

Understanding structural and cultural school characteristics in relation to educational change: the case of ICT integration

Jo Tondeur^{a*}, Geert Devos^a, Mieke Van Houtte^b, Johan van Braak^a and Martin Valcke^a

^aDepartment of Educational Studies, Ghent University, Ghent, Belgium; ^bDepartment of Sociology, Ghent University, Ghent, Belgium

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This study builds on the idea that school characteristics affect educational change, such as ICT integration. The goal of this inquiry is to explore both structural school characteristics (i.e. infrastructure and support) and cultural school characteristics (i.e. leadership and innovativeness) and how they contribute to ICT integration in the classroom. A survey of 527 teachers in 68 primary schools in Flanders (Belgium) was conducted that focused on teacher perceptions about structural and cultural school characteristics and their use of ICT in the classroom. In order to study the variables at school level, teacher responses were aggregated. The next step was to delineate school profiles originating from structural and cultural school characteristics by using a cluster analysis. Finally, the relationship between these school profiles and ICT integration was studied. The results suggest that (1) structural and cultural school characteristics fit together and (2) are relevant catalysts for ICT integration in the classroom.

Keywords: educational change; ICT integration; school policies; school culture; primary education

Introduction

The speed with which the revolution of Information and Communication Technology (ICT) has taken place is phenomenal. Today, school teachers in many countries of the world are dealing with “digital natives” who are growing up with ICT as an omnipresent tool, in the same way that an earlier generation took television for granted. The changes have been faster and more sweeping than could have been imagined two or three decades ago (Facer et al. 2003). ICT allows us to create, collect, store and use knowledge and information; it enables us to connect with people and resources all over the world, to collaborate in the creation of knowledge and to distribute and benefit from knowledge products (Loveless and Dore 2002).

In this context, teachers are almost inevitably pressed to integrate ICT into the curriculum. But integrating ICT is a complex process of educational change, and the adoption of ICT applications in schools is still extremely varied (O’Dwyer, Russell, and Bebell 2004) and, in many instances, very limited (Smeets 2005). Some teachers are intrinsically motivated to use ICT in educational practice, while others do not share this affinity. For this reason, many researchers have centred on critical teacher characteristics associated with educational ICT use, such as teachers’ innovativeness

*Corresponding author. Email: jo.tondeur@ugent.be

(e.g. van Braak 2001) and their computer experience (e.g. Bovée, Voogt, and Meelissen 2007). A mere focus on teacher characteristics could lead to “individual blame” rather than “system blame” when focusing on explaining variables related to limited ICT integration.

Previous research often ignored the systemic nature of ICT integration, including the role of school characteristics. In this respect, Tondeur, van Braak, and Valcke (2007) point at the differences between schools, suggesting that aspirations of national educational authorities do not automatically lead to educational change. Schools differ with respect to performance levels, innovation capacity and contextual characteristics (Otto and Albion 2002). This implies that educational improvement or innovation efforts should consider to a large extent – the “power of site or place” (Fullan 2001). Therefore, this research centres on the hypothesis that school characteristics affect the integration of ICT at classroom level.

Several studies reveal that ICT works in some schools and hardly in others because of *structural* school characteristics, such as the provision of infrastructure (Bradley and Russell 1997) and ICT-related support (Lawson and Comber 1999). Bradley and Russell (1997), for instance, conclude that, without adequate recourses, there is little opportunity for teachers to integrate computers into their teaching. It also appears that teachers reporting a high degree of support incorporate ICT into their practice more often. Successful ICT integration, then, seems to be related to structural actions taken at school level.

Nonetheless, evidence indicates that, despite large expenditures, increased access and almost universal ICT use by school-age children, only a small number of teachers have integrated ICT as such that it results in significant changes in classroom practices (Kozma 2003; Smeets 2005). One reason could be the solidity of *cultural* school characteristics (see, Lam, Yim, and Lam 2002; Tearle 2003). Every school develops a distinct culture, which could be loosely defined as “the way we do things here” (Deal and Peterson 1999). While most research on ICT integration in education concentrates on structural school characteristics, it tends to neglect the cultural dimensions.

