Original article

Towards a typology of computer use in primary education

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Abstract In the present study, we reject the view that computer use can be studied as an isolated variable in a learning environment. Our main objective is to develop an instrumental tool to measure different types of educational computer use in the classroom. This builds on a comprehensive review of the literature about computer use in education. This review helped to construct a questionnaire to identify a typology of computer use in primary education. In addition, the questionnaire was enriched by input of experts in this field. The questionnaire was presented to a sample of 352 primary school teachers. The input from a first subsample was used to carry out an exploratory factor analysis; the second subsample was used to verify the identified factor structure via confirmatory factor analysis. A three-factor structure of computer use in primary education was identified: 'the use of computers as an information tool', 'the use of computers as a learning tool,' and 'learning basic computer skills'. The three-factor structure was confirmed in the confirmatory factor analysis. The results underpin a number of meaningful differences in the current practice of computer use in primary education.

Keywords computer use, evaluation methodologies, primary education, questionnaire.

Introduction

The use of computers in education is steadily increasing. In this context, it is essential for educational researchers to investigate the extent of computer integration and the factors influencing computer implementation. The actual use of computers in education can be defined and determined in different ways. Many researchers measure computer use by reporting the percentage of teachers who use computers in their classroom, or the amount of technology used in the classroom, or the time teachers and pupils spend working with computers, etc. Although these indicators are valuable, they hardly help to understand the educational use of computers in the classroom.

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This introduces the question of how to identify different types of educational computer use in the classroom. In an earlier study (van Braak *et al*. 2004), two different types of computer use by teachers could be identified: 'class use of computers' (e.g. computer as tool for presentation, encouraging pupils to train skills, instructing pupils in the possibilities of computers) and 'supportive use of computers' (e.g. administration, preparing worksheets for the pupils, looking for information on the Internet for lesson preparation). Further research pointed out that supportive and class use of computers were influenced by computer experience and teacher attitudes. Computer experience affected both types of computer use. Supportive computer use was influenced by 'general computer attitudes', whereas class use of computers was rather influenced by 'technological innovativeness' and 'attitudes towards computers in education'. This illustrates that different types of computer use refer to different sets of characteristics. The main objective of the present study is to develop an 1 instrument to determine types of educational use of computers in the classroom. This aim goes beyond studying percentages of time that teachers or pupils spend on computers, but focuses on the question of how computers are used in view of supporting learning and instructional processes.

The available instruments in the research literature suggest that computer use in classrooms is a complex phenomenon and represents multiple interrelated factors. Any research on computer use in education involves selecting specific facets. This includes making choices about what aspects of computer use are important and how these should be measured. In prevalent empirical research, the arguments behind these choices have rarely been described. In this study, we will pursue transparency in this process by describing step by step the instrument design and development. A particular difficulty in this context is that much of the research on computer use in education is value-laden in an additional sense; it adopts, implicitly or explicitly, a philosophical stance (Twining 2002). The question is how to avoid bias in the process of instrument development.

Before describing the empirical study, we first examine recent approaches of computer integration research. This review of the literature was set up in order to gather a comprehensive set of different applications of classroom-related computer use. This set will be the starting point to develop questionnaire items in the context of our instrument development. In the next section, the development approach is described, building on a survey conducted among 352 primary school teachers. The paper concludes with a discussion of the results and the implications for future research.

Types of computer use in education

A range of sources of information has been analysed with respect to educational computer use: government agency reports, theoretical frameworks, and empirical studies from peer-reviewed journals. Examination of these sources has resulted in a wider conceptual understanding of the various applications of classroom use of computers. This paper emphasizes the (limited number of) empirically based literature.

