indexes (χ 2/df < 4, AGFI = .931, RMSEA = .064).

4.2.3. Computer self-efficacy

The Computer Self-efficacy Scale (CSE, 14 items) was utilized to explore student teachers' self-efficacy about computers (see Appendix C). It was derived from The Microcomputer Utilization in Teaching Efficacy Beliefs Instrument (MUTEBI) (Enochs, Riggs, & Ellis, 1993). Two items from CSE were suggested to be removed on the base of an exploratory factor analysis, due to low structure coefficients loading below .30. We utilized a 5-point Likert scale format (from 1- strongly disagree to 5- strongly agree). Negatively worded items were scored in the opposite direction with strongly agree receiving 1. Cronbach's alpha was calculated to determine internal consistency ($\alpha = .90$). Testing the one-factor model (CFA), resulted in good fit indexes (χ 2/df < 3, AGFI = .962, RMSEA = .050).

4.2.4. Computer attitudes

The 8-item Attitudes toward Computers in Education Scale (ACE, see Appendix D), designed and by van Braak (2001) was used in the present study. The ACE measures teachers' attitudes toward the effects of computer adoption in the classroom. The scale uses 5-point Likert scale format (from 1- strongly disagree to 5- strongly agree). The internal consistency was good ($\alpha = .81$). A CFA test of a one-factor model, resulted in good goodness-of-fit indexes (χ 2/df < 4, AGFI = .957, RMSEA = .061).

4.2.5. Prospective computer use

Teacher education programs in China require student teachers to be involved in teaching practices for 6-8 weeks during their 4-year academic career (Chen, 2004). Since this offers limited opportunities for student teachers to actually experience classroom computer use, we decided to examine student teachers' reported prospective educational computer use as a dependent measure. The Prospective Computer Use Scale (PCU, see Appendix E) was used that was derived from the "Computer Use Scale" of van Braak et al. (2004). The Likert items of "computer use frequency" were changed into "computer interest" (1 = not at all interested, 2 = somehow interested, 3 = interested, 4 = very interested). Cronbach's alpha reflected a good level of internal consistency (α = .87). The one-factor model test resulted in acceptable goodness-of-fit indexes (χ 2/df < 4, AGFI = .942, RMSEA = .064).

4.3. Data analysis

Bivariate correlation analysis procedures were applied to explore the interrelations between the different research variables. In order to be able to consider the complex relationships and direct/indirect effects, path modeling was applied, using AMOS 7.0 (Arbuckle, 2006).

5. Results

5.1. Descriptive results

The mean scores and standard deviations of CTB, OSTES, CSE, ACE and PCU are summarized in Table 1. All mean scores are >3.0, ranging from 3.09 to 4.07. This indicates an overall positive response to the scales.

Subscale	Number of items	Mean	SD	alpha
CTB	10	4.07	.53	.81
OSTES	12	3.67	.47	.84
CSE	9	3.92	.79	.90
ACE	8	3.49	.76	.81
PCU	10	3.09	.53	.87

Table 1. Descriptive statistics and reliability coefficient for each subscale

5.2. Correlation analysis

A first picture of the nature of the relationships between the research variables can be derived from the results of the bivariate correlation analysis (Table 2). For the purpose of this study, the correlations with prospective computer use are of primary interest. The results suggest high interrelationships among computer use variable and the set of teacher thinking process variables. Furthermore, teacher thinking process variables seem to be significantly to one another. For instance, constructivist teaching is significantly related to all other variables. Teaching efficacy is also related to all related other variables, except for gender.

Table 2. Correlations coefficients for pairs of variables (N= 727)

	{1}	{2}	{3}	{4}	{5}
{1}computer use					
{2}gender	.02				
{3}constructivist teaching	.42**	.12**			
{4}Teaching efficacy	.35**	01	.51**		
{5}computer self efficacy	.31**	.02	.19**	.20**	
{6}computer attitudes in education	.46**	03	.35**	.38**	.02

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

5.3. Path modelling

Taking computer use as endogenous variable, gender, constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy and computer attitudes toward education as exogenous variables, a path model was tested. A first goal was to estimate the predictive power of the set of independent variables on prospective computer use. Secondly, the strength of the direct and indirect effects of the predictor variables on the dependent variable was assessed. All the indices are in line with recommended benchmarks for acceptable fit (*GFI* > .9, *RMSEA* < .04, X^2/df < 3). The total explained variance in prospective computer use amounts to 34% (R² = .34). Table 3 summarizes the fit indices when testing the proposed research model.

Fit Index	Recommended	Proposed
	Level of Fit	Research Model
χ2	n.s at p < .05	8.353 (p = .079)
χ2 / df	< 5	2.088
AGFI	> .90	.980
NFI	> .90	.988
CFI	> .90	.994
RMSEA	< .05	.039

Table 3. Summary of goodness-of-fit indices

Figure 2 shows the resulting path coefficients in the research model. The figure includes both direct and indirect effects on prospective computer use (represented by path coefficients or β 's). Each teacher thinking process variable has a direct effect on prospective computer use: constructivist teaching beliefs ($\beta = .23$), teaching efficacy ($\beta = .06$), attitudes toward computer in education ($\beta = .36$), computer self-efficacy ($\beta = .23$). Furthermore, gender has only an indirect effect on prospective computer use, and affects constructivist teaching beliefs ($\beta = .13$), in a direct way.



Figure 2 Path coefficients of the research model.

6. Discussion

Research about educational ICT integration has raised questions about cultural influences on ICT use (Holmes, 1998; Li & Kirkup, 2008). By arguing that Chinese university students reflect a higher confidence levels in programming and systems technology than their British counterparts, Li, Kirkup and Hodgson (2001) exemplify the interaction between culture and computer and Internet technology. It is therefore not a complete surprise that the present study, building on instruments developed in a Western settings, shows certain consistencies and inconsistencies when applied to the Chinese pre-service teacher sample.

6.1. Gender differences of teacher thinking processes and ICT integration

As discussed earlier, a number of studies report gender differences in relation to computer attitudes, computer self-efficacy, and the adoption of constructivist beliefs of teachers. In the present study, gender is only significantly correlated with constructivist beliefs. It is interesting to observe that gender plays no further - direct - significant role. This suggests that the impact of gender fades when mediating variables are taken into account. Also other researchers have reported the lesser impact of gender when the interaction between a variety of variables is taken into account; e.g., teacher efficacy, computer efficacy, and computer attitudes of pre-service teachers (Gencer & Cakiroglu, 2007; Liao, 1998; Riggs, 1991).

As reviewed earlier, computer is a "male domain". However, given the fact that all the Chinese teacher candidates have to be prepared integrating ICT into their future teaching activities, it is not surprising that the gender of student teachers has no direct effect on their prospective ICT integration. This finding is in line with previous findings in Western settings and Eastern settings. For instance, Shapka and Ferrari (2003) did not observe any gender differences in computer related attitudes of teacher candidates in Canada. Yuen and Ma (2002) who studied one hundred and eighty-six pre-service teachers in Hong Kong also found no significant gender differences in undergraduate trainee teachers. For instance, Hong and Koh (2002) found no significant differences between male and female teachers in overall computer anxiety levels and overall attitudes. The results can also refer to the increased overall acceptance of technology in the workplace as suggested by other authors (e.g., King, Bond, & Blandford, 2002)

6.2. Teacher thinking processes and prospective ICT integration

Our study produced empirical evidence to argue that student teachers (a) holding stronger constructivist teaching beliefs, (b) strong teaching efficacy and (c) computer self-efficacy, and (d) more favorable attitudes toward computer in education, are more interested to integrate computers into their

future teaching practice. Among the teacher thinking variables, attitudes toward computer use in education seem to be the strongest predictor of prospective computer use. This finding is in accordance with previous studies involving in-service teachers (e.g., Wu & Morgan, 1989; van Braak et al., 2004) and with pre-service teachers (e.g., Khine, 2001; Lin, 2008).

Constructivist teaching beliefs of student teachers strongly influence their prospective computer use in a direct and indirect way (mediated by teaching efficacy, computer self-efficacy and attitudes toward computer in education), indicating that student teachers with higher constructivist teaching beliefs are more inclined to integrate technologies into their future teaching. This finding is in line with previous studies that state constructivist beliefs consistently predict student teachers' computer-related behaviors in Western settings (e.g., Becker & Ravitz, 1999; Higgins & Moseley, 2001) and in Eastern settings (e.g., Lin, 2008).

As mentioned earlier, teaching self-efficacy is related to teacher behavior in the classroom. Teachers' self-efficacy has also repeatedly been reported to be a major variable to understand the frequency and success of computer use in education (Albion, 1999; Oliver & Shapiro, 1993), even in Singapore and Malaysia in Asian cultural contexts (Teo, in press). This is strongly supported by our study. Teacher self-efficacy predicts – directly – student teachers' prospective computer use in education, and indirectly via its impact on the mediating variables attitudes towards computers in education and computer self-efficacy. Computer self-efficacy is also a strong predictor of student teachers' prospective computer use. This finding is in line with other studies that emphasize the importance of computer self-efficacy on teachers' computer-related behaviors (e.g., Compeau et al., 1999). This implies that the more confident student teachers are about their capacity to teach or/and to use computers in education, the more likely they are to be interested in teaching with computers. This is consistent with the basic hypothesis of Bandura (1977): people scoring high on both outcome expectancy and self-efficacy would act in an assured, decided manner.

7. Implications, limitations, and conclusions

7.1. Implications for the innovation of teacher preparation

According to our findings, ICT integration is influenced by the complex of student teachers' constructivist teaching beliefs, teaching self-efficacy, computer attitudes in education and their computer self-efficacy. The latter implies that teacher education should reconsider its training approaches. Teacher education should be carried out in constructivist learning environments and provide student teachers with a conducive and non-threatening environment to experience success in using the computers. This will allow them to gain competence and confidence in using computers for teaching and learning (Teo, 2008). In addition, Albion (1999) stresses the need for real life experiences in classroom settings. Wang et al. (2004) claim that real life experiences might help to attain vicarious learning experiences increasing student teachers' self-efficacy for technology integration. At the same time, these real life experiences are expected to influence the interrelated set of teacher thoughts (e.g., teaching beliefs, self-efficacy, and attitudes) in relation to prospective educational use of technology.

7.2. Limitations and directions for further research

It should be noted that this study has a number of limitations. The quantitative research methodology is mainly based on self-report measures. Future studies could build on classroom observation of internship activities and/or interviews with student teachers. Furthermore, longitudinal studies are recommended that might be helpful to track changes in thinking processes and related teaching practices with and without educational technologies. Since the potential of ICT can differ according to specific curriculum goals and specific knowledge domains, more attention should be paid in future studies to the nature of the curriculum taught with or without ICT. As Lundeberg, Bergland and Klyczek (2003) suggested, we can additionally carry out action research to develop pre-service teachers' confidence, knowledge and beliefs about technology.

It should also be noted that the findings of the present study have to be

interpreted in a careful way since a convenience sampling procedure was applied. Based on a bilateral collaboration between Ghent University and four Chinese Normal universities, all student-teachers from these particular institutions were involved in the study. The selection of these four institutions can have caused uncontrolled bias.

7.3. Conclusion

Our study has provided insight into the interrelated nature of student teachers' thinking processes and gender on the potential level of ICT integration in a Chinese context. The findings suggest that successful ICT integration is clearly related to the thinking processes of classroom teachers, such as teacher beliefs, teacher efficacies, and teacher attitudes toward ICT. The results underpin the importance of an integrated and concurrent understanding of teachers' thinking processes. The study also suggests that in order to improve the innovation of classroom activities, teachers' thinking processes should be challenged.