This study builds on the idea that both structural *and* cultural school characteristics affect educational change, such as ICT integration. It is expected that schools, characterised by structural characteristics including, e.g. adequate infrastructure and ICT-planning, as well as by cultural characteristics, such as supportive leadership and innovativeness, will reflect a higher level of ICT integration. Therefore, the study first researches whether schools can be clustered on the basis of a typical set of structural school dimensions and a set of cultural school characteristics. We expect this clustering activity to result in different school profiles. In a second step, we examine how different school profiles can be related to differences in ICT integration in the classroom. Before presenting the results of the empirical study, we first elaborate the complexity of ICT integration. Then, we describe the different dimensions underlying structural and cultural school characteristics and how they are likely to influence the use of ICT in the classroom. In a concluding paragraph, the implications for practice and future research are discussed.

Background

In this background section, we review the literature grounding the importance of both structural and cultural school characteristics. In particular, we concentrate on studies that link these characteristics to educational change and, more specifically, the change



linked to the use of ICT in education. Yet, this list of factors cannot reflect the full complexity of school characteristics. The knowledge base presented in this article is by no means definitive or exhaustive. Understanding one element leads to the necessity to understand the foundation on which that element rests, which in turn can lead to the discovery of other significant elements. First, we elaborate on the dependent research variable: the integration of ICT in education.

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ICT integration in education: a complex process of change

Until recently, ICT was known only as “Information Technology” (IT). That term was coined in the 1970s (Loveless and Dore 2002) to describe technology that gives the user direct access to a wide range of diverse information types (Ertmer 2005). IT has been superseded by the term “ICT” to explicitly include the field of electronic communication (Kennewell, Parkinson, and Tanner 2000). Today, ICT has ballooned to encompass many types of technological devices. However, in the present study, we concentrate on computers (laptop, desktop) as technological tools. Linkage to the Internet is an additional component. “ICT integration” and “the adoption of computer use” will be used as interchangeable concepts.

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Despite large expenditures, increased access and almost universal use by school-age children, several observers have questioned the extent to which ICT is affecting teaching and learning. Research reveals that, although we observe an overall increase in the use of ICT, significant differences are observed in the way ICT is actually implemented in classroom and school settings (Waxman, Connell, and Gray 2002). These studies demonstrate that ICT integration does not easily result in concrete changes in educational practices at class level.

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In the literature, the question is repeatedly put forward as to what variables determine whether and how teachers use computers in the classroom. Clearly, effectively integrating ICT into learning systems is much more complicated than providing computers and securing a connection to the Internet. Computers are merely tools; no technology can fix an underdeveloped educational philosophy or compensate for inadequate practices (Ertmer 2005). Critical choices have to be made in terms of the relationship between ICT use and educational objectives. In this respect, the process of ICT integration is a dynamic one involving interacting factors over time. Moreover, no single solution exists to address the challenges related to the varying perspectives on ICT use (Niederhauser and Stoddart 2001).

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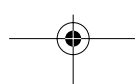
Therefore, researchers argue for a more holistic approach to study ICT integration (Kennewell, Parkinson, and Tanner 2000; Kozma 2003). Recent studies have incorporated additional factors, such as the role of educational beliefs (Ertmer 2005; Tondeur et al. 2008) and how teachers perform their role (Postholm 2006). But these factors are again treated as individual teacher characteristics. Our aim is to shift the focus from individual teachers to the school in which teachers participate and interact. In this respect, we assume a relationship between ICT integration and school characteristics. We make in this context a distinction between structural and cultural school characteristics.