Government agency reports

2 From the point of view of Baron and Bruillard 2003), any evaluation of computer usage in education depends on its educational uses as defined by society. In this context, an analysis of national and international com- 3
puter curricula (e.g. Qualification and Curriculum Authority/Department for Education and Employment 1999; Commission of the European Communities 2002; 4
Ministry of the Flemish Community. Department of Education 2004) reveals two main aims. A first aim 5
builds on the rationale that all children must be digitally literate in order to be prepared for a knowledge-based society. A second aim is related to the assumption that computer use can improve student learning. The first aim legitimates the study of computers as a separate school subject in view of developing a number of operational skills. The second aim states that computers should be embedded in the curriculum and should take its point of departure in pedagogy. Despite the growing convergence between the socio-economic and the pedagogical rationale (OECD/CERI 2001), the distinction 6
implies two types of computer use: computers as a subject and computers as an educational tool.

In Flanders (Belgium), these two types of computer use are reflected in the official information and communication technology (ICT) attainment targets (Ministry of the Flemish Community. Department of Education 2004). The core of this non-compulsory curriculum, 7
formulated as ICT competencies, focuses on supporting the learning process, e.g. 'pupils exercise autonomously with computers.' A second cluster encompasses technical competencies, such as 'pupils are able to use the computer, peripheral equipment, the technical system, and software.' According to the Ministry of the Flemish government (2004), it is preferable to develop these 8
competencies while embedding computer use into subject-related learning activities. A third cluster of competencies contains the social and ethical dimension of the application of ICT (e.g. 'to be able to cope in a responsible manner with the new technology'). Tondeur *et al*. (2006) point out that currently teachers in Flemish primary education principally stress the acquisition of technical ICT skills. ICT competencies focusing on the learning process and social and ethical components reflect lower priority levels.

Theoretical frameworks

A large number of theoretical frameworks are available in the literature about educational computer use. Squires and McDougall (1994, cited in Twining 2002) 9 differentiate between three types of frameworks: (1) frameworks that are based on categories of software use; (2) frameworks that focus on the instructional role of the software; and (3) frameworks that relate software to educational rationales. The authors criticize the narrow and isolated focus in these frameworks on software use. They stress 'the perspectives interactions paradigm', because they want to stress educational issues, such as classroom practices and teacher roles. In the same way, Lim (2002) also rejects an isolated view of computers in education. He stresses the integrated nature of computer use in the learning environment. He adopts an activity theory when defining a 'concentric' model to demonstrate the mechanisms that link computer use to learning, and the sociocultural setting. Similarly, the framework of the Second Technology in Education Study (SITES) Module 2 specifies a set of factors and interrelations between factors that contextualize computer use fostering innovative pedagogical practices (Kozma 2003). Pedagogical practices are determined by sets of goals, materials, activities, and people engaged in classroom teaching and learning activities. These practices are to be observed at the classroom level (micro level), the school and/or the local community level (meso level), and at national level and international entities (macro level). At each level, actors and factors can be distinguished which mediate pedagogical practices involving computers use. This alternative approach results in a more complex picture of educational computer use that even goes beyond the scope of the present study. School characteristics are yet not considered. A future study should examine how different types of computer use are related to contextual school variables.

The theoretical frameworks just presented help to achieve a better understanding of the relationship between computer use and educational practices. As already stated, they provide us with a more holistic approach towards the study of educational computer use. However, there is little empirical evidence available to ground the conceptual frameworks regularly presented in the literature. This is the main focus of the present paper.

Empirical studies

The distinction between 'computers as a subject' and 'computers as an educational tool' is the focus in a series of recent studies that aim at obtaining a more in-depth understanding of classroom use of computers. In the study of Baylor and Ritchie (2002), computer use was delineated according to nine subcomponents, including 'subject-matter content'. Other subcomponents refer to the use of computers as an educational tool, such as 'the use of computers for collaboration' and 'the use of computers for higher order skills'. Computers as an educational tool may fit into a spectrum of instructional approaches, varying from traditional to innovative. Niederhauser and Stoddart (2001) differentiate between two main types of educational computer use: 'skill-based transmission use' and 'open-ended constructivist use'. 'Skill-based computer use' aims at enhancing pupils' basic knowledge and skills by supporting drill and practice exercises and embraces two subtypes of traditional software: 'drill and practice' and 'keyboarding'. 'Open-ended computer use' presents computers as a tool for helping learners to construct their own knowledge. Three subtypes of open-ended constructivist software are identified: 'educational games', 'exploratory programs' (e.g. LOGO), and 'tool programs' (e.g. Word).
The results of Niederhauser and Stoddart's (2001) 10
evaluation study indicate that the majority of teachers centre on skill-based educational computer use.