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APPENDICES

APPENDIX A

Constructivist Belief Scale	Factor score (B)
1. I make it a priority in my classroom to give students time to work together when I am not directing them	.64
2. I involve students in evaluating their own work and setting	.63
3. I believe that expanding on students' ideas is an effective way	.54
to build my curriculum 4. I prefer to cluster students' desks or use tables so they can	.52
work together	40
and conferences	.49
6. I often create thematic units based on the students' interests and ideas	.49
7. I invite students to create many of my bulletin boards	.43
χ2/df	< 3
AGFI	.967
RMSEA	.052

APPENDIX B

Teacher Self-efficacy Scale	Factor
	score (β)
1. How much can you do to motivate students who show low interest in schoolwork?	.65
2. How much can you do to control disruptive behavior in the classroom?	.60
 How much can you do to calm a student who is disruptive or noisy? 	.59
4. To what extent can you use a variety of assessment strategies?	.56
5. To what extent can you craft good questions for your students?	.55
6. How much can you do to get children to follow classroom	.54
7. How much can you do to get students to believe they can do well in schoolwork?	.54
8. How well can you establish a classroom management system with each group of students?	.53
9. How much can you assist families in helping their children do well in school?	.52
10. How well can you implement alternative strategies in your classroom?	.52
11. How much can you do to help your students value learning?	.51
12. To what extent can you provide an alternative explanation or example when students are confused?	.49
χ2/df	< 4
AGFI	.931
RMSEA	.064

APPENDIX C

Teacher Computer Efficacy Scale	Factor
	score (β)
1. When students have difficulty with the computer, I am usually at a loss as to how to help them	.77
2. I wonder if I have the necessary skills to use the computer for instruction	.74
3. I generally employ the computer in my classroom ineffectively	.73
4. Whenever I can, I avoid using computers in my classroom	.68
5. I am not very effective in monitoring students' computer use in my classroom	.68
6. Even when I try very hard, I do not use the computer as well as I do other instructional resources	.68
7. I do not know what to do to turn students on to computers	.68
8. I find it difficult to explain to students how to use the computer	.65
9. Given a choice, I would not invite the principal to evaluate my computer-based instruction	.60
χ2/df	< 3
AGFI	.962
RMSEA	.05

APPENDIX D

Attitudes toward Computers in Education Scale	Factor
	score (β
1. The computer provides opportunity for improving the	.75
learning performance	
2. The efficiency of the learning process is increased through the use of computers	.72
3. The computer used as a learning tool, increases student motivation	.65
 4. Students with learning difficulties can strongly benefit from the didactic possibilities which the use of computers entail 	.64
5. The computer increases the level of creativity of students	.60
6. The use of computer helps students to achieve better text writing	.51
7. Computer knowledge and practical experience should be more integrated in the curriculum	.48
8. Computers can help the teacher to apply differentiation	.37
among the students	
χ2/df	< 4
AGFI	.957
RMSEA	.061

APPENDIX E

Computer Use Scale	Factor score (β)
1. I would use the computer as a tool for demonstration working with existing presentations, or those someone else has made for me	.70
2. I would use the computer as a tool to teach new subject knowledge, i.e. the pupils acquire knowledge directly from the computer	.68
3. I would encourage pupils in class to search for relevant information on the Internet	.67
4. I would use educational software with my pupils for learning subject knowledge through drill and practice	.64
5. I would teach pupils to consider the implications and opportunities of computer use	.62
6. I would use the computer as a tool for demonstration working with presentations I have made myself (e.g., PowerPoint)	.61
7. I would ask pupils to undertake tasks or follow up classwork at home on the computer	.60
8. I would use the computer to assist with differentiation or implementing individual learning plans	.58
9. I would I encourage pupils to work collaboratively when using a computer	.56
10. I would use e-mail to communicate with pupils out of	.52
school (or class time)	
χ2/df	< 4
AGFI	.942
RMSEA	.064

Chapter 6

Challenging science teachers' beliefs and practices through a video case-based intervention in Chinese primary schools*

Abstract

The use of multimedia cases provides an essential avenue for teacher development. By viewing, analyzing, reflecting on video cases, teachers can investigate the visible teaching practice and have reflection on it. The present study aims at challenging primary science teachers' educational beliefs, science teaching efficacy beliefs, and teaching practices, through a multimedia case-based intervention program in a Chinese educational setting. Forty six in-service teachers were involved in this study (experimental group = 23, control group = 23). Pre- and post-questionnaire surveys were administered to examine possible changes in participants' educational beliefs and science teaching efficacy beliefs. Video data was gathered through classroom observations of 9 participants from the experimental group and 9 participants from the control group. The results of ANCOVA analysis indicate that the reported beliefs of teachers who participated in the intervention differed significantly from the pretest. More specifically, teachers in the experimental groups reported less traditional and more constructivist beliefs and personal science teaching efficacy beliefs after the intervention. Video data shows that teaching practice was changed into a more constructivist dimension in terms of practical activities and student ICT use.

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1. Introduction

Video materials have been used as learning tools for teacher development since the early 1970s (Ward, 1970). At that time, publications primarily reported results from microteaching studies. Santagata (2009) reviewed that teachers learned from watching brief clips of classroom instruction that featured specific instructional techniques to be modelled (e.g., Limbacher, 1971; Ward, 1970). Afterwards, the reflective use of videotaped cases of classroom activities has been proved as an effective tool to promote teachers' practices (Finn, 2002; Sherin & van Es, 2005). Multimedia cases provide new opportunities for teacher development and an innovative pedagogical method for teacher education programs (Kim & Hannafin, 2008; Moreno & Ortegano-Layne, 2008). By viewing, analyzing, and reflecting on video cases together with teachers, teacher educators can help teachers investigate the visible practice of teaching and raise questions about the associated thinking and practice of teachers (Kim & Hannafin, 2008). Furthermore, video-based materials can help teachers notice and recall events that are not easily observed during the act of teaching (Frederiksen, Sipusic, Sherin & Wolfe, 1998).

Although video-case based professional development models have been proved to be effective in setting constructivist teaching environments, and enhancing teachers' ability of technology integration into teaching (Yamagata-Lynch, 2003; Yocam, 1996; van den Berg, Wallace, & Pedretti, 2008), very little research has examined effects of such models in a Chinese educational setting. The reason was mainly explained by insufficiency of teacher education and development programs in China (Wang & Liu, 2007). The main purpose of the present study was to challenge primary school science teachers' educational beliefs, science teaching efficacy beliefs and teaching practice through a video case-based professional development project entitled Video-based Teacher Development Project (VTDP), in a Chinese educational setting.

2. Theoretical perspective

In this background section, we first review the available research about teacher beliefs and teacher development. Based on the review, the intervention program VTDP is presented.

2.1. Teacher beliefs: defining and challenging

Teacher beliefs present as such a window to look at teacher decision-making, practices, and in some cases, the efficacy of instructional practices (Nespor, 1987; Pajares, 1992). More than two decades ago, Clark & Peterson (1986) argued that teacher behavior is substantially influenced and even determined by teacher beliefs, because teachers' beliefs represent the rich store of knowledge of teachers affecting their instructional planning and practices. According to Richardson (1997), teacher beliefs are largely congruent with their classroom practices and may act as filters that bias teachers' educational practice.

Generally, two broad categories of teachers' educational beliefs have been recognized repeatedly in the literature (Hermans, van Braak, & Van Keer, 2008; Kerlinger & Kaya, 1959; Woolley, Benjamin, & Woolley, 2004). Woolley et al. (2004) distinguish between "traditional teaching" beliefs that mirror teacher-centered approaches to teaching and learning versus "constructivist teaching" beliefs of elementary teachers that mirror student-centered approaches. The traditional beliefs are also labeled as teacher-centred (Bramald, Hardman & Leat, 1995) or transmissive beliefs (Hermans et al., 2008). These beliefs are adopted by teachers who concentrate on knowledge transmission, devise well-organized teaching plans, and adopt step-by-step teaching methods. On the other hand, "constructivist beliefs" are also referred to as "supporting student learning" (Samuelowicz & Bain, 1992), a "constructivist philosophy of learning" (Bramald et al., 1995), "progressive beliefs" (Kerlinger & Kaya, 1959), or "student-centred approaches" (Bramald et al., 1995). These beliefs are adopted by teachers who focus on constructive, progressive teaching and learning processes.

Research on teacher efficacy beliefs is grounded in Bandura's social cognitive theory and his construct of self-efficacy (Bandura, 1977). By

referring to the extent to which teachers believe they have the capability to positively affect student achievement, teacher efficacy beliefs may account for individual differences in teacher effectiveness (e.g., Berman & McLaughlin, 1977; Bleicher & Lindgren, 2005). As Riggs and Enochs (1990) stated, within the literature about teacher efficacy beliefs, two dimensions "Teaching Efficacy (Outcome Expectancy)" and "Personal Teaching Efficacy (Self-Efficacy)", have been defined and utilized. They developed the Science Teaching Efficacy Beliefs Instrument (STEBI), which consists of two dimensions called Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). PSTE have been positively related to teaching performance (Riggs & Enochs, 1990). Teachers' scoring low on PSTE can be reported as spending less time teaching science, being rated weak by observers, and using more text-based, rather than activity-based instruction (Riggs, 1995). Teachers who report low scores on STOE can be rated as less effective in science teaching, since they may often use more text-based teaching strategies (Riggs, 1995).

A consensus exists among researchers stating that beliefs are often deep-rooted and persistent (Calderhead & Robson, 1991) and changes in teacher beliefs are not evident (Kagan, 1992; Pajares, 1992), because it involves the process of challenging the core values held by teachers regarding the purpose of education (Richardson & Placier, 2001). However, researchers and teacher educators have also found evidence to state that teacher beliefs can be challenged by some well-designed interventions (Korthagen, & Kessels, 1999; Luft, 2001; Wang, Ertmer, & Newby, 2004; Wingfield, Freeman, & Ramsey, 2000). For instance, Wang et al. (2004) argue that vicarious learning experiences and goal setting influence preservice teachers' self-efficacy beliefs for integrating technology into the classroom. Luft (2001) reports influences of an inquiry-based demonstration classroom in-service program on science teachers' beliefs.

2.2. Teacher development

Teacher development can be described in terms of learning, change, improvement, implementation of something new, cognitive and affective change (Richardson & Placier, 2001). In Cuban's research, teacher

development was described as first-order change - minor changes in the organization of the classroom, curriculum etc. - or they may be second-order changes that embody different ways of thinking and teaching (Cuban, 1988). These changes may be prompted or supported by discussions with other teachers, a workshop etc. (e.g., Richardson & Placier, 2001). Korthagen (2004) has summarized teacher development as different levels, such as behaviour, competencies, beliefs and identity. "If a teacher believes that attention to pupils' feelings is just 'soft' and unnecessary, he or she will probably not develop the competency to show empathic understanding" (Korthagen, 2004, p81). Every level of development has been related with a specific kind of pedagogical or curricular intervention. For instance, conceptual-change approaches are proper to change teacher beliefs. Structured reflection is also important in promoting sound professional behaviour of teachers (Korthagen & Lagerwerf, 1996). Studies have shown links between teacher development program and change of teacher beliefs and practice (Hofer & Pintrich, 1997). As teachers become more competent in dealing with the demands of teaching, they progress into more ambitious forms of teaching if constructivist ideas are introduced during a teacher development program (Cady, Meier, & Lubinski, 2006).

The reflective use of video cases in teacher learning has been used as a way to bridge the perceived gap between theory and practice and augment the opportunities to observe and interact on real classroom activities (Santagata, 2009; Sherin & van Es, 2005). Generally, video cases have been used to help teachers' teaching and learning in three ways. First, by providing vast amounts of rich detail using images and sound that capture the immediacy of a real classroom, video cases can be used to analyze students' learning analyses that teachers would not be able to handle while teaching a lesson (LeFevre, 2004; Sherin & van Es, 2005). Second, as Perry and Talley (2001) noted, situating the video case studies in real-world classroom experiences and events - authentic activities - can be a powerful tool for bringing the complexities of the classroom into focus and supporting teachers' learning. Finally, reflections on videotaped lessons have great potential for improving teachers' professional development (Ball & Cohen, 1999). Korthagen and Kessels (1999) also address the importance of reflection in their "level approach" to teacher learning, in which reflection or critical thinking was

emphasized to influence schematization and theory formation. Teachers might reflect on the action appearing in the video and reframe their thinking through different levels of learning (Korthagen & Kessels, 1999; van den Berg et al., 2008).