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Structural school characteristics

At the school level, it is generally acknowledged that educational change benefits from a supportive structural environment (e.g. Fullan 2001; Senge 2000). The “structural



perspective” stressed the adoption of a rational, systematic and coordinated strategy (van den Berg, Vandenberghe, and Slegers 1999). Subsequently, team development and professionalism of teachers are necessary conditions (Stoll 1999). Other authors stress sufficient support to guide changes and continuous quality control (MacBeath 1999). These structural factors require the development of a local school policy in order to guarantee a sustainable change process (Tondeur et al. 2008).

Studies focusing on the relationship between structural school characteristics and ICT integration are often limited to a focus on access to computers and software (cf. Bradley and Russell 1997). However, recent studies (e.g. Dawson and Rakes 2003; Otto and Albion 2002) demonstrate that a substantial proportion of the variation in educational ICT use is rather explained by other structural school characteristics, such as the development of an ICT plan (Otto and Albion 2002). It appears that strategic ICT plans that set clear goals and define the means to realise these goals are a crucial step towards actual ICT integration (Bryderup and Kowalski 2002). In addition, Kennewell, Parkinson, and Tanner (2000) suggest that successful ICT integration should also comprise an assessment and evaluation approach to obtain a clear picture of current ICT use. This fosters an iterative cycle in planning and monitoring ICT integration. Based on the research mentioned above, we account for three different dimensions of structural school characteristics: “ICT planning”, including aspects of evaluation and cooperation, “ICT-related support” and the “availability of infrastructure”.

Cultural school characteristics

As stated earlier, the focus on structural school characteristics can be criticised, since it neglects the cultural dimension. According to Stoll (1999), this is because structural school characteristics are visible and relatively easy to manipulate. Others state that a focus on structural school characteristics will only result in short-lived and superficial educational changes (Creemers 2002). Therefore, several researchers (e.g. Fullan 2001) argue that explaining failures in educational change has to go beyond structural problems, such as a lack of adequate materials, ineffective planning or minimal support.

But what exactly are *cultural* school characteristics? “Culture” is difficult to define; it is elusive because it is largely implicit, and we only see surface aspects. “Cultural school characteristics” are about the way people perceive, think and feel about things at the school. In this study, cultural school characteristics are defined as “the basic assumptions, norms and values and cultural artefacts that are shared by school members, which influence their functioning at school” (Maslowski 2001, 8–9). In other words, school culture can be considered as learned assumptions shared by group members (Schein 1992) and assumed ways of doing things among communities of teachers who have had to deal with similar demands and constraints over many years (Hargreaves 1995). This broad definition introduces a multifaceted concept that is composed of different dimensions (Devos et al. 2007; Engels et al. 2008; Maslowski 2001). In this study, we centre on three underlying aspects of cultural school characteristics (based on Devos et al. 2007):

- (1) “Innovativeness” reflects the staff’s attitude towards educational innovations and to what extent they adapt themselves to changes and have an open attitude towards educational innovations.

- (2) “Goal orientedness” reflects to what extent the school vision is clearly formulated and shared by school members.
- (3) “Leadership” reflects to what extent the principal engages in supportive behaviour.

The selection of these specific cultural characteristics can be grounded in a large body of innovation and change literature that can easily be linked to changes invoked by ICT integration (e.g. Lam, Yim, and Lam 2002; Tearle 2003). The innovativeness of a school, for instance, can be linked to how “ready” it is to adopt ICT (Tearle 2003). With respect to the goal orientedness of a school, Dexter, Anderson, and Becker (1999) conclude that successful ICT integration depends upon goals shared by different actors and at different levels. Finally, several studies (e.g. Dawson and Rakes 2003; Kennewell, Parkinson, and Tanner 2000) support the claim that leadership that promotes change is a key factor when it comes to merging ICT and instruction. The leadership dimension is expected to have a specific impact on the implementation of innovations by teachers via their influence on participation in decision-making, feelings of uncertainty and professional developments (van den Berg, Vandenberghe, and Slegers 1999). When teachers feel that the school leader stands behind them, is concerned about their feelings and supports them when problems arise, they will be stimulated to adopt an innovation (Hargreaves 1994).