Typologies of computer use are required to construct research instruments in view of empirical studies. Few studies published in the literature report in an explicit way how the research instruments have been designed.
The IEA's SITES Module 2 (Kozma 2003) study is an 11
exception because its research methodology is clearly described. Based on 174 case studies from across 28 countries, both qualitative and quantitative methods were used to identify seven clusters of innovative pedagogical practices building on computers use. Also, in the study of Hogarty *et al.* (2003), the development and validation of the instrument is transparent. Factor analytic and correlation methods were used to identify two factors delineating types of software use by teachers. The first factor represents the use of 'instructional software', including the use of educational software, drill and practice, and educational games. The second factor encompasses 'application software use'. Typical examples of the latter are the use of word processors, web browsers, and presentation programs. Similarly, two fac tors were identified regarding student use of software.

'Application' of software is explored in many studies, but these studies hardly help to clarify the educational use of the software. The questionnaire designed by Kent and Facer (2004) reflects a range of computer activities (e.g. e-mailing, gaming, writing, and drawing) in order to compare pupils' home and school use of computers. In Pelgrum (2001), a list of seven items of computer use is presented in order to identify the main obstacles regarding computer integration in education: operating a computer, writing documents, making illustrations, calculating, etc. In only a few studies, the focus is on the instructional objectives that are pursued by adopting types of computer use. For example, Ainley *et al*. (2002) identified four broad categories, based on a proposal by Rubin (1996): 'computers as information resource tools' (to provide access to an information base), 'computers as authoring tools' (to work with and present information), 'computers as knowledge construction tools' (to explore knowledge), and 'computers as knowledge reinforcement tools' (to engage in drill and practice activities). In Becker (2000), both an instructional and a software application approach can be found when he studied the relationship between types of computer use and teachers' educational beliefs. The survey asked teachers to select three instructional objectives out of a list of 10, such as 'communicate electronically', 'improve computer skills', and 'learn to collaborate'. The survey also asked teachers to name the software that is considered most valuable in their teaching. The data suggest that teachers with a strong constructivist orientation are eager to adopt types of computer use that foster constructivist learning approaches, e.g. Internet browsers. Similarly, Waite (2004) reported teachers' responses about the aims and uses of computers for literacy in primary schools.

To summarize, most available studies reflect particular views on the educational use of computers. Although each study enriches the picture, a comprehensive view is lacking: some studies focus on software applications, other studies only define broad categories of computer use; in some studies the focus is on the teacher, in others on the pupils. Only a few studies centre on the educational assets of computer use.

Research design

Purpose

The purpose of the present study is to develop an instrument that integrates types of actual computer use in the classroom. The research was set up along four distinct phases, involving specific groups of respondents. In the first phase, the analysis of the literature helped to define questionnaire items that reflect types of computer use in primary education. Second, exploratory factor analysis (EFA) was carried out to identify clusters in the variety of educational computer use. In a third phase, confirmatory factor analysis (CFA) was conducted to examine the stability of the exploratory factor structure. Finally, the psychometric quality of the final version of the instrument was determined.