According to the review of Richardson and Placier (2001), in the naturalistic change process, changes in beliefs were preceding changes in practice (e.g., Bullough & Knowles, 1991) or that the process of changing beliefs and practices is interactive or synergistic (e.g., Peterman, 1993). Richardson (1990) suggests that empirical premises are considered as warranted practice, which, in combination with teachers' practical knowledge, become the content of reflective teacher change. A number of studies have examined the changes of science teachers' practice. For example, Luft (2001) argues that "learning how to implement inquiry instruction requires that science teachers participate in professional development programs that have been developed with attention to the research surrounding in-service teacher education" (p520). Science teachers need to be engaged in an experience that simulates the advocated methodology (O'Brien, 1992). Changes of teaching practice may rely on reflections on practice and experiences, because reflection on practice enables practitioners to assess, understand and learn through their experiences (Schön, 1987).

2.3. The intervention

The aim of this study was to examine the impact of the video-case-based teacher development program on teachers' educational beliefs, science teaching efficacy beliefs and teaching practices. The central goals of the intervention were 1) to support teachers' efforts to design constructivist classroom environments, and 2) to reflect on one's own teaching or on observations of mentor teachers and to develop effective instruction. Based on the framework of "Learning Cycle" (Kolb, 1981), the video-based intervention was conducted in four stages as shown in Figure 1.



Figure 1 The four stage intervention cycle (based on Kolb, 1981).

According to Kolb (1981), the cycle comprises four different stages of learning from experience and can be entered at any point but all stages must be followed in sequence for successful learning to take place. The core in this cycle is experience, which serves as the main driving force in learning, as knowledge is constructed through the transformative reflection on one's experience (Baker, Jensen, Kolb, 2002). By engaging in this cycle, learners construct meaning in a way unique to themselves, incorporating the cognitive and emotional aspects of learning (Kolb, 1981).

2.4. Research questions

The present study focuses on three research questions. Firstly, can this intervention study influence science teachers' educational beliefs and science efficacy beliefs? Secondly, are there any differences between teaching practice of control group teachers and experimental group teachers? Thirdly, what kind of relationship can be found between teacher beliefs and teaching practice?

3. Methodology

In order to explore the changes of participants' beliefs and teaching practice in both quantitative and qualitative ways, a parallel/simultaneous mixed-methodology approach was utilized during the data collection (c.f., Tashakkori & Teddlie, 1998). This paradigm combines both qualitative and quantitative methods to give both breadth and scope to the research project (Greene, Caracelli, & Graham, 1989).

3.1. Design of the intervention

The 10-week intervention courses were assigned to the experimental condition (See Table 1 for a detailed list of workshop activities). The workshop contents covered from constructivist teaching and learning theories to ICT integration in constructivist science classroom. After each organized workshop activity, all participants were invited to discuss their feedback on the online platform provided. In the first module, video cases of two mentor teachers were presented to the participants. For the rest nine modules, beside some video cases of mentor teachers, two participants of EG were invited to prepare new teaching activities for each module, based on knowledge of the previous module. During the first 20 minutes of each module, theories related to constructivist science teaching and science curriculum standard were presented to the participants in an interactive way. After that, the teachers watched the videos through an overhead projector with the help of focal questions for about 30 minutes. For the next 50 minutes, the participants were organized to have group (or pair) discussions and to form reflection reports. The final phase of each module consisted of practical tasks. The teachers were asked to improve some existing teaching designs and to develop new teaching activities. The whole process of the intervention was videotaped by a research assistant.

Projec	et activities				
0	Reflection on science teaching strategies in Chinese				
	primary schools				
0	Reflection on science learning environment in				
	Chinese primary schools				
0	Constructivist learning environment and science				
	teaching				
0	Situated learning theory and science teaching				
0	Autonomous learning in science				
0	Cooperative learning in science				
0	Scientific learning theories and strategies				
0	Integrating related subjects and science learning				
0	ICT use in constructivist leaning environment design				
0	Integrating ICT into science teaching and learning				

Table 1. The workshop topics

3.2. Participants

A quasi-experiment method is used in this intervention study. A suburb district (with 76 primary schools) in the southeastern part of Beijing was involved to this intervention study. All the science teachers (N = 180) were enlisted by an educational administrator of the district for random selection. Forty-six teachers participated in this study. They were randomly assigned to two groups: control group (CG, N = 23) and experimental group (EG, N = 23). In both groups, one third of the participants were male. On average, teachers of CG had 40 years of age, 19 years of teaching experience, and almost 5 years of teaching experience in science. Those of EG had 33 years of age, 12 years of teaching experience, and almost 7 years of teaching experience in science. Table 2 presents the general characteristics of the participants.

	Control group	Experimental group		
Gender				
Male	8	8		
Female	15	15		
Age				
Mean (SD)	40.26 (10.20)	32.78 (5.30)		
Minimum-Maximum	23-54	23-42		
Teaching experience (in years)				
Mean	19.30	12.13		
SD	10.03	6.09		
Minimum	2	1		
Maximum	33	21		
Teaching experience in science (in years)				
Mean	4.78	7.13		
SD	4.21	4.95		
Minimum	1	1		
Maximum	14	20		

Table 2. Characteristics of participating teachers

Before and after the treatment, both group members were asked to finish the pre/post-test questionnaires. The EG received a treatment of a ten-week video-based training. And the teachers from the CG were only involved into questionnaire survey and classroom observations.

3.3. Data processing and analysis

The main sources of data for the present study are teachers' written responses to a questionnaire and video data of classroom observations.

3.3.1. Quantitative data and analysis

Next to questions asking for demographic information, four scales addressing teachers' educational beliefs and science teaching self-efficacy were included in the surveys administered prior to and at the completion of the intervention program. The participants were asked to rate their levels of agreement on a

five-point scale (from 1- strongly disagree to 5- strongly agree). Numbers of items and the measures of internal consistency (Cronbach's alpha) for each of the four scales are presented in Table 3.

Teachers' educational beliefs were measured through the Teacher Beliefs Survey (Woolley et al., 2004) which contains two sub-scales: "traditional teaching beliefs" (TTB) and "constructivist teaching beliefs" (CTB). Example item of TTB: "*I base student grades primarily on homework, quizzes, and tests*" and of CTB: "*I believe that expanding on students' ideas is an effective way to build my curriculum*".

The "Science Teaching Efficacy Beliefs Instrument" (STEBI) (Riggs & Enochs, 1990) was used to measure science teaching efficacy beliefs of the participants. The STEBI contains two sub-scales: Personal Science Teaching Efficacy Belief (PSTE) such as "*Even teachers with good science teaching abilities can not help some kids to learn science*", and Science Teaching Outcome Expectancy (STOE) such as "*When teaching science, I usually welcome students' questions*". The scores of negative items were reverted.

		Control group		Experimental group	
Sub-scales	Number	Cronbach's	Cronbach's	Cronbach's	Cronbach's
	of items	alpha	alpha	alpha	alpha
		(pre-test)	(post-test)	(pre-test)	(post-test)
CTB	10	.76	.67	.56	.63
TTB	7	.61	.54	.68	.63
PSTE	13	.86	.51	.74	.62
STOE	12	.65	.64	.70	.66

Table 3. Questionnaire "Teacher beliefs and science teaching efficacy beliefs"

One-way analysis of covariance (ANCOVA) was conducted in the analysis of the experimental design data.

3.3.2. Video data and analysis

Video data on classroom observation provide detailed real-time records of teaching and learning behavior that can enable researchers to view, code, analyze, and construct. For this project we worked with video data of 18 classroom observations. Based on the framework of TIMSS video study (Gonzales, Guzman, Partelow et al., 2004), we developed a 3-dimension framework: class activities, independent activities and ICT integration Video (see Table 4).

The video data was coded and analyzed using a qualitative data analysis program, NVivo 8, which is designed to combine subtle coding with qualitative linking, shaping and modelling and to integrate the processes of interpretation and focused questioning (QSR International, 2007). Durations of the 18 classroom videos ranged from 20 minutes to 52 minutes. Two researchers were involved in to develop and apply codes that capture teaching activities related to the three dimensions observed in the videotaped lessons. Specific time interval (1 minute) events were captured across multiple categories. A segment could be coded into more than one dimension. For example, if students search information from the internet, the segment can be coded into "individual practical work" and "student ICT use". We followed several procedures in order to ensure coding reliability. First, the "master" coder developed a coding map (see Appendix) and explained it to the other coder. Then, we individually coded one class video. We compared the coded units to see what percentage of the units matched across the two coders. The intercoder reliability (Cohen's kappa) reached .74, which is substantial (Landis & Koch, 1977).

Coding category	Indicators
 Class activities 	
Practical work	O Demonstration
	O Showing objects to the class
Seatwork	O Class discussion
	OTeacher lectures
	O Presentations
	O Reading
	O Writing
 Independent activities 	
Practical work	O Inquiry
	O Building models
	O Hand-on activities
	O Observing phenomena
	O Experimenting
Seatwork	O Answering questions
	O Discussing in small groups
	O Coping notes
• ICT integration	
Teacher activities	O Computer using
	O Camera using
	O PPT presenting
Student activities	O Computer using
	O Camera using
	O PPT presenting

Table 4. Coding categories and indicators

4. Results

We first present the findings of the questionnaire data: findings in terms of teachers' educational beliefs and science teaching self-efficacy beliefs. Secondly, the findings of video data derived from classroom observation are presented, with a qualitative description of two teaching segments.

4.1. Changes in teacher beliefs

Science teachers' scores on beliefs, before and after the intervention program, were calculated. ANCOVA analyses adjusted pre-test differences and compared post-test results. Table 5 shows the descriptive statistics and a summary of the analysis of covariance (ANCOVA).

		Pre-test	Post-test		Effect
Scales	Group	Mean (SD)	Mean (SD)	<i>F</i> (1,43)	size η^2
TTB	Control	3.93 (.68)	3.69 (.49)	14.416	.251
	Experimental	3.63 (.62)	3.08 (.61)	**	
	Control	3.86 (.45)	4.04 (.43)		.070
СТВ	Experimental	3.64 (.46)	4.32 (.37)	/.831*	
	Control	3.59 (.43)	3.45 (.48)	9.166+	1(0
PSTE	Experimental	3.50 (.50)	3.79 (.34)	8.100*	.100
	Control	3.63 (.45)	3.43 (.41)	1.072	024
STOE	Experimental	3.73 (.47)	3.76 (.36)	1.073	.024

Table 5. Descriptive statistics and summary of ANCOVA

**p* < .01

** p < .001

After adjusting for pre-test scores, there were some significant effects of between subjects factor group. Significant differences were found for constructivist beliefs (F(1, 43) = 7.831, p < .01) and science teaching efficacy beliefs (F(1, 43) = 8.166, p < .01) between Control group and Experimental group. Scores on Traditional Teaching Beliefs sub-scale of Experimental group have been decreased significantly (F(1, 43) = 14.416, p < .001). There was no significant effect of intervention on science teaching outcome expectancy after controlling for the effect of pre-test.

4.2. Changes in instructional practice

We examined teacher changes in their teaching behaviors by exploring video data of classroom observations, based on the results of time codes (see Figure 3). Examining the records of practice in regard to Control group and Experimental group teachers revealed that statistical significance at .05 level existed in whole-class practical activities (t = 2.257, p < .05) and independent practical activities (t = 2.213, p < .05). In other words, teachers of Experimental group had more interest on both whole-class and independent practical activities. There were no statistical differences between whole-class and independent seatwork for the two groups.

An independent *t*-test analysis was conducted to examine differences

between ICT integration scores of Control group and Experimental group. The results showed that in the classes of Experimental group, participants gave more opportunities of ICT use to students (t = 3.541, p < .01). For teachers' ICT-related activities, no significant difference was found between the two groups.