Research objectives and research questions

The present article centres on the empirical study of the relationship between ICT integration and organisational and cultural school characteristics. In a first step, we aim at delineating school profiles based on structural characteristics (infrastructure, ICT planning and ICT support) and cultural school characteristics (leadership, innovativeness, goal orientedness). In a second step, we examine how different school profiles are related to levels of ICT integration in the classroom. This results in the following list of research questions:

- (1) How and to what degree have primary school teachers integrated ICT into their classroom practices?
- (2) Can school profiles be distinguished that are characterised by different dimensions of structural and cultural school characteristics?
- (3) What is the association between school profiles and ICT integration in the classroom?

Research method

Sample

Sixty-eight primary schools in Flanders (the Dutch-speaking region of Belgium) participated in the study. At least one teacher for each grade level completed a questionnaire, resulting in data from at least six teachers per school. The sample comprised 527 teachers, of which 428 were female. Teacher age varied from 22 to 64 years, with an average age of 38 years.

Mainstream primary education in Flanders is aimed at children from 6 to 12 years of age and comprises six consecutive years of study. Educational policies are

characterised by a high level of local school autonomy as to curriculum development, classroom organisation, evaluation approaches, etc. Nevertheless, most schools opt for a traditional year group system, and most classes and subjects are taught by the same teacher during the school year (Ministry of the Flemish Community 2005).¹

Procedure and instruments

A questionnaire was developed in order to gather information from teachers about (1) the central dependent variable “ICT integration in the classroom” and (2) “dimensions of structural and cultural school characteristics”. In order to study these characteristics at the school level, the individual teacher responses were aggregated (see Van Houtte 2004).

Measuring ICT integration in the classroom

The “Class Use of Computer Scale” (eight items) of van Braak, Tondeur, and Valcke (2004) was used for measuring how and how often teachers use computers in their classrooms (dependent variable). This instrument builds on eight items that refer to educational computer use in Flemish primary education (see Table 3). The respondents were asked to indicate on a five-point scale the extent to which they use the computer for various tasks: 0 = “never”, 1 = “every term”, 2 = “monthly”, 3 = “weekly” and 4 = “daily”. The scale reflects a high level of internal consistency ($\alpha = 0.79$).

Measuring structural and cultural school characteristics

In this study, structural school characteristics were operationalised by administering the scales “ICT planning” and “ICT support”. “ICT planning” identifies ICT-related (formal) policies such as “In our school, there is a formal team with respect to ICT integration” and “In our school, we evaluate the integration of ICT in a systematic way”. “ICT support” represents the number of actors, if any, providing ICT-related support, including “Teachers at our school help each other when problems arise with ICT” and “In our school, the ICT coordinator plays an important role”. Mean, standard deviation and Cronbach’s α of the two scales are presented in Table 1. Finally, “ICT infrastructure” represents the number of computers available when working with pupils.

Subscales related to cultural school characteristics build on the three dimensions discussed above: “innovativeness” (Maslowski 2001), “goal orientedness” (Staessens and Vandenberghe 1994) and “supportive leadership” (Hoy and Tarter 1997). The schools’ innovativeness scale (Maslowski 2001) contains items such as “At our school we try to be attentive to developments in society” and “Teachers at our school are expected to try something new”. Examples of the goal orientedness scale (Staessens and Vandenberghe 1994) are “All teachers work together to accomplish our school goals” and “Some of the teachers have opinions that do not fit in our school”. Finally, the dimension supportive leadership encompasses such aspects as “The principal complements teachers” and “The principal looks out for the personal welfare of the school”.

Respondents were asked to rate each statement in the subscales on a five-point scale: 0 = “strongly disagree”, 1 = “disagree”, 2 = “neither agree nor disagree”, 3 = “agree” and 4 = “strongly agree”. To facilitate data analysis, sum scores were

Table 1. Descriptive statistics and reliability measures scales.