Procedure

A first version of a research instrument, based on types of computer use identified through a review of the literature, was evaluated by 25 stakeholders (e.g. teachers, computer coordinators, and policy makers). The review focused on the identification of relevant applications of 'class use of computers' in the context of Flemish primary education, to direct the wording of the test items and to reduce item complexity. This resulted in the refinement of the instrument and the removal of some irrelevant items (e.g. pupils' use of the computer to make graphics). The review process resulted in a 12
pool of 29 items reflecting classroom use of computers in primary education. The item set is presented in Table 1.

This new version of the instrument was presented to a sample of 352 primary school teachers. The results of a first subsample ($n = 176$) were used to carry out an EFA. The responses of the second subsample ($n = 176$) were included in a CFA.

Measure

The 352 teachers were contacted through their principals. A paper version of the questionnaire was completed anonymously by these teachers. Each item in the questionnaire was presented as a statement about the adoption of a particular type of computer use. Respondents were asked to rate each statement on a five-point scale: 0 = 'never', 1 = 'every term', 2 = 'monthly', 3 = 'weekly', and 4 = 'daily'. The questionnaire also included information about a number of background characteristics (age, gender, teaching grade) and computer experience profile (computer experience and level of class use of computers).

Table 1. Descriptive statistics for the 29 applications of computer use in primary education ($n = 352$).

		Weekly or more regular use (% of teachers)
Item 01	The pupils use the computer to practise knowledge or skills	61.3
Item 02	I teach the pupils how to make good use of the keyboard and mouse	48.3
Item 03	I teach pupils to use computer terms correctly	47.2
Item 04	The pupils use the computer to elaborate learning content	39.4
Item 05	The pupils use the computer to 'catch up' if they have fallen behind with their work	39.2
Item 06	The pupils use the computer to do further research on specific subject matter	38.1
Item 07	I teach pupils the basics of the operating systems used at school	32.6
Item 08	The pupils use the computer to select and retrieve information	27.9
Item 09	I teach pupils the basic operations of generic programs	27.1
Item 10	The pupils use the computer for writing text	23.2
Item 11	The pupils use computer for direct instruction, i.e. to learn something new	20.9
Item 12	I teach the pupils how to print a document	20.2
Item 13	I use the computer as a demonstration tool	19.0
Item 14	The pupils use the computer as an encyclopaedia	17.2
Item 15	I teach pupils how to use specific peripherals and facilities	15.4
Item 16	The pupils use the computer to store information	15.2
Item 17	The pupils use the computer for problem solving	14.0
Item 18	I give the pupils computer-based tests	13.1
Item 19	The pupils use the computer to organize information	11.9
Item 20	The pupils use the computer to present information	10.5
Item 21	I use time in class to teach pupils keyboard skills	9.8
Item 22	The pupils use the computer to exchange information with others	8.5
Item 23	The pupils use the computer for looking up the meaning of a word	8.0
Item 24	The pupils use the computer to compare information from different sources	7.0
Item 25	The pupils use the computer to make drawings	6.3
Item 26	The pupils use the computer to organize their thinking, e.g. mind mapping	4.9
Item 27	The pupils use the computer to undertake calculations	4.3
Item 28	I use the computer to simulate events the pupils cannot otherwise experience	4.3
Item 29	The pupils use the computer to make diagrams or tables	0.9

Demographics and computer profile

Questionnaire data were collected from a sample of 352 primary school teachers in 70 primary schools in Flanders (Belgium). All participants teach in grades 1–6. The sample included 72.6% females. The age ranges from 22 to 59 years, with an average age of 38. The sample was randomly divided into two equal subsamples. Both samples were matched based on gender, grade, and age.

All teachers in the sample reported to be at least somehow familiar with computers. Only 2.0% of the sample reported not using a computer. The average computer experience was 9.48 years ($sd = 4.22$). On average, teachers use the computer 4.70 h ($sd = 4.08$) a week for professional support and 2.94 h a week for leisure activities ($sd = 3.49$).