Figure 2 Codes (time in minutes) of instructional activities in both groups.

In almost all lessons, the typical inquiry-based teaching which advocated by national science reform standards was organized by teachers from both groups. The following scientific inquiry steps were adopted by the teachers: questioning, hypothesizing, planning, experimenting, interpreting data, drawing conclusion, and communicating.

However, as can be seen in Figure 2, lessons of the two groups differed in specific teaching activities. In lessons of Experimental group, compared to Control group, more practical activities were organized. Experimental group teachers became more accepting of inquiry-based approaches to teaching science that encourage students' involvement in science learning. For example, after typing in the text for the first component, teacher Yao asked

special questions (wh-questions) to her students:

Teacher Yao: Very good. Now I want to ask you to take a little quiz. Can you draw the shape of this seed? Please observe it carefully. Take out your pencil and draw it on our record sheet.

Class: (The students were drawing for 3 minutes)

Teacher Yao: Now please stop. I want one of you to show us your drawing. How can we evaluate this drawing?

Student Zhao: It described the seed very well.

Teacher Yao: Well, thank you. We have already observed the shape of the seed. How can we know the inner structure of it?

Student B: We can cut the marinated seed.

Teacher Yao: Let's take a look at this video (about seed growing). What did you find?

Student C: A seed can germinate in water.

Teacher Yao: That means there is a magic part inside the seed. Please guess it and draw it on your drawn shape. Well, how can we see it?

Student D: We can cut it.

Teacher Yao: Yes, we can peel the skin of the seed using tweezers and observe inner structure by a magnifier. Please caution when using tweezers. Record your results on the experiment record sheet.

In this a short segment of teacher Yao's class, students were involved in some practical work such as drawing, evaluating, hypothesizing, and observing. She guided students' learning in order to get at the core of the teaching content by ask prompting and probing questions.

Comparing to this segment, we take another example from teacher Zhang, who belonged to CG. In this example, students were organized in groups for inquiry-based scientific experiment about thermometer:

Teacher Zhang: Have you finished your experiment? It is time to stop. Now let's take a look at your results. Group 1.

Student Yan (the head of group 1): The liquid column of the thermometer raised in hot water (interrupted by the teacher).

Teacher Zhang: Please tell us the name of the liquid you tested.

Student Yan: We used oil to test the change of thermometer. Oil raised in hot water and descended in cold water.

Teacher Zhang: Do you all agree?

Class: Yes.

Teacher Zhang: Please be aware that volume of liquid raises or descends. And please be accurate when you answer. Good, what about group 2?

Student Teng (the head of group 2): We tested milk. Milk expands with heat and contracts with cold.

Teacher Zhang: Sit down please. What else? Group 3, what did you test?

Student Liu (the head of group 3): Vinegar. We found similar phenomenon.

Teacher Zhang: Based on all of your findings, we can conclude that liquid...(pointing at the blackboard)

Class students: Expands with heat and contracts with cold (reading from the blackboard).

In this segment, instead of asking the whole class, teacher Zhang named the students who were arranged to be responsible for experimental control to present their findings. More general questions (yes/no questions) which can be easily answered without any high order thinking were asked to students. This may limit the function of hands-on practical activities. Furthermore, he failed to lead an interactive communication among students about experiences and results of their experiments. The scientific fact "liquid expands with heat and contracts with cold" was noted on the blackboard and emphasized by teacher Zhang. It claims a content/examination based teaching.

5. Discussion

Analysis of teachers' educational beliefs, science teaching efficacy beliefs and their teaching practice indicates that, to some extent, video-based intervention influences teachers' thinking and practice.

5.1 Changes in teacher beliefs

Following the cycles of reflection and learning, through video-taped teaching cases, science teachers' reported that their educational beliefs have been influenced. The results indicate that the teachers who participated in the intervention program reported both lower traditional beliefs and higher constructivist beliefs compared to those who did not participated in the intervention. These results support previous research findings regarding the changes of teachers' beliefs (Angell, 1998; Kagan, 1992; Nettle, 1998) and enrich evidence to argue that teacher-centred educational beliefs of teachers can be challenged by a video case-based constructivist learning program; although a consensus exists among researchers stating that changes in teacher beliefs are not evident (e.g., Pajares, 1992).

Studies related to changes of science teaching efficacy reported mixed results (e.g., Bleicher & Lindgren, 2005; Ginns & Watters, 1999; Wingfield et al., 2000). For example, Wingfield et al. (2000) found significant changes in both self-efficacy and outcome expectancy. Tosun (2000) found significant changes only in self-efficacy. Plourde (2002) found significant changes only in outcome expectancy. The results of this study indicates that teachers who participated in the intervention program experienced significantly greater increases in judgments of personal science teaching efficacy than those who did not participated in the intervention. However, there was no statistically significant difference between the mean of science outcome expectancy beliefs gain scores among the two groups of teachers.

5.2 Changes in instructional practice

Eighteen videos of classroom observation were coded and analyzed in terms of whole-class and independent activities, in terms of the opportunity for students' engagement into practical work versus seatwork activities, and in terms of ICT-related teaching practices. The results indicate that statistically high frequencies and long duration of whole-class and independent practical work were recognized for the class videos of those who participated in the intervention, compared with those who did not participated in.

No statistical differences were found for both whole-class and independent seatwork for the class videos of the two groups. Previous research on innovation implementation shows that it is difficult to change teacher behavior (e.g., Fullan, 1991). Teachers find it very hard to change their lessons merely on the basis of suggestions, which require a lot of additional work (van den Berg, 1996). Similarly, Sherin and van Es (2005) have described how teachers participating in year-long video clubs developed "professional vision" and evolved from noting teacher actions and strategies when viewing their own and others' classroom teaching videos to focus on student meaning-making and learning.

With respect to ICT-related teaching practices, teachers of experimental group had more interests on students' involvement in ICT use. This finding is in line with studies conducting with the goal of improving ICT integration, in which it is claimed that effective professional development can involve a complex interplay between teachers' theory and practice, which could result in more ICT use (Bereiter, 2002; Wang & Hannafin, 2005). For teachers' ICT-related activities, no significant difference was found between the two groups.

The changes in the teaching practices are further illustrated by viewing at the video clips of two lessons from both groups. Comparing to the example from control group, it is not difficult to express, in the lesson of the experimental group, teacher Yao was trying to focus on students' involvement in scientific learning in a more interactive way of guiding the teacher-pupil interaction. An emphasis on students' involvement is one of the characteristics of constructivist teaching and learning approaches (Hand & Treagust, 1994). According to Mathews (1998), productive and efficient instruction on philosophical dimensions of scientific inquiry begins when students and teachers slow down the science lesson sufficiently to allow time for meaningful questions to be asked and explored. Practical or hands-on work is one of the characteristics of constructivist scientific inquiry (Huber & Moore, 2001). Science teachers participated in our study were guiding hand-on activities during their teaching. However, a careful planning and a meaningful discussion of the hand-on activities may improve science teaching and learning. Conversely, as mentioned above, it may become a traditional approach of constructivist scientific inquiry.

5.3. Linking teacher beliefs and teaching practices

As reviewed above, the influence of teacher beliefs on teaching practices has been emphasized by a large number of researchers (Clack & Peterson, 1986; Hampton, 1994; Nespor, 1987; Richards, Gallo, & Renandya, 2001). Richards et al. (2001) reviewed that changes in teaching practices are the result of changes in teacher beliefs. Furthermore, teachers high on personal science teaching efficacy are more likely to spend the time needed to develop science concepts in class (Riggs & Jesunathadas, 1993) and to enjoy student-centered instructional strategies (Watters & Ginns, 2000). In our study, although a design issue is absent to link the change of teacher beliefs and practices, we may still claim that more progressive changes of teacher beliefs support evidence to more practical and constructivist classroom teaching. More specifically, lower scores on traditional teaching beliefs and higher on constructivist teaching beliefs of experimental group reflect less traditional teaching activities and more constructivist teaching activities. Furthermore, EG teachers high on PSTE are more likely to organize student-centered teaching and leaning activities. Those activities can be read in Figure 3 and video clip transcripts in previous session.

6. Limitations and suggestions for future work

The results of the present study should be considered in the light of several limitations. First, the characteristics of the participants in this study may limit the generalizability to those with different characteristics. For instance, comparing with CG participants, the experimental participants in this study had less teaching experience (mean difference = 7.2 years) but more teaching experience in science (mean difference = 2.4 years). Secondly, our study did

not include a comparison of video-based interventions to text-based interventions. This feature would make it difficult to argue that video-based interventions are better than text-based interventions, although a comparison of with-intervention and without-intervention had been carried out to investigate their differences. Thirdly, another shortage of this study was that the intervention was administered to the experimental participants during ten weeks, which would be considered a relatively short treatment time. Finally, in gathering evidence of teacher learning, methodological limitations of analyzing videotaped lessons still exist in terms of sample restriction (Santagata, 2009) and researcher's preconception.

Therefore, for future research, considerations might be made to administer a longer period intervention to investigate the long-term effects of video-based experiences. If some positive finding of this study can be supported by a longer period intervention program, meaningful implications might be made to the benefit of teacher professional development programs. The findings of this study could also be further qualified by a comparative research design and experiment with different types of training strategies and contents.

7. Conclusions

This intervention study was framed by Kolb (1981) who developed a four-stage experimental learning cycle. We have been interested in adapting this learning cycle to challenge science teachers' beliefs and practice in Chinese educational context. The findings of the present study contribute to the existing literature in three ways: (1) this study provided evidence for statements from previous studies that teacher beliefs can be challenged, even they are stable and resistant to change; (2) this study confirmed teachers' instructional behaviors can be influenced by video-based and constructivist-orientated intervention programs.

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Appendix: Science class coding map



Chapter 7

General discussion and conclusions

Abstract

In this final chapter, a general discussion and conclusion of previous chapters are presented in a more reflective way. We relate the research findings to the research objectives and the research questions of the dissertation, as elaborated in Chapter 1. Limitations of the studies are spelled out. Directions for future research and recommendations for teacher education in China are proposed.

1. Introduction

Information and communication technology (ICT) has brought about tremendous changes in teaching and learning approaches. The integrated use of ICT has become a central issue in the discussion of educational innovations and how ICT affects instructional approaches. This has clear implications for in-service and pre-service teacher education. In view of taking full advantage of ICT, teachers play and have to play a key role; not just as imparters of knowledge but especially as facilitators who will guide their students in using ICT. In view of this, teacher education has to go beyond the development of basic ICT knowledge and skills. The key assumption of this PhD is that teacher cognitions play a central role. Therefore, this dissertation especially points at the relationship between specific teacher cognitions and the level of integrated ICT use.

In the Chinese educational context, ICT has made significant progress in education; both in developed areas and in Western rural areas (Zhao & Xu, 2010). The effectiveness of ICT in education has considerably improved, teachers' competence of ICT has been strengthened, and the traditional teaching and learning approach has been significantly refined (Zhao, 2009). ICT has played a critical role in education, which serves as a fundamental

means to realize educational modernization. Both teachers and students are familiar with ICT and would like to use it to support their teaching and learning (Zhao & Xu, 2010). Although the availability of ICT in schools has increased, we also observe some serious disappointments. One reason could be related to the understanding and challenging of teacher cognitions. As elaborated in previous chapters, a growing body of research stressed, studied and documented the relationship between teacher cognitions and ICT classroom integration (Ertmer, 2005; Higgins & Moseley, 2001).

The main objective of our study was to explore the nature of pre-service and in-service primary teacher cognitions and the relationship between teacher cognitions and ICT integration in the classroom in the cultural context of China. More specifically, we center on the level of ICT integration and particular teacher cognitions: teacher educational beliefs (constructivist and traditional beliefs), teacher self efficacy beliefs, teacher perceptions of ICT policies, teacher attitudes toward ICT, teacher ICT motivation, teacher computer self-efficacy.