Scale	<i>M</i>	<i>SD</i>	α	ICC
<i>Cultural school characteristics</i>				
Supportive leadership (Hoy and Tarter 1997) [7 items]	66.7	18.9	0.92	0.78
Innovativeness (Maslowski 2001) [6 items]	67.5	14.4	0.84	0.66
Goal orientedness (Staessens and Vandenberghe 1994) [6 items]	64.0	14.8	0.77	0.81
<i>Structural school characteristics</i>				
ICT support [4 items]	56.9	21.6	0.72	0.78
ICT planning (Tondeur et al., in press) [4 items]	47.1	22.0	0.76	0.86

calculated for the five school characteristics scales (minimum 0 to maximum 100). Control of the psychometric quality of the research instrument reveals a high level of internal consistency ($\alpha > 0.70$). A one-way analysis of variance shows that the schools in the sample differ significantly with respect to the structural and cultural characteristics. The mean rater reliability, calculated by means of the Spearman-Brown formula based on the intraclass correlation of a one-way analysis of variance (see Shrout and Fleiss 1979) indicated that it is legitimate to speak of structural and cultural *school* characteristics: ICC = (Between Mean Square–Within Mean Square)/Between Mean Square is higher than 0.60. Mean, standard deviation, Cronbach’s α and the mean rater reliability are reported in Table 1.

Table 2 summarises the bivariate correlations between the research variables. The product-moment correlations between the three cultural school characteristics vary between $r = 0.38$ and $r = 0.49$. Further, the results suggest significant interrelationships between the three structural school characteristics (between $r = 0.22$ and $r = 0.64$) and the other research variables. This suggests that the school characteristics share a high percentage in variance. In other words, if teachers stress a particular structural school characteristic dimension, they are likely to pursue also the other structural dimensions.

Table 2. Pearson product-moment correlation coefficients among the research variables ($N = 68$).

	1	2	3	4	5	6
<i>Cultural school characteristics</i>						
1. Innovativeness						
2. Supportive leadership	0.56**					
3. Goal orientedness	0.66**	0.58**				
<i>Structural school characteristics</i>						
4. ICT policy planning	0.42**	0.49**	0.21			
5. ICT support	0.41**	0.56**	0.28*	0.77**		
6. Infrastructure	0.13	0.10	-0.02	0.35**	0.46**	

** $p < 0.001$, * $p < 0.05$.

Data analyses

Research question one is discussed on the basis of descriptive statistics. In view of the research question about school profiles, a cluster analysis was performed (*k*-means clustering procedure). Cluster analysis, also referred to as multivariate similarity (Gore 2000), is an exploratory analysis technique that helps to group a number of entities into clusters so that members within a cluster are more similar to each other than those in another cluster (Aldenderfer and Blashfield 1984). To depict profiles of schools by means of a cluster analysis, it is necessary to delineate patterns in structural and cultural school characteristics that are shared across schools. Lastly, the relationship between different school profiles and ICT integration in the classroom was studied by computing one-way ANOVA.

Results

ICT integration in primary education

Most teachers in the sample were – at least at a basic level – familiar with ICT use. Only 4.3% reported that computers were never used in the classroom. Results in Table 3 illustrate that the computer is mainly used for training skills, such as drill and practice (43%), and differentiation activities (37%).

On average, teachers reported using the computer 6.7 hours a week: 4.5 hours a week for professional support (administration, email, looking for educational software, etc.) and to a lesser extent for class activities (2.2 hours a week). Most of the teachers used the computer between one to two hours per week (66.8%), and 22.2% adopted integrated computer use for three hours or more. It can be concluded that computers have become part of the basic collection of instructional practices, but the average time spent on computers in classrooms remains rather limited. The average length of experience in using computers was 10 years.