Results

Item analysis

Descriptive item statistics are presented in Table 1. Based on the results, 13 items are deleted from the list because of a low degree of reported application in

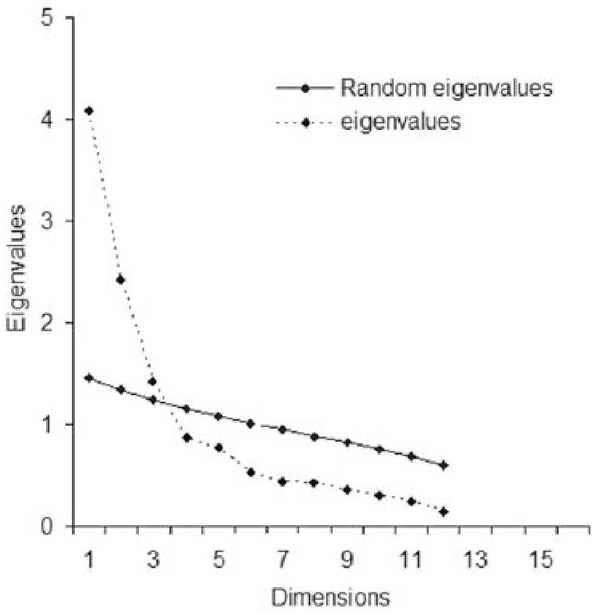

Fig 1 Scree plot and parallel analysis evidence for the 15 perceived attributes of class use of computer.

Flemish classrooms (<15% of the teachers using the application weekly or more). These items were excluded from further analyses (items 17–29 in Table 1).

EFA

Exploratory factor analysis helped to identify a number of factors to cluster types of educational computer use. A maximum likelihood analysis (orthogonal rotation) was adopted.

As a first solution, a three-factor structure was apparent, by building both on the K1 criterion (Kaiser 1960) and the parallel analysis method (O'Connor 2000). Three items were deleted because of loadings across factors (item 9, 12, and 15 in Table 1). An additional item was removed because of a low communality value (item 11).

A second analysis resulted again in a three-factor model, representing three types of educational computer use: 'basic skills', 'information tool', and 'learning tool'. Figure 1 represents the eigenvalues in the scree plot (Cattell 1966), in combination with the results of the parallel analysis.

The eigenvalues of the three factors are 4.08, 2.41, and 1.42. Table 2 summarizes the results of the EFA.

All items in Table 2 represent a significant loading (>0.50) on one of the three factors. The three factors can be labelled as 'computers as an information tool' (IT), 'computers as a learning tool' (LT), and 'basic computer skills' (BS). Together, the three factors can be regarded as comprising the types of computer application in primary education.

CFA

Confirmatory factor analysis was conducted to examine the stability of the exploratory factor structure. Several fit indices were calculated: Goodness-of-Fit Index (GFI), the Adjusted Goodness of Fit Index (AGFI) (Jöreskog & Sörbom 1993), the Normed Fit Index (NFI), and the Comparative Fit Index (CFI) (Bentler 1990). A critical value of 0.90 was put forward to draw conclusions about the adequacy of the model fit.

The results of the CFA, including the individual item coefficients, are presented in Fig 2.

The results show a good fit between the structure based on the analysis of the data from the first teacher sample and the data structure drawn from the second sample: $\chi^2 = 104.3$ (d.f. = 27), GFI = 0.91, AGFI = 0.87, CFI = 0.95, and NFI = 0.90. The results point at significant loading of all items on the three latent factors (all pattern coefficients between 0.43 and 0.95 and statistically different from zero at the 0.001 level). No error terms were allowed to be correlated. 13

Correlations between the latent factors are significant ($r = 0.20$ for IT and LT; $r = 0.49$ for IT and BS; 0.49 for IT and BS). Therefore, a one-factor CFA was carried out. A test of this model revealed poor model fit results [$\chi^2 = 562.4$ (d.f. = 54), GFI = 0.61, AGFI = 0.43, CFI = 0.48, and NFI = 0.46]. These results help to conclude that it is not possible to consider the three types of computer use – identified earlier – as a one-dimensional construct.

