Educ Inf Technol (2012) 17:205–231
DOI 10.1007/s10639-011-9154-z

Changes in the basic ICT skills of freshmen between 2005 and 2009: Who's catching up and who's still behind?

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Published online: 29 March 2011

Abstract In the last decade, ICT use has expanded enormously in most Western countries. In line with this development, we hypothesised that freshmen at university would not only have mastered more ICT skills, but would also use computers more often than their counterparts of 5 years previously. To compare students' opinions and behaviour between 2005 and 2009, responses to two online questionnaires (N= 714 in 2005 and N=1529 in 2009) offered at a large university were compared. The main variables of the Technology Acceptance Model (as well as facilitating factors, study motivation and some contextual variables) were used as predictors to explore the possible changes between 2005 and 2009 in the mastering of 19 ICT skills, and the frequency of the use of computers for six different tasks. The results of the study show that freshmen became more proficient in some ICT skills, while proficiency in other skills did not change or even dropped. Gender is still an important factor to predict ICT skills and the frequency of using computers, but it is shown that for some skills female students have caught up with their male counterparts.

Keywords ICT skills · Computer use · Freshmen · Universities · Change of computer use · Change of ICT skills · Technology acceptance model · TAM · Survey · Longitudinal analysis

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1 Introduction

Looking for an answer to the question of whether the ICT skills of freshmen at university and the frequency of computer and/or Internet use changed between 2005 and 2009, and the reasons for this change, we should not forget that these students belong to a society that is developing into an 'Information Society' or a 'Network Society'. A network society offers an ideal climate in which proficiency in ICT skills and the use of ICT can grow. What are the main characteristics of a network society? Castells offers the following definition of this type of society: "a network society is a society where the key social structures and activities are organized around electronically processed information networks. So it's not just about networks or social networks, because social networks have been very old forms of social organisation. It's about social networks which process and manage information and are using micro-electronic based technologies". (Castells and Kreisler 2001). Not all countries in Western Europe have attained the same level of development (Salajan 2008) as an "Information Society". Belgium, where the university in which our research was conducted is located, is called an information society by Salajan's interviewees. Looking at some indicators this thesis is not only supported, but the figures also show that the country had a positive development in the direction of a network society between 2005 and 2009. The overall situation for ICT in Belgium visibly improved between 2005 and 2009. Some examples: in 2005 Belgium had 17.4 broadband access lines per 100 inhabitants and 28.3 in 2009; in 2005 41% of households with at least one member aged 16 to 74 had broadband access, in 2009 the figure was 63%; in 2005 50% of households had internet access whereas in 2009 this increased to 67%; in 2005 50% of individuals aged 16 to 74 regularly used the Internet, in 2009 the figure was 70% (Eurostat 2010). All these figures are higher than the European averages.

Not only has the overall position of the use of PCs and the Internet in Belgium improved, but the standing of ICT in primary and secondary schools has also been enhanced. OIVO (2010) reported that 92% of people aged 6–17 surf the Net. In comparison with 2007, the number of students surfing the Net was raised by 1% (to 14%) depending on the age of the students. PCs and the Internet are used for a wide range of activities by these youngsters, but mainly for chatting (83%), sending emails (62%), searching the Web (74%), downloading music (63%) and hobbies (68%).

But PCs and the Internet do not only support the traditional function of receiving information; Web 2.0 technologies have recently received a lot of attention. These technologies, according to Hartshorne and Ajjan (2009), open a path for the creation and sharing of information with others, for instance: wikis, blogs, Internet telephony, social networking, video sharing, etc. Out of the 10–17 year olds in Belgium, 37% have their own blog (OIVO 2010). Socialbakers (2011) calculated that in February 2011, Belgium had 3.92 million Facebook users (i.e. 48.39% of Belgium's online population), 26% of whom were between 18 and 24 years old. This creates, of course, not only more opportunities, but also a greater need for youngsters to learn to work with computers and the Internet. However, even if it is true that a large proportion of students opt for these new types of ICT applications, it does not mean that all students are equally familiar with them (Kennedy et al. 2008).

Whether the familiarity of students with ICT is in turn guaranteed to make a positive contribution to their studies is still another question. Research (Littlejohn et al. 2010) has shown that a lot of students still expect a more traditional pattern of study, above an arrangement where ICT is more incorporated. Moreover, the results of research concerning the influence of CAI (computer assisted instruction) are equivocal. Chandra and Loyd (2008) have shown that e-learning in secondary schools can improve student performance for some scholars, but reduce it for others. In higher education, Schmid et al. (2009) calculated that using ICT during teaching had a positive influence on the achievement of students, although they stress that ICT-supported teaching also needs good instructional design and teaching practices.