School profiles in structural and cultural school characteristics

The cluster analysis results are helpful to classify the 68 schools into two clusters: 41 schools are found in Cluster 1, and 27 are found in Cluster 2. Figure 1 summarises the mean scores for the different structural and cultural school characteristics as reflected in the two distinct school profiles.

Table 3. Overview of the “Class Use of Computer Scale” items and % of teachers using specific applications at least once a week (*N* = 527).

	Frequency (%)
Encouraging pupils to improve computer skills	43
Using the computer for differentiation	37
Encouraging collaborative learning	34
Asking pupils to do assignments on the computer	33
Encouraging pupils to search for information on the Internet	22
Using the computer as a tool for instruction	14
Using the computer as a tool for demonstration	12
Teaching about the possibilities of computers	8

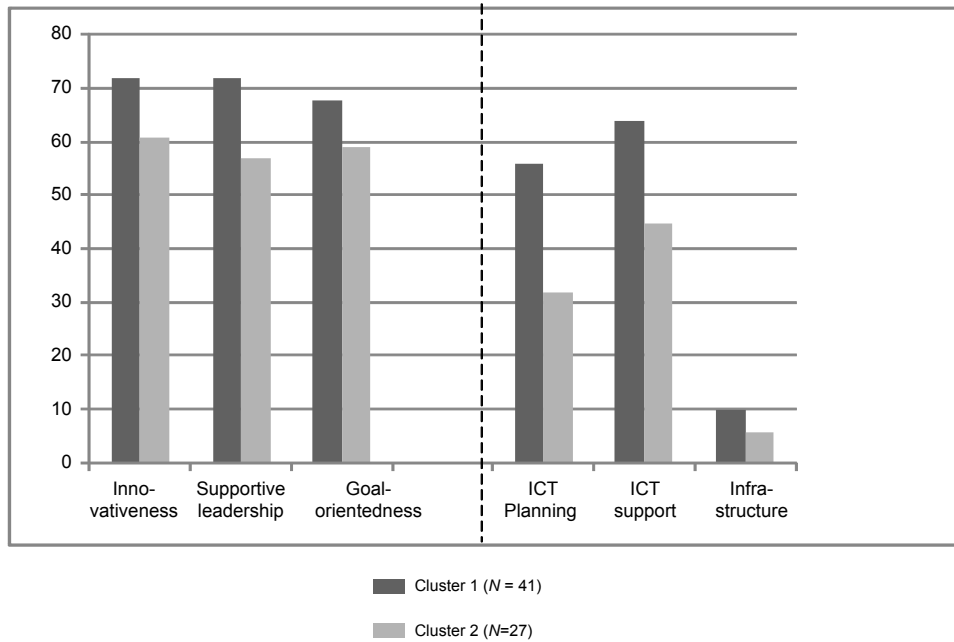


Figure 1. Mean values of structural and cultural school characteristics as reflected in the two school profiles.

The differences between the mean scores of the clusters were statistically significant for all scale scores with the exception of “Infrastructure”. In other words, the structural and cultural school characteristics vary significantly between school profiles. Interesting is that schools in the first school profile report relatively high scores on both structural and cultural school characteristics. In contrast, schools in the second school profile reflect lower scores in relation to all structural and cultural school characteristics.

Relationship between school profiles and level of ICT integration in class

In the next step, the use of ICT in class was entered as dependent variable to assess the relationship with the two school profiles. One-way analyses of variance show a significant effect ($F(1, 514) = 16.901; p < 0.001$). In accordance with the findings mentioned above, the first school profile – reflecting a relatively stronger ICT-related organisation and school culture – reports a higher level of computer use in the classroom ($M = 40.0; SD = 8.8$). Schools with the second school profile report a significantly lower mean level of computer use in the classroom ($M = 30.6; SD = 9.8$).