Scale characteristics

In the next step, the psychometric quality of the newly designed instrument was determined. Internal consistency was measured with Cronbach's α coefficient. Alpha coefficients for both samples are presented in Table 3; these point at high internal consistency levels (α > 0.70).

Table 2. Results of the exploratory factor analysis (sample 1, $n = 176$).

		Factor 1	Factor 2	Factor 3
Item 14	The pupils use the computer as an encyclopaedia	**0.83**	0.05	0.07
Item 08	The pupils use the computer to select and retrieve information	**0.78**	0.06	0.13
Item 16	The pupils use the computer to store information	**0.69**	–0.06	0.09
Item 13	I use the computer as a demonstration tool	**0.56**	0.09	0.27
Item 10	The pupils use the computer for writing text	**0.53**	0.09	0.10
Item 06	The pupils use the computer to do further research on specific subject matter	0.08	**0.93**	0.12
Item 04	The pupils use the computer to elaborate learning content	0.06	**0.88**	0.09
Item 05	The pupils use the computer to 'catch up' if fallen behind with school work	0.02	**0.53**	0.16
Item 01	The pupils use the computer to practise knowledge or skills	0.04	**0.52**	0.23
Item 03	I teach pupils to use computer terms correctly	0.17	0.20	**0.82**
Item 02	I teach the pupils how to make good use of the keyboard and mouse	0.13	0.26	**0.76**
Item 07	I teach pupils learning basics of the operating systems used at school	0.21	0.14	**0.63**

Table 3. Cronbach's α and correlation coefficients for sample 1 and 2.

	Cronbach's α		(1)		(2)		(3)	
	S1	S2	S1	S2	S1	S2	S1	S2
(1) Information tool	0.82	0.84	1.00	1.00				
(2) Learning tool	0.84	0.83	0.18*	0.20*	1.00	1.00		
(3) Basic skills	0.82	0.78	0.36**	0.49***	0.37**	0.42**	1.00	1.00

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

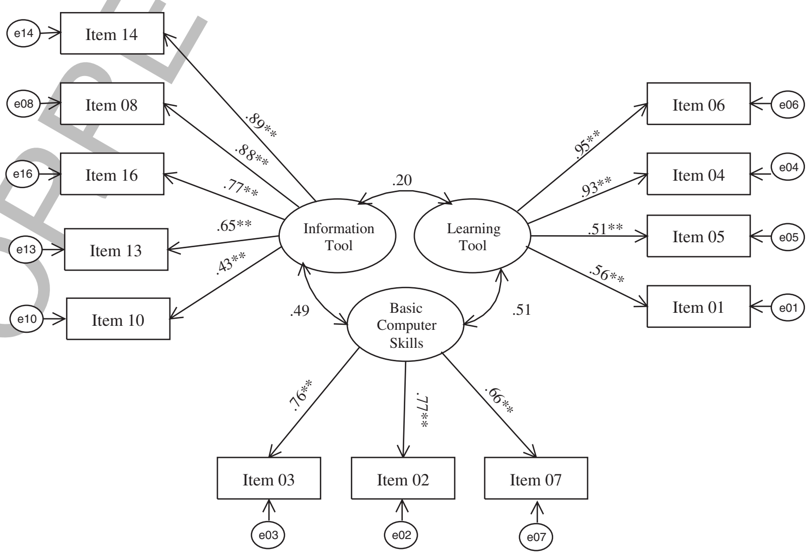

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Fig 2 Results of the confirmatory factor analysis: structure coefficients for the information tool, learning tool, and basic computer skills items.

Table 3 also includes the correlations between the three sum scales. The results suggest that there is a reasonable positive association between 'basic skills' and both 'information tool' [$r = 0.36$ (S1), $r = 0.49$ (S2)] and 'learning tool' [$r = 0.37$ (S1), $r = 0.42$ (S2)]. Figure 3 relates the frequency of the adoption of the three types of computer use to primary education grade level.