The dissertation builds mainly on a Western conceptual framework and on research instruments and instructional approaches that have been developed in Western contexts. This introduces automatically the question about the generalizability of this conceptual and instrumental approach for the Chinese context. Though the cultural context is not being manipulated and/or compared in the researches discussed in this dissertation, reflections and conclusions about the feasibility and success in the adoption of our conceptual and instrumental framework can be presented on the base of the findings in the previous chapters.

2. Overview of the research questions and main findings

In Chapter 1, three research objectives and five research questions, which arose from a review of related research and a discussion of problems in the Chinese primary school context, have been presented.

Those objectives are: (a) exploration of the nature of teacher beliefs in China; (b) examination of the relationship between teacher cognitions and the level of ICT integration, and (c) the impact of challenging teacher beliefs and practice. These objectives form the basis for five general research questions formulated in this dissertation:

- 1. What are the profiles of Chinese in-service primary school teachers' educational beliefs and how can this be related to teacher background variables (socioeconomic and geographical characteristics)?
- 2. What is the nature of Chinese pre-service primary school teacher cognitions?
- 3. How are teacher cognitions of in-service teachers related to their teaching practices with and without ICT?
- 4. How are teacher cognitions of pre-service teachers related to their prospective teaching practices with and without ICT?
- 5. What is the effect of a video-based intervention on in-service teachers' cognitions and educational practices?

The research questions have been tackled in five subsequent studies, documented in chapters 2 to 6. In the following sections, we discuss the findings in relation to the general research questions.

2.1. The nature of in-service teachers' educational beliefs

The study reported in Chapter 2 explored the nature of and profiles in Chinese in-service primary teachers' educational beliefs about teaching and learning.

At a general level, the instruments assessing educational beliefs reflect higher scores in relation to constructivist beliefs as compared to the adoption of traditional beliefs. Gender and the subject domain of the teacher clearly affect the adoption of traditional educational beliefs. Compared to female teachers, male teachers report the significantly higher adoption of traditional beliefs. The number of years of teaching experience is not related to the adoption of either constructivist or traditional beliefs. Significant differences appear when we consider teacher background variables, such as economical and geographical variables. In teachers from urban areas, we observe significantly higher scores in relation to constructivist beliefs and significantly lower scores in traditional beliefs as compared to teachers from rural areas. Teachers from developed areas reported significantly lower scores in relation to constructivist beliefs and traditional beliefs as compared to teachers working in developing regions. A comparison between teachers from four school categories revealed significant differences. This is true for both traditional and constructivist beliefs. Teachers from urban schools in developing areas hold significantly higher constructivist beliefs than teachers from the other areas. Teachers from rural schools in developing areas reported significantly higher traditional beliefs than teachers from both urban and rural schools in developed areas. This finding implies that - at a general level - teacher cognitions are clearly related to contextual, geographical background variables. However, no significant differences were observed between teachers from rural schools in developed areas or developed areas, and teachers from urban schools in developed areas and developing areas.

Cluster analysis helped to delineate four teacher belief profiles: a constructivist profile, a mixed high constructivist/traditional profile, a traditional profile, and a mixed low constructivist/traditional profile. Interrelations between teacher belief profiles and school categories were discussed indicating that teachers from urban schools in developed areas mostly adopt a traditional profile and constructivist profile. Most of the teachers from rural schools in developed areas adopt a mixed high constructivist/traditional profile. Teachers from urban schools in developing reflect highest areas the proportion of the mixed high constructivist/traditional profile and constructivist profile. As to teachers from rural schools in developing areas, they mostly mirror a traditional beliefs profile.

2.2. The nature of pre-service teachers' educational beliefs

The primary aim of the study reported in Chapter 3 was to examine the relationship between the pre-service teachers' educational beliefs and teacher background variables, such as gender, level of study year and subject matter specialization.

The results showed that female pre-service teachers reflect to a significantly higher extent constructivist teaching beliefs as compared to their male colleagues. However, the results did not indicate that male and female

teachers differed with regards to their traditional teaching beliefs. When studying the potential relationship between pre-service teacher beliefs and the study year, we observed a significant difference in the adherence to constructivist beliefs. No significant differences are observed in the adoption of traditional beliefs. We find that freshmen (year 1) reflect significantly higher constructivist teaching beliefs than those in the other training years. Seniors hold significantly lower constructivist teaching beliefs as compared to students in other training years, but this difference seemed to be only significant when comparing year 1 and year 3 students.

It can be derived that pre-service teachers who majored in general primary education reported higher constructivist beliefs than those who majored in individual subject domains. No significant differences were observed concerning the level of adoption in traditional beliefs.

2.3. Teacher cognitions and ICT integration

The study in Chapter 4 centers on the complex interplay of a number of internal teacher variables to explain ICT classroom integration. These variables comprise "teachers' constructivist teaching beliefs", "teacher attitudes towards computers in education", "teachers' computer motivation", "teacher perception of ICT-related policy". Path modeling was used to explore the direct and indirect effects of the teacher related variables on their level of ICT classroom integration. In view of parsimony, only significant effects were retained in the model. The results showed that ICT classroom use was directly predicted by the supportive use of ICT and ICT motivation. All other relationships in the model seemed to be of an indirect nature, considering the role played by the mediating variables: perception of ICT policy, attitudes towards ICT in education, and ICT motivation.

The mediating role of the attitudes towards ICT in education is clear when we consider the relationship between constructivist beliefs and the attitudes towards ICT in education and its consecutive impact on ICT motivation. The attitudes towards ICT in education play a comparable role in linking constructivist beliefs and ICT motivation to the supportive use of ICT. The mediating role of ICT motivation is clear when we see the path from constructivist beliefs via ICT motivation to classroom use of ICT. In a comparable, less significant, and somewhat complex way, the perception of ICT policy mediate in the relationship between constructivist teaching beliefs and supportive ICT use. The perception of ICT policy also has an indirect effect on ICT classroom use mediating by ICT motivation.

2.4. Pre-service teacher cognitions and ICT integration

Chapter 5 centers on the impact of Chinese pre-service teachers' gender, constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy, and computer attitudes on their prospective ICT use. A first picture of the nature of the relationships between the research variables could be derived from the results of the bi-variate correlation analysis. For the purpose of this study, the correlations with prospective computer use were of primary interest. The results suggested high interrelationships between computer use variable and the set of teacher thinking variables. Furthermore, teacher cognitions seemed to be significantly related to one another. For instance, constructivist teaching beliefs were significantly related to all other variables. Teaching efficacy is also related to all the other variables, except for gender.

Taking computer use as endogenous variable, gender, constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy and computer attitudes toward education as exogenous variables, a path model was tested. Results showed that prospective ICT integration is significantly linked to all teacher related variables, except for gender. Gender had only an indirect effect on prospective computer use, and influenced constructivist teaching beliefs in a direct way. Building on the results of a path analysis model, prospective ICT integration could be directly predicted on the base of teacher thinking variables, and indirectly by the gender of the pre-service teachers.

2.5. The impact of a video-based intervention

The study reported in Chapter 6 aims at challenging primary science teacher cognitions (educational beliefs, science teaching efficacy beliefs, and teaching practices), through a multimedia case-based intervention program in the Chinese primary school setting. The use of multimedia cases provided a promising avenue for teacher development. By viewing, analyzing, reflecting

on video cases, teachers could investigate their own teaching practices and reflect upon it.

The results of the analyses indicated that the reported beliefs of teachers who participated in the intervention differed significantly from the initial pretest picture. More specifically, teachers in the experimental group reported less traditional and more constructivist beliefs and personal science teaching efficacy beliefs after the intervention. There is an exception as to the science teaching outcome expectancy beliefs. Video data of classroom teaching activities show that teaching practices changed following more constructivist dimensions in terms of practical activities and stronger involvement of pupils in ICT use. In other words, teachers in the experimental group showed more interest in both whole-class and independent practical activities. In the experimental classes, teachers gave pupils more opportunities to ICT use.

3. General discussion

In this section, we overview the most important results summarized above and discuss the findings in three parts: (1) teacher beliefs profiles; (2) teacher cognitions and ICT integration; and (3) teacher development.

3.1. Teacher beliefs: a bipolar/mixed distinction and a cultural-shadowed system

Researchers have made attempts to delineate prototypical teacher beliefs. In the literature, authors mainly distinguish between "traditional beliefs" and "constructivist beliefs" (Woolley, Benjamin, & Woolley, 2004). We explored the nature and structure of educational beliefs of Chinese teachers. Four different beliefs-based profiles were identified: Constructivist profile; Traditional Constructivist/traditional Low profile; profile; constructivist/traditional profile. The profile of mixed constructivist/traditional beliefs is a new finding in the Chinese context. However, in Western settings, researchers already observed that some teachers can hold both high constructivist and traditional beliefs (e.g., Tondeur et al., 2008). As stated earlier, the bipolar distinction between teacher-centred "traditionalistic" and the one hand and student-centred "progressive" beliefs (Kerlinger & Kaya, 1959) at the other, is again to be challenged. Of importance is the fact that many teachers are able to hold opposing beliefs within their belief system. This finding is consistent with studies about conceptions about teaching (e.g., Pratt, 1992) and teachers' educational beliefs (Van Driel, Bulte, & Verloop, 2007). These sets of opposing beliefs are considered to be "functional paradigms" (Lantz & Kass, 1987), that are helpful to cater for very different situations in the teaching and learning settings.

Teaching is a cultural activity and thinking about teaching and learning is informed by culturally shared ideas about teaching and learning (Stigler & Hiebert, 1999). Considering the nature of beliefs, teachers' educational beliefs are expected to be largely shaped by culturally shared experiences and values. Culturally shared educational beliefs of teachers may be so ubiquitous and familiar that they become difficult to recognize (Correa, Perry, Sims et al., 2008). Chinese culture is regarded as part of Confucian-heritage and reflecting particularities of a collectivist society (Ho, 1993). It is based upon a synthetic and holistic view of the world, perceiving the human being and the nature as one unified entity, taking into consideration the interdependent relationship of living things and the environment, the natural and human elements, and their mutual shaping in the construction of meaning (Chen, Mashhadi, Ang, & Harkrider, 1999). The Chinese culture holds a view of collectivism, urging individuals to surrender their own genuine interests for the sake of the well-being of a collectivity, whether that is the family or the state (Huang, 2002). But the question is whether the typical Chinese cultural context and the related discussion about teacher cognitions, holds when we introduce Western concepts and research instruments? What about the research instruments? Will they be able to capture the same teacher cognition constructs as developed in Western contexts? Do we find patterns in teacher cognitions that are aligned with the patterns found in Western settings? The results of the different studies allow us to be positive about the cross-cultural validity of the conceptual base and methodological approach to study Chinese teacher cognitions building on a Western conceptual framework. Nevertheless, the studies underpin the need to be sensitive when translating and adapting existing instruments to be used in different cultural contexts. Also, the results point out that the nature of and the profiles in teacher

cognitions are somewhat different in the Chinese setting. In this way, the present study contributes to the research literature since further evidence is presented that cultural and contextual differences exist in teacher cognitions, such as e.g., educational beliefs. In addition, the current study identified the potential structure of pre-service teachers' educational beliefs in Chinese settings. This better understanding of pre-service teacher beliefs might improve the effectiveness of local teacher education programs (Richardson, 2003).

As stated by Pei (2002), the diversity of regional cultures in China reflects related differences in social structures, belief systems, rituals, customs as well as the linguistic, artistic and literary systems. This stressed the need to study teacher background variables that are related to these regional variations in China. The within-China cultural diversity asked us to examine regional differences in teacher cognitions. The fact that such significant differences were found re-emphasizes the need for contextualizing teacher cognitions in a cultural setting. Teachers from developed versus developing, and urban versus rural areas report differences in their educational beliefs.

3.2. Teacher cognitions and ICT integration: a complex link

The findings from the studies involving either in-service or pre-service teachers indicate that teacher cognitions affect - either directly or indirectly - ICT use in primary education.