Discussion

In contrast to earlier studies that specifically point at the teacher as the central actor to explain differences in ICT integration, the present study adopted a school perspective and focused on structural and cultural school characteristics. This particular perspective considers the school as a unit of change and pays close attention to the internal school conditions. The results of the present study underpin the relevance of adopting

this perspective. School profiles could be defined on the basis of shared structural and cultural school characteristics. In addition, these school profiles could clearly be linked to differences in the level of educational ICT use. Schools in the cluster that share relatively high scores on the structural and cultural school characteristics report a higher frequency of educational computer use.

The findings are in accordance with earlier research that stressed the importance of verifying the influence of characteristics at school level (e.g. Kennewell, Parkinson, and Tanner 2000). While there is still much to learn with respect to the interrelationship between the different dimensions, the present findings show, e.g. that, within a particular school profile, high scores related to structural characteristics go together with high scores related to cultural school characteristics. MacGilchrist et al. (1995) would argue in this context that the way a school undertakes its structural development is a reflection of its culture. This suggests that schools that adopt an innovative culture and understand their strategic directions are better able to determine the structural changes needed to foster ICT integration in education.

However, structural characteristics can also influence cultural characteristics. If, for instance, more innovativeness in schools is desirable but the infrastructure doesn't allow teachers to use new technologies, this will act as a barrier. This calls for research about the causal nature of the relationships discussed. Some authors prefer a multi-directional perspective since successful practices depend on the ways these factors fit together and reinforce each other (Kozma 2003) or can be part of variables in a cyclic process. Cultural characteristics influence structural characteristics which, in turn, influence again cultural characteristics.

As stated earlier, structural school characteristics are relatively more easily manipulated (Stoll 1999). Nevertheless, Tondeur et al. (2008) indicate that ICT school policies are often underutilised and that ICT integration is not yet achieved in a systematic way in most schools. As ICT continues to drive changes in society and in education, school policies need to define their structural vision and actions more clearly in view of planned change (Senge 2000).

What if a school did – thus far – not adopt a culture that promotes the use of ICT? According to Schein (1997), cultural changes are difficult, take time and may provoke considerable anxiety among teaching staff. Some authors refer to the key role of leaders in this context. Kennewell, Parkinson, and Tanner (2000) argue that school principals are the most influential actor in defining a school culture and the organisation of their schools. Also, Grace (1995) refers to school principals as the key players that foster reflective and critical thinking about the school culture and school organisation and about whether these can or ought to be changed. The literature about school improvement stresses the importance of leadership in developing a commitment to change (Fullan 2001). While planned change – including organised assessment and problem solving – can be useful, leaders often also need to be able to cope with more cultural change. Their capacity to develop and articulate, in close collaboration with other actors from the school community, a shared vision about ICT use and integration is considered a critical building block in this process.

In the present study, we focus on “school level” variables to study ICT integration. This focus has proven to be relevant. Nevertheless, the focus on the teacher remains of importance. In future studies, researchers might wish to explore how teacher characteristics relate to the school they work in. Even in doing the latter, we still neglect the role of the macro level. At the macro level, educational authorities heavily influence education, despite the impact of school autonomy. It would therefore be of

interest to study how schools respond to, e.g. new ICT standards that have recently been introduced by the Flemish government. A study about the impact of these standards would help clarify whether class use of ICT changes more rapidly when a school policy is firmly established and pushed by macro-level variables.

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Conclusion

This study has demonstrated the complexity of implementing educational innovations, and, more specifically, of ICT integration in primary schools. The results clearly show how ICT integration is positively related to a school profile that reflects higher levels of both structural and cultural school characteristics. The results re-emphasise how important and influential school-related characteristics are to establish educational change. Although ICT integration also depends on the willingness and attitudes of individual teachers, an important conclusion arising from this study is that structural and cultural school characteristics are relevant vehicles to promote educational change in general and ICT integration in particular.

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Note

1. More information about the Flemish educational system is available at: www.ond.vlaanderen.be/English

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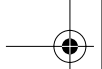
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