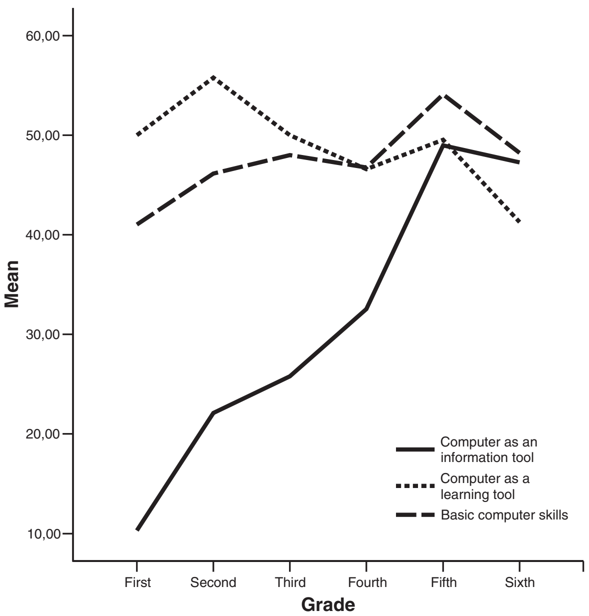

Fig 3 Frequency of use of computers as an information tool, computers as a learning tool, and basic computers skills in relation to primary education grades.

From Fig 3 it is clear that the use of 'computers as a learning tool' ($M = 48.9$; $sd = 25.0$) and 'basic computer skills' ($M = 46.0$; $sd = 26.4$) receive the highest priority in primary education as compared to the use of 'computers as an information tool' ($M = 30.5$; $sd = 24.0$). The use of computers as an information tool seems to be related with grade; higher grade levels reflect higher levels of computer use as an information tool. Univariate analysis of variance was used to test the differences in frequency of computer use as 'information tool' between grade levels statistically. The primary education grade levels were included as dependent variables; the adoption of computer use as 'information tool' was included as the independent variable. The results reveal a significant upward trend in the use of computers as 'information tool' throughout primary grade levels ($F = 35.3$; d.f. = 5; $P = 0.00$).

Discussion

Within the context of educational use of computers, a range of definitions, classifications, and typologies can be found. In the present paper, we rejected a unidimensional approach. As a result, an instrument has been developed to measure different types of computer use in the classroom. Three types of educational use could be identified: 'basic computer skills', 'computers as an information tool', and 'computers as a learning tool'.

The first type, 'basic computer skills', identifies the use of computers as a (separate) school subject to teach pupils technical computer skills, such as 'making good use of the keyboard and mouse' and 'learning basics of operating systems'. This type is regularly found in the literature, although it is conceptualized in a variety of ways.

The second and third types represent educational uses of computers. According to these two categories, computer use is considered a general support tool, not restricted to its use in view of a particular school subject. This distinction can be linked to main categories found in certain national curricula (e.g. Qualification and Curriculum Authority/Department for Education and Employment 1999; Ministry of the Flemish 14
Community. Department of Education 2004): comput- 15
ers as a subject versus computers as an educational tool.

The 'computers as an information tool' dimension encompasses the following aspects: 'using computers to select and retrieve information', 'using the computer for demonstration', etc. The emphasis is on the interaction between pupils and the subject-domain content: researching and processing information and communication. These items cover the four broad categories of computer application classified by Ainley *et al*. (2002). 'Computers as learning tools' include items such as 'using the computer to do future research on specific subject-matter' and 'using computers to practise knowledge or skills'. According to Hogarty *et al*. (2003), this factor is defined as 'instructional software' and represents similar items (e.g. drill and practice).