Constructivist beliefs

A body of research - in Western settings - has found a direct relationship between teachers' constructivist beliefs and ICT adoption (Higgins & Moseley, 2001). Becker (2000) claims that teachers with a strong constructivist thinking are eager to adopt ICT in educational settings. In our results, only an indirect relationship was confirmed between teachers' constructivist beliefs and their ICT classroom integration. Constructivist teaching beliefs of pre-service teachers strongly influence their prospective computer use in a direct and indirect way, indicating that pre-service teachers with higher constructivist teaching beliefs are more inclined to integrate technologies into their future teaching. This finding is in line with previous studies that state constructivist beliefs consistently predict pre-service teachers' computer-related behaviors in Western settings (e.g., Higgins & Moseley, 2001) and in Eastern settings (e.g., Lin, 2008).

Teaching efficacy

Teaching self-efficacy is related to teacher behavior in the classroom. Teachers' self-efficacy has also repeatedly been reported to be a major variable to understand the frequency and success of computer use in education (Albion, 1999). This is strongly supported by our study. Teacher self-efficacy predicts - directly - pre-service teachers' prospective computer use in education, and indirectly via its impact on the mediating variables attitudes towards computers in education and computer self-efficacy. In another Asian setting, Teo (2009) found that student teachers' self-efficacy is a significant indicator whether they use technology in a traditionalist or a constructivist way.

Computer self-efficacy

Computer self-efficacy is a strong predictor of pre-service teachers' prospective computer use. This finding is in line with other studies that emphasize the importance of computer self-efficacy on teachers' computer-related behaviors (e.g., Compeau, Higgins, & Huff, 1999). This implies that the more confident pre-service teachers are about their capacity to teach or/and to use computers in education, the more likely they are to be interested in teaching with computers. This is consistent with the basic hypothesis of Bandura (1977): people reporting high levels of outcome expectations and self-efficacy are expected to act in a more assured, and decisive manner.

Attitudes towards ICT in education

Attitudes towards ICT in education indirectly influence ICT classroom integration through the mediation of motivation towards ICT in education

and ICT supportive use. The added value of this finding is that the mediating role of these teacher attitudes is confirmed within a larger complex of other variables and processes that influence ICT use in Chinese primary education. This implies that if primary teachers adopt favorable attitudes towards ICT in education, they are more eager to integrate ICT into their teaching. This finding is in accordance with the findings of previous study of van Braak, Tondeur and Valcke (2004). They observed that a favorable attitude towards computers did positively and directly affect the degree of computer use in class. Moseley & Higgins (1999) also stated that teachers who adopt positive attitudes towards ICT efficiently use technology in classroom teaching. For pre-service teachers, attitudes toward computer use in education seem to be the strongest predictor of prospective computer use. This is in line with other studies stating pre-service teachers' attitude towards computer use is a major predictor for future computer use in the classroom (Myers & Halpin, 2002; Teo, 2008).

ICT motivation

According to Karsenti, Villeneuve and Goyer (2006), teachers who are motivated and have a strong commitment to foster learning processes, integrate technology more easily into their teaching processes. This is consistent with our findings that among the teacher cognitions, ICT motivation seems to be the strongest predictor of ICT classroom use. In addition, teacher attitudes toward ICT use in education are strongly related to teacher ICT motivation. Furthermore, teachers' perception of the ICT policy is correlated with their ICT motivation. This is in line with the finding of Hughes and Zachariah (2001) claiming that efficient ICT use relies on the development of a shared vision. Furthermore, the research confirms a strong interrelation between attitudes towards ICT in education and ICT motivation.

Perception of ICT policy

In our theoretical base, we also centered on the critical role of teacher personal perceptions of an ICT school policy. Repeatedly, authors stress that an appropriate level of school planning is needed to enhance the successful integration of ICT in the classroom (Tearle, 2003). Teachers are more willing to adopt new modes of ICT when the school aims underpin these modes of teaching and learning. But, next to the availability of such a policy, research also stresses that it is especially the perceptions of teachers of this policy will have a decisive impact. Although a direct effect of these perceptions of the ICT school policy is not supported in our empirical model, evidence is found to approach teacher perceptions of the ICT school policy as a mediating variable in view of classroom use of ICT. This is in line with the conclusions of Hughes and Zachariah (2001) stating a successful ICT integration depends upon the development of a shared vision. It appears that teachers engaged in school ICT planning and policy will be more likely to apply ICT in an innovative way (Kozma, 2003). The development of ICT school plan and policy aiming at setting clear goals and defining the means to realize these goals, are crucial steps towards ICT integration (Bryderup & Kowalski, 2002).

3.4. Teacher development: a challenging process

Many authors, including Jackson (1992) and Richardson (1994) have documented that teacher development has to focus on - next to knowledge and skills – beliefs, attitudes, practices etc. Studies have clearly shown clear links between teacher development programs and shifts in of teacher beliefs and related practices (Hofer & Pintrich, 1997). As teachers become more competent in dealing with the demands of teaching, they progress into towards more ambitious forms of teaching. The latter is especially true if these teachers are challenged by presenting them with new - such as constructivist - ideas during a teacher development program (Cady, Meier, & Lubinski, 2006). Changes in teaching practice are expected to build upon practice and experience based reflections. Reflection is considered to be the core to enable practitioners to assess, understand and learn through their experiences (Schön, 1987). Reflection activities introduce automatically considerations about personal teacher cognitions. The development of better teaching skills and deeper knowledge of subject matter can therefore not be divorced from the development of teacher beliefs. As Hargreaves and Fullan (1992, p.7) point out, "To focus on behavioral skills alone without reference

to their grounding in or impact on attitudes and beliefs is misguided and liable to prove ineffective". Hence, an understanding of the personal beliefs, and helping them to gain self-understanding through reflection on their classroom practices and articulation of their practical knowledge are equally important.

Rethinking teacher education from a pedagogical point of view, should challenge the ineffectiveness of traditional teacher education programs through the integration of insights from the theoretical and practice-based approaches towards teacher education (Schepens, 2005). Our intervention study was framed by the experimental learning cycle of Kolb (1981) and the teacher development model of Korthagen et al. in which they include five stages of teacher development: (1) Action; (2) Looking back on the action; (3) Awareness of the essential aspects; (4) Creating alternative methods of action; (5) Trial. (Korthagen, 2004; Korthagen & Vasalos, 2005). Korthagen (2004) claims that "If a teacher believes that paying attention to pupils' feelings is a 'soft' activity and unnecessary, he or she will probably not develop the competency to show empathic understanding" (p.81). In the context of the fifth study of this PhD, we adapted this learning cycle to challenge science teachers' beliefs and practices in the Chinese primary school context. Video cases were used reflectively in our intervention. The video-based intervention was a way to bridge the perceived gap between theory and practice and augment the opportunities to observe and interact with real classroom activities (Santagata, 2009; Sherin & van Es, 2005). This type of professional development is also coined by Spillane (2000) as a "quasi-cognitive perspective" assisting teachers in "reconstructing their existing knowledge and beliefs, rather than the passive assimilation or rote memorization of new knowledge" (p.17). The findings of the present study contribute to the existing literature in three ways: (1) the present study provides evidence that teacher beliefs can be challenged, even though they are considered to be stable and resistant to change; (2) this study confirmed that teachers' instructional behaviors can be influenced by working with a video-based and constructivist-orientated intervention programs; (3) the study can partly support claims that the actual use of ICT in a teacher development program will - in a reciprocal way - promote specific teacher cognitions and practices related to ICT (see Chen, 1997, cited in Liu, 2010); and (4) to a certain level,

this study supports the consensus about the interrelationship between teacher cognitions and teaching practices.

4. Limitations and future research

In this section we outline the limitations of the studies that might have affected the results and consequently affect the generalizability of our findings. The limitations are related to (a) the research methodology, (b) our research sample, (c) the research instruments, (d) the research design, (e) the analysis approach, and (f) the intervention method. Directions for future studies are linked to these limitations.

a. The first limitation concerns the research methodology. Most of the individual studies build only on self report research instruments. Qualitative methods (such as interviews, classroom observation) should substantiate the research findings. A mixed research method of qualitative and quantitative should therefore be adopted for further studies. In view of corroborating the present findings, qualitative studies have to be set up, next to a study of actual teaching and learning practices of Chinese (pre-service) teachers; e.g., based on interviews, focus groups, and observations of real classroom behaviors.

b. Secondly, the sample was too small to reflect the Chinese (pre-service) teacher population in a representative way, especially in Chapter 6. This affects the generalizability of our research findings. It should also be noted that the findings of the study have to be interpreted in a careful way since a convenience sampling procedure was applied. The sampling procedure was based on a bilateral collaboration between Ghent University and four Chinese Normal universities (and their associated primary schools). The selection of the participants may have caused uncontrolled bias. In this respect, the results cannot simply be generalized to other educational levels and other regions, provinces. Future research may pay more attention to rigor in the sampling procedure.

c. Thirdly, the research instruments used in the sub-studies were originally developed by Western researchers in Western educational settings. Although much time and energy was put into the translation and adaptation of the Chinese versions, this version might still be less suitable for Chinese respondents (e.g. in the way questions were stated, or the way it reflects the Chinese context). As recommended in the literature, "single forward and back-translation procedure" is an insufficient method of making and checking the quality of a translation and may result in a poor translation, since the translation and adaptation task is complex and requires a combination of techniques (Hambleton, 2001). This calls for the development of research instruments that are completely based on Chinese educational settings.

d. The fourth limitation of our studies is that the concept of "cultural context" was used in a particular way within our analytic framework. As clearly stressed in the introductory chapter the cross-cultural nature of the studies was limited to the indirect check whether the teacher cognitions and instruments used to determine them were applicable in the Chinese setting. Since we have to admit that teacher cognitions are embedded in their cultural context and are developed over long periods of time (Correa et al., 2007) and that ICT integration is also a cultural process embedded within a specific context, additional research is needed. Cross-cultural investigations can be a valuable approach to study the similarities and differences between the nature of teacher cognitions, and the nature of ICT classroom integration and teacher development processes in a Chinese culture and other cultural context.

e. The fifth limitation is the assumed independence of individuals as units of analysis. School level factors (leadership, school culture, infrastructure etc.), social background factors (economic status, social culture etc.) and national level factors (national policy, curriculum innovation etc.) influence teachers' ICT integration. A multilevel analysis would be helpful to consider the above levels. Especially when setting up replication studies with a larger group of (pre-service) teachers from a larger number of primary schools or teacher education institutions, a multilevel analysis approach could be adopted to consider the particular differences in teacher cognitions and ICT integration that could be attributed to differences related to other level related variables and processes.

f. A last important limitation concerns the nature of our intervention study. Our study did not include a comparison of video-based interventions to alternative (e.g., a text-based) interventions. This limitation makes it difficult to argue about the superior impact of video-based interventions as compared to e.g., text-based interventions. Nevertheless, in the present study a control group (no-intervention) was involved to test for differences. Furthermore, the intervention was presented to the experimental group during a relatively short treatment period of ten weeks. Therefore, in future research, a longer period or repeated intervention period could be implemented to investigate the short-term, middle-term and long-term effects of the experimental treatment. If the current some positive findings are supported by a longer period intervention program, this will have stronger implications for teacher professional development programs. The findings of this study could also be further qualified by a comparative research design and by setting up experiments with different types of training strategies and contents.

5. Implications

5.1. Theoretical implications

At the theoretical level, the dissertation contributes to a better understanding of pre/in-service teacher cognitions, the interactions between teacher cognitions and their influence on the integrated educational use of ICT in Chinese primary schools.

First, considering the construct of teacher educational beliefs, researchers have made attempts to delineate prototypical teacher beliefs. In the literature, authors mainly distinguish between "traditional beliefs" and "constructivist beliefs" (Woolley et al., 2004). This was elaborated in previous chapters. the results of this dissertation contribute to the state of the art by reconfirming the two key dimensions (constructivist and traditional) in educational beliefs in Chinese primary school teachers and pre-service teachers. The two-dimensional construct seems to be largely in line with the two key dimensions reported in western settings.

Second, this study highlights the vital role of teacher cognitions influencing ICT integration in Chinese primary schools. By gaining a better understanding of the complex relationship we might gain a better understanding why some teachers are not willing to integrate ICT in ways advocated in the literature (Ertmer, 2005). As noted by Ertmer (2005), ultimately, the goal is to facilitate uses of ICT that lead to increased student learning. "Little will have been accomplished if research into educational beliefs fails to provide insights into the relationship between beliefs...and teacher practices, teacher knowledge, and student outcomes" (Pajares, 1992, p. 327).

Third, our studies contribute to the literature about teacher development by stating that teacher beliefs can be challenged and teachers' instructional behaviors can be influenced by video-based and constructivist-orientated intervention programs. The latter is an interesting finding that contrasts with a consensus among researchers that beliefs are deep-rooted and persistent (Calderhead & Robson, 1991) and changes in teacher beliefs are not evident (Kagan, 1992; Pajares, 1992). Also Sherin and van Es (2005) have described how teachers participating in year-long video clubs developed "professional vision" and evolved from noting teacher actions and strategies when viewing their own and others' classroom teaching videos to focus on student meaning-making and learning.

Lastly, although the study is out of the scope of a cross-cultural study, it still contributes to the research literature by adding further evidence about cultural and contextual differences in teacher cognitions and the influencing factors of ICT integration. This contribution builds on – as explained above – the cross-cultural generalizability of theories (conceptions and instruments) developed in Western settings.

5.2. Practical implications

The findings of the study also provide direct and clear implications for educational teacher education practices, teacher professional development, and educational policy development. In this section, the most important practical implications of the results will be outlined.

First, our research implies that teacher education and teacher development programs should reconsider its training approach. To prepare the teachers for effective ICT use, a well-designed professional development program is mandatory. Teacher cognitions have to be considered to explore and challenge during the program. Too many professional development courses

focus solely on teachers' acquiring basic ICT skills in Chinese settings. According to our findings, ICT integration is influenced by the complex of (pre-service) teacher cognitions. Teacher education and training programs should involve (pre-service) teachers in professional development projects in view of developing a richer set of teacher cognitions, such as broader belief systems that are aligned with a constructivist learning environment and provide (pre-service) teachers with a conducive and non-threatening environment to experience success in using ICT. This will allow them to gain competence and confidence in using computers for teaching and learning (Teo, 2008). Furthermore, teachers' individual cognitions should be challenged since there is a clear connection between e.g., teachers' educational beliefs and their instructional practices (Ertmer 1999; Richardson, 1996). Nespor (1987) suggests that instructional change is not a matter of abandoning beliefs, but of gradually replacing or enriching them with belief systems that are relevant in view of the instructional context. In addition, it is stressed that these beliefs can best be influenced through concrete experiences in a supportive environment (Nespor, 1987). This introduces a change in the way professional development is to be set up. Even for pre-service teachers, teacher training program should consider providing them with tools and experiences that will be used regularly in their future job as a teacher as teaching has became a highly complex activity in this knowledge economy (Teo, Lee, & Chai, 2008).

Second, the reflective use of video cases in teacher learning has been used as a way to bridge the perceived gap between theory and practice and augment the opportunities to observe and interact on real classroom activities (Sherin & van Es, 2005). The Video-based Teacher Development Project implemented in our intervention study supplies teachers with relevant practical experiences which can be shared with other teacher educators in Chinese educational settings. The project has examined and adjusted experimental learning cycle theory and realistic teacher education theory with videotaped teaching cases from Chinese primary classrooms. It is a context-related, video-based, constructivist-orientated, practical reflection-focused teacher education model.

Finally, as ICT continues to drive changes in present and future society, school policies need to define upfront their organizational vision and actions

in view of planned change. A number of studies (e.g., Tearle, 2003) present evidence that an increase in classroom use of ICT in classroom can be linked to a favorable policy environment. A school-level policy produces the desirability to build a coherent and supportive community of practice associated with effective, regular, and consistent ICT use (Dawes, 2001). ICT policy-makers need to realize that teachers shouldn't be excluded from school policy planning when considering future educational ICT use. Their perceptions about this school policy are too important to be neglected. Thus, teachers should be involved and be familiar with school level policies. Lastly, considering the influence of the teacher cognitions on classroom use of ICT, teacher professional development should be aware of the direct and mediating impact of these variables. Especially, the essential role of teacher ICT motivation should be recognized.

6. Final conclusions

The central goal of the dissertation was to explore the nature of teacher beliefs and the relationship between teacher cognitions and the level of ICT integration. Specific teacher cognitions and their practices with and without ICT use were challenged by way of an intervention study.

Overall, the following conclusions can be drawn from our study:

First, considering the nature and profile of teacher beliefs, the two educational belief dimensions (constructivist and traditional) that were identified in the Chinese context seem to be largely in line with the two key dimensions reported in western settings, both within pre-service and in-service teachers. Both pre-service and in-service teachers reported higher constructivist beliefs than traditional beliefs. We may also claim that under the influences of modern (Western) educational theories and innovations, constructivism has become a trend in both Chinese teacher education programs.

Second, the intention of pre-service teachers and practices of in-service teachers about ICT integration significantly correlates with teacher cognitions variables, such as teacher constructivist beliefs, teacher self-efficacy, attitudes toward ICT in education, motivation on ICT use etc. Furthermore, a clear interplay between teacher cognitions was found to be associated with the integration of ICT in Chinese primary classrooms.

Third, our study did provide evidence for statements from previous studies that teacher beliefs and instructional behaviors can be challenged through reflection based teacher development programmes. In the present context this was based on video-based and constructivist-orientated intervention programs. This shows that teavher cognitions, though stable and resistant to change – can be affected through specific intervention programs.

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Summary

Teacher characteristics and ICT integration: a study in pre-service and in-service primary education teachers in China

Introduction

In current information society, information and communication technologies (ICTs) play an essential role in teaching and learning. ICT has the potential to support rich learning environments, allowing learners to become active learners, and adopt multiple perspectives on complex phenomena. By using ICT in learning, students can foster flexible knowledge construction in complex learning domains (Godfrey, 2001). Primary schools in China have more and more access to up-to-date ICT hardware and software. However, there is a serious contradiction in the extent the access to ICT is mirrored in the actual integrated use of ICT in education (Li, 2003). Next to access to ICT, other critical variables seem to play a role to foster a basic level of ICT integration. Xie (2006) argues in this context that researchers should help teachers reflect and develop their beliefs about ICT in Chinese primary schools. This statement is exemplary for the central problem studied in this dissertation: What is the nature of Chinese primary school teacher cognitions and how is this related to the nature and level of ICT integration.

Theoretical framework

A review of the literature about teacher cognitions and ICT results in a large conceptual confusion about the nature of these teacher cognitions. In addition, available research is less clear how all these different teacher cognitions (e.g., beliefs, self-efficacy, attitudes, motivation) are interlinked and play a role in teachers' intention to use and the actual use of ICT. In the introductory chapter, we therefore introduce a section about our conceptual framework

and available theories that - from an eclectic point of view - help to bring together the concepts currently being used in the research literature about ICT in education and teacher cognitions. We therefore integrate four mainstream theories that help to describe and explain teachers' ICT adoption. (a) Teacher thoughts and action process theory (Clark & Peterson, 1986). These authors argue that teacher behavior is substantially affected and even determined by teacher cognitions, e.g., teacher beliefs, perceptions, and decision making process. (b) The theory of planned behavior (Ajzen, 1991). The theory is an extension of the theory of reasoned action developed by Martin Fishbein and Icek Ajzen (1975). The key relevance of the theory of reasoned action is the way it predicts behavioral intentions, and how attitude predict behavior. (c) The expectancy-value theory of achievement motivation (Wigfield & Eccles, 2000). This theory introduces the importance of – next to external variables – internal variables that comprise cognitive processes (perceptions and attributions) and motivational beliefs (goals, self-concept and affective memory) that determine a persons' judgment about the value of a task and the expectancy they will be able to carry out the task. It is this perspective on the value-expectancy of a task that will determine a persons' willingness choose a task, to persist in carrying out the task, and performance well. Finally, the (d) technology acceptance model (Davis, Bagozzi, & Warshaw, 1989), which links the perceived usefulness and ease of use with attitudes toward using technology and its actual use.

Given the conceptual confusion in the literature about the internal teacher related variables, we decide in this PhD to adopt the umbrella concept of teacher cognitions to point at the set of teacher beliefs, attitudes, motivation, self-efficacy, and perceptions. But next to this umbrella term, also the concept of teacher thoughts and teacher thinking processes are used interchangeably.

Lastly, in this dissertation, we point at the cultural context that plays a role in teaching and learning contexts. A cultural perspective is presented to indicate that the adoption of Western conceptions about teacher cognitions and Western research instruments is not obvious and that we should take care in interpreting the findings and in developing implications from the research findings.

Research objectives

Given the central role of teacher cognitions to explain the potential educational use of ICT by teachers, the central research problem of this dissertation is clear. Especially the fact that there is a lack of research set up in the Chinese cultural context, our dissertation aims at mapping the nature of teacher cognitions in Chinese in-service and pre-service primary school teachers. Next, the relationship between teacher cognitions and ICT integration in the classroom is explored. This brings us to three research objectives: (1) exploration of the nature of teacher beliefs in China; (2) examination of teacher cognitions as they can be related to ICT integration; and (3) a study of ways to challenge teacher beliefs and educational practices.

The studies

The dissertation builds on five studies which will be clustered around the three research objectives.

Exploration of teacher cognitions

The first two studies focus on developing a deeper understanding of teacher cognitions in in-service (Chapter 2) and pre-service (Chapter 3) teachers. In particular, we focus on teacher educational beliefs as part of teacher cognitions. We build on existing beliefs dimensions, such as traditional versus constructivist beliefs about teaching and learning. Additionally, we take into account a number of teacher background variables. The results show that in-service teachers' gender and subject domain especially interact with the adoption of traditional educational beliefs. In-service teacher beliefs could be clustered following four profiles: a constructivist profile, a mixed constructivist/traditional profile, a traditional profile, and a mixed low constructivist/traditional profile. Significant differences in 'constructivist teaching' with respect to gender, grade level, and studying subjects of pre-service teachers were found. First year pre-service teachers hold to a larger extent constructivist beliefs as compared to senior year student

teachers. This might be due to their increase in actual teaching and learning experiences.

Linking teacher cognitions and ICT integration

The studies in Chapters 4 and 5 center on the complex interplay of a number of teacher cognitions and how this interconnected set of teacher cognitions helps to explain educational ICT integration. Path analysis was used to explore the relationships between teacher cognitions and ICT integration. In-service teachers' classroom use of ICT seems to depend in a direct way on teachers' motivation to use computers in the classroom and the actual supportive use of ICT by teachers. Teacher constructivist beliefs, their attitudes towards computers in education and perceptions about the ICT-related school policy influence ICT integration rather in an indirect way. For pre-service teachers, prospective ICT integration could be directly predicted on the base of teacher cognitions (constructivist teaching beliefs, teacher self-efficacy, computer self-efficacy and computer attitudes in education), and indirectly by the gender of student teachers.

Teacher development

The study reported in Chapter 6 aims at challenging primary science teachers' cognitions and teaching practices. After the intervention, teachers in the experimental groups reported the adoption of a lesser degree of traditional and a larger degree of constructivist beliefs. In addition, there is an increase in the adoption of personal science teaching efficacy beliefs by in-service teachers after the experimental intervention. Video data show that teaching practices have changed and reflect a stronger constructivist dimension. The teachers seem to adopt to a larger extent practical (application oriented, hands-on) activities and involve to a larger extent students in the use of ICT.