In educational practice, it is often less easy to differentiate in a straightforward way between the three types of computer use. This complicates the problem of evaluating computer use in education (Baron & Bruilllard 2003). For example, the distinction between basic computer skills and educational computer use can be marred by the fact that technical use of computers involves nevertheless some knowledge construction. In the present study, analysis results suggest that when teachers stress the use of computers as an information and learning tool, they are also likely to stress the development of basic computer skills.

A number of studies shows that, although the use of computers in education is increasing, computers are rather poorly integrated into the teaching and learning process (e.g. Loveless & Dore 2002; Sutherland *et al.* 2004). A recent study (Hennessy & Deaney 2004) reports that teachers only recently started to integrate computers into their own learning and teaching processes. These results seem to reinforce the point that teachers especially focus on basic computer skills. However, the present findings suggest an alternative explication. The results propose that the frequency of 'computers use as an information tool' is different depending on grade level in primary education. Fifth- and sixth-grade teachers are more likely to provide opportunities to use computers as an information tool. It could be argued that this represents a 'higher order use' of computers and that this is related to the curriculum of fifth and sixth graders. But, as stated earlier, this alternative explanation introduces a value judgement about preferable or less preferable types of computer use. However, the three types of computer use do not comprise value judgements about 'good practice'.

Many studies provide a longer list of dimensions to distinguish between types of computer use. A too large number is less helpful to identify relevant use patterns. This illustrates an apparent tension between the need for simplicity and the need to present a rich picture of computer use (Twining 2002). The three dimensions presented in this study synthesize *actual* types of computer use in Flemish primary education. Because a certain amount of types of computer use that have hardly been observed in current educational practice have been excluded from the instrument, innovative computer-based learning activities were ignored, such as 'the use of computers to organize their thinking (e.g. mind mapping or concept mapping or 'the use of computers for problem solving').

In this study, an attempt has been made to link computer use and classroom practice without taking diversity in underlying educational beliefs into consideration. As a recommendation for further research, teachers' educational beliefs can be explored as potential determinants of the three different subsets of computer use. Different types of computer use could refer to different teacher characteristics and/or antecedents. For instance, teacher beliefs about learning and instruction could be identified as a critical predictor of types of computers use, e.g. teachers with a strong constructivist orientation are eager to adopt 'computers as an information tool' and this in view of computer use to 'communicate electronically' or to 'present information to an audience' (Becker 2000).

Next to the possibility of exploring potential determinants of different types of computer use, the instrument can be used to measure the variation of computer use across countries. Although patterns of computer use in schools are both context- and time-dependent, the instrument has the potential to investigate these variations. The instrument can also be used as a tool to examine whether teachers are using computers in accordance to policies or guidelines of educational 16
authorities. A transparent understanding of the types of computer use can result in more adequate and informed measures of policy developers in view of fostering the integrated use of computers in the classroom. Policies can include information and awareness campaigns, in-service training, or focused action programmes. Finally, the instrument can encourage individual schools to reflect on the educational use of computers at school level. A better understanding of the variety of computer use can stimulate the discussion about the adoption of specific computer-related school policies. Computer use will – as a result – become linked to teacher, classroom, and school variables.

Conclusion

Based on the adoption of a multidimensional approach towards computer use in primary education, a new scale was developed and evaluated in this study. The instrument helped to identify three different dimensions in computer use at the primary education level: 'basic computer skills', 'computers as an information tool', and 'computers as a learning tool'. A clear attempt was made to avoid value-laden in the development of the 17
instrument. Future use of the instrument is envisioned to explore the determinants on the types of computer use in primary education, e.g. at teacher, classroom, and school levels.

Further refinement and evaluation of the instrument might be needed: use and evaluation at other educational levels and an evaluation outside the Flemish educational context. Although the results in this study cannot be generalized beyond the context of Flemish primary schools, the results of the present study can inspire other researchers to examine computer use in their educational context and/or to update the content and structure of the present version of the research instrument.

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