Implications

At the theoretical level, the dissertation contributes to a better understanding of pre/in-service teachers' cognitions and the way these cognitions are related to ICT integration in Chinese primary schools. It contributes to the literature about teacher development by stating that teacher beliefs can be challenged and teachers' instructional behavior can be influenced by video-based and constructivist-orientated intervention programs. The findings of the study also have clear implications for educational practices in the context of teacher education, teacher professional development, and educational policy development.

Limitations

The limitations of the studies are related to the dominant use of surveys, the generalizability of the findings, and other characteristics of the research design. Most of the studies built only on self-report questionnaires. Though large samples were involved in the study, these nevertheless remain small considering the size of the population. Lastly, the research instruments could have been developed in a different way. Whereas – in the current studies – they build on translations and adaptations of existing instruments from Western origin, it is recommended to develop localized versions of such instruments. The latter should start from a qualitative perspective to be able to capture the specificities of the Chinese cultural context.

Conclusions

To conclude, this dissertation explored the nature teacher cognitions and how this is related to educational ICT integration. Firstly, considering the nature of particular teacher cognitions, we can conclude that - also in the Chinese cultural context - two educational belief dimensions (constructivist and traditional) can be identified; these are largely in line with the two key dimensions reported in Western settings. This seems to be the case in both pre-service and in-service teachers. Secondly, the interplay between teacher cognitions was found to be associated with levels of ICT integration in Chinese primary school classrooms or helps to explain how pre-service teachers seem to be willing to adopt ICT in their future teaching practices. Thirdly, the study presents evidence in line with previous studies that teacher cognitions and instructional strategies can be challenged through a video-based and constructivist-orientated intervention program.

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Nederlandstalige samenvatting

Inleiding

In onze westerse samenleving speelt informatie- en communicatietechnologie een belangrijke rol voor onderwijzen en leren. ICT biedt mogelijkheden om rijke leeromgevingen te creëren zodat leerlingen meer actief betrokken worden bij hun leerproces en complexe fenomenen op meervoudige manieren kunnen benaderen. Door ICT in te zetten in leerprocessen kunnen leerlingen hun kennis op een flexibele manier construeren in complexe leerdomeinen. (Godfrey, 2001). Basisscholen in China beschikken steeds meer over de nodige hard- en software. Er is echter een grote kloof tussen de beschikbaarheid van ICT en de mate waarin ICT werkelijk wordt ingezet in onderwijs- en leerprocessen (Li, 2003). Xie (2006) beargumenteert in deze context dat onderzoekers leraren moeten ondersteunen om te reflecteren over hun opvattingen over de rol van ICT in onderwijs. Leraren moeten ook ondersteund worden hun onderwijsopvattingen over ICT in onderwijs verder te ontwikkelen.

Dit sluit aan bij de probleemstelling van dit proefschrift: welke cognities hebben leraren in het Chinese basisonderwijs en op welke wijze houden deze verband met de aard en de graad van ICT-integratie?

Theoretisch kader

Een literatuurstudie over leraarcognities en ICT wijst op een grote conceptuele verwarring. Bovendien is de bestaande literatuur minder duidelijk hoe deze verschillende cognities (bv. opvattingen, doelmatigheidsbeleving, attituden, motivatie...) met elkaar in verband staan en op welke manier deze verklarend zijn voor de intentie van leraren om ICT te gebruiken en het werkelijke gebruik. In het inleidende hoofdstuk introduceren we om deze reden een conceptueel raamwerk en een overzicht van bestaande theorieën dat ons helpt om – vanuit een eclectische benadering – verschillende concepten samen te brengen die beschreven staan in de

onderzoeksliteratuur over ICT en onderwijs en over leraarcognities. Daarom integreren we vier toonaangevende theorieën die ons helpen om de adoptie van ICT te beschrijven en te verklaren. (a) Denkprocessen van leraren en action process theory van Clark en Peterson (1986). Uitgangspunt in deze theorie is dat het gedrag van leraren beïnvloed en zelfs bepaald wordt door cognities zoals lerarenopyattingen, percepties en beslissingsprocessen. (b) De theory of planned behavior (Ajzen, 1991). Deze theorie is een uitbreiding van de theory of reasoned action van Fishbein en Ajzen (1975). De voornaamste bijdrage van deze theorie is de causale keten tussen attituden, intenties en gedrag. (c) Expectancy value theory of achievement motivation (Wigfield & Eccles, 2000). Deze theorie introduceert het belang van externe variabelen naast interne variabelen die cognitieve processen (percepties en attributies) en motivationele overtuigingen (doelen, zelfconcept en affectief geheugen) omvatten. Deze zijn determinerend voor het oordeel van een individu over de waarde van een taak en de verwachting dat deze taak zal worden uitgevoerd. Het is deze benadering van waarde-verwachting van een taak die determinerend is voor de bereidheid van een individu om een taak te kiezen, om door te zetten bij het uitvoeren van een taak en om goed te presteren. Ten slotte het (d) Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989), waarin zelfwaargenomen bruikbaarheid en gebruiksgemak, samen met ICT-specifieke attituden voorspellend zijn voor ICT-gebruik.

Gegeven de conceptuele verwarring in de literatuur over interne leraargebonden variabelen, beslissen we in dit proefschrift te *leraarcognities* (teacher cognitions) te hanteren als een overkoepelend begrip om te wijzen op een geheel van lerarenopvattingen, attituden, motivatie, doelmatigheidsbeleving en percepties. Naast leraarcognities, hanteren we ook het begrip 'gedachten van leraren' (teacher thoughts) en denkprocessen van leraren (teacher thinking) als equivalente aanduidingen van ditzelfde begrip.

Ten slotte wijzen we er in dit proefschrift op dat de culturele context een belangrijke rol speelt voor leren en onderwijzen. Er wordt een cultureel perspectief geïntroduceerd om aan te geven dat het gebruik van westerse concepties over leraarcognities niet vanzelfsprekend is, net zoals het gebruik van westerse onderzoeksinstrumenten en dat we om deze reden voorzichtig moeten zijn bij het interpreteren van bevindingen en formuleren van implicaties vanuit het onderzoek.

Onderzoeksdoelen

De centrale rol van leraarcognities om het onderwijskundige gebruik van ICT te verklaren, maakt het onderzoeksdoel duidelijk. Vanuit een gebrek aan onderzoek in de Chinese culturele context, wil dit proefschrift bijdragen om leraarcognities in beeld te brengen, dit zowel bij leraren die in de praktijk staan als bij leraren in opleiding. Vervolgens willen we het verband verkennen tussen leraarcognities en ICT-integratie in de klas. Dit leidt tot de onderzoeksdoelen: volgende drie (1)het exploreren van onderwijsopvattingen in China; (2) het onderzoeken hoe leraarcognities samenhang vertonen met ICT-integratie, en (3) een interventiestudie om leraren te laten reflecteren op hun opvattingen en hun gedrag.

De verschillende studies

Dit proefschrift vat vijf studies die hieronder gekoppeld worden aan de drie onderzoeksdoelen.

Het exploreren van leraarcognities

De eerste twee studies richten zich op de verkenning van leraarcognities bij leraren in de praktijk (Hoofdstuk 2) en leraren in opleiding (Hoofdstuk 3). In het bijzonder richten we ons op onderwijsopvattingen als een onderdeel van leraarcognities. We bouwen verder op bestaande dimensies van onderwijsopvattingen, zoals traditionele en constructivistische opvattingen over leren en onderwijzen. Verder houden we rekening met een aantal achtergrondkenmerken van leraren. De resultaten laten zien dat sekse en vakgebied van leraren in de praktijk samenhangen met traditionele opvattingen over onderwijs. Leraren in de praktijk werden geclusterd in vier profielen: een constructivistische en traditionele opvattingen en een profiel met lage scores voor beide types opvattingen. Ook bij leraren in opleiding werden er significante verschillen gevonden in constructivistische opvattingen op basis van sekse, graad en vakgebied. Laatstejaars in de lerarenopleiding rapporteren minder constructivistische opvattingen in vergelijking met eerstejaars. Dit is mogelijk te wijten aan hun groeiende onderwijs- en leerervaringen.

De relatie tussen leraarcognities en ICT-integratie

Hoofdstukken 4 en 5 richten zich op het complexe samenspel tussen een aantal leraarcognities en hoe dit kluwen aan leraarcognities een bijdrage levert tot het verklaren van onderwijskundig ICT-gebruik. Om de relatie tussen leraarcognities en ICT-integratie te verkennen, werd gebruik gemaakt van padanalyses. De resultaten tonen aan dat ICT-gebruik van leraren in de praktijk direct verklaard wordt door de motivatie om ICT te gebruiken en tevens door de mate van ondersteunend computergebruik. Constructivistische onderwijsopvattingen, computerattituden en opvattingen over het ICT-beleid hebben eerder een indirect effect op het gebruik van ICT in de klas. Het verwachte ICT-gebruik door studentleraren wordt uitsluitend verklaard door cognities, met name constructivistische onderwijsopvattingen, doelmatigheidsbeleving, computerspecifieke doelmatigheidsbeleving en computerattituden en indirect door sekse.

Professionele ontwikkeling

De studie in hoofdstuk 6 beschrijft een interventie die als doel heeft om de cognities van leraren wetenschappen in het basisonderwijs en hun onderwijspraktijk uit te dagen. Leraren in de experimentele groep rapporteren de interventie minder traditionele en meer constructivistische na onderwijsopvattingen en een hogere doelmatigheidsbeleving met betrekking wetenschapsonderwijs. Het videomateriaal toont aan dat de tot veranderd sterker is onderwijspraktijk is en doordrongen van constructivistische praktijken. De leraren blijken meer praktische activiteiten uit te voeren en betrekken de leerlingen meer bij het gebruik van ICT.
Implicaties

De theoretische relevantie van dit doctoraat schuilt in een beter begrip van de relatie tussen leraarcognities en de manier waarop deze cognities samenhangen met ICT-gebruik in de basisschool in China. Het doctoraat levert een bijdrage tot het domein van de professionele ontwikkeling door aan te tonen dat onderwijsopvattingen van leraren kunnen uitgedaagd worden en dat instructiegedrag van leraren kan beïnvloed worden door een constructivistisch georiënteerde interventie. Deze bevindingen in deze studie hebben duidelijk implicaties voor de lerarenopleiding, de professionele ontwikkeling en het onderwijsbeleid.

Beperkingen van het onderzoek

De beperkingen van deze studie hebben te maken met het dominante gebruik van vragenlijsten, de generaliseerbaarheid van de resultaten en andere kenmerken die met het onderzoeksdesign te maken hebben. Hoewel grote steekproeven werden bevraagd, blijven deze toch nog relatief klein indien men rekening houdt met de grootte van de totale populatie. Ten slotte konden de onderzoeksinstrumenten op een andere manier worden ontwikkeld. De instrumenten die werden gebruikt in de beschreven studies zijn gebaseerd op bestaande schalen die in een westerse context werden ontwikkeld. Het verdient aanbeveling om gecontextualiseerde versies van deze instrumenten te ontwikkelen. Dit kan door te vertrekken vanuit een kwalitatieve benadering om op deze wijze de specificiteit van de Chinese culturele context beter te vatten.

Conclusie

In dit proefschrift werd de aard van leraarcognities onderzocht en hoe deze samenhangen met onderwijskundig ICT-gebruik. We kunnen ten eerste besluiten we dat de instrumenten om traditionele en constructivistische opvattingen te meten quasi dezelfde dimensionaliteit vertonen in de Chinese context, zowel bij leraren als in de lerarenopleiding. Ten tweede blijkt dat verschillende leraarcognities samenhangen met de integratie van ICT in de Chinese basisschool. Deze cognities spelen ook een belangrijke rol om het verwachte gebruik van ICT in de praktijk van toekomstige leraren te begrijpen. Ten derde werd bewijskracht gevonden voor de stelling dat leraarcognities en instructiestrategieën van leraren kunnen uitgedaagd worden onder invloed van een videogebaseerd, constructivistisch georiënteerd interventieprogramma.

Referenties

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