In spite of the resistance of some lecturers to the application of CAI (see Eynon 2008), computers and the Internet have gained an undeniable place in universities. Universities have virtual learning environments, provide information not only through books but by bringing literature into students' rooms through the Internet, require students to write papers and produce PowerPoint presentations, etc. Most students are interconnected through the Internet and are eager users of social networking sites (Pembek et al. 2009). This means that students are supposed to know the most basic skills in order to work with computers and the Internet. Moreover, given the increasingly ubiquitous presence of ICT in the life of students, we also can expect students in 2009 to have a better knowledge of ICT skills and to use computers more intensely for all kinds of activities than their predecessors of 2005. While this seems obvious, the real question is whether all students possess these skills and whether freshmen in 2009 have a better knowledge of ICT than their counterparts from 2005. That this is not evident has been shown by Strømsø et al. (2004) and Kaminski et al. (2009). They came to the conclusion that among senior students, the knowledge of some ICT skills diminished in comparison with their knowledge of ICT as freshmen. Exposure to ICT use is no guarantee of a better knowledge of ICT skills. In the following pages we will look for answers to the following two questions: 1) Do freshmen in 2009 think they have a better command of ICT skills and do they assume that they use computers more than their predecessors of 2005? And; 2) What variables can contribute to an explanation for this change?

2 Theoretical background

There is a long tradition in social science of searching for the causes of innovations in society and in particular the acceptance of new technologies. In relation to this, a remarkable step was made at the end of 1980s by Davis (1989), and Davis et al. (1992). They created the Technology Acceptance Model (TAM) while studying the intentions of people to use computers and the actual use of computers. Since then, quite a number of researchers have applied the key variables, *perceived usefulness* and *perceived ease of use of the technology*, as explanatory variables for the acceptance of new technologies. Tao et al. (2009) confirmed the central meaning of these variables for the explanation of the acceptance of ICT and the level of ICT competences attained by ICT users.

In an article published in 2010, it has been shown that this model was rather successful among social researchers and that it was often a starting point for all kinds of variations. (Verhoeven et al. 2010; see also Pouratashi and Rezvanfar 2010; Fillion et al. 2009). The nucleus of TAM was preserved, but expanded with some other variables (e.g. Chatzoglou et al. 2009) or other theories (e.g. Lee 2010). Most of the researchers were interested in the acceptance of a specific form of ICT, and only a few paid attention to the acceptance of computer use or use of the Internet. In this latter tradition some researchers are interested in the explanation of the intention to use ICT technologies, while others are focused on the causes of the application of ICT technologies. Nevertheless, besides this model other explanations for the acceptance of ICT technologies have been used in literature; for example, the agency theory, the expectation confirmation theory, the theory of planned behaviour, the flow theory, etc. (Tao et al. 2009; Lee 2010).

Other researchers have studied the acceptance of information technologies as part of the need people have to communicate, or as part of large innovation processes within society. Viherä and Nurmela (2001) see some factors as necessary for the introduction of information technologies within a society. First, they claim that all participants need an access point. *Access points* may take many forms. They include PCs and the Internet, but in contrast with the current study, these researchers were also interested in the use of the telephone, fax, mobile phone, television, radio, etc. If these access points are not available to all participants for communication, problems may arise (for instance, divides between social strata, gender categories, age groups, etc.). Second, in order to communicate, people also need to master *communication skills*. Given the large variety of access points, learning all the different communication skills is challenging for many people, as they not only have to learn the technological language, but also need to learn how to use the different instruments for communication. Third, people must have some *motivation* to communicate. If people have no reason to communicate with others, there is no need to learn how to use information technologies. The current study also focuses on these factors, but not in respect of investigating all the types of information technologies within society. We are only interested in the changes relating to the use of computer and Internet technology within a university.

The explanation of the digital divides given by S. Molnar (2003 quoted by Mancinelli 2008) also focused on the innovation processes of technologies in large societies. Three factors are important for determining the different divides in society: the access to new technologies, the use of these technologies and the impact of these technologies. The *access divide* is characterised by a distinction between those who do, and those who do not, have access to ICT. It is also termed the early digital divide. The main causes of this divide are the differences between income groups, settlement types, level of education, ethnic groups and age groups. The second divide is the *usage divide*; also termed the primary digital divide. This divide is characterised by a relatively widespread acceptance of ICT, but differentiates between those who do, and those who do not, want to use these technologies. The main differentiating factors between users and non-users can be found in income and age. The third divide is based on *the quality of use of ICT*. It is also termed the secondary digital divide. In this stage, ICT is widely accepted within society, but there are still differences between the users of ICT: some users have more ICT skills

than others and some users have more abilities than others. The factors relevant to this divide are mainly level of education, income, gender, age and period of use. Our research relates to a society that is characterised by this third divide. Although we only analyse a small part of this society (freshmen at university) we will show that this divide between users still exists: not all students are equally competent at making use of the possibilities offered by ICT.

An important expansion of TAM was proposed by the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003). The nucleus of this theory is composed of four variables: 1) *perceived usefulness of the technology,* or the perception of the degree of convenience of a particular technology for doing a job; 2) *perceived ease of use of the technology,* or the level of conviction that applying a particular technology does not demand too much effort; 3) *social influence,* or the conviction of participants that a significant number of others support the use of a technology and; 4) *facilitating conditions,* or the belief of participants that there is technical support for applying the technology. Next to these four variables, Venkatesh et al. (2003) mention three more variables that might have an indirect influence on the acceptance of ICT: self-efficacy, anxiety and attitude. These variables are said to have an indirect influence on the acceptance of ICT because their influence is mediated by another variable, for instance, self-efficacy and anxiety are mediated by perceived ease of use of technology. Self-efficacy refers to the belief of a participant that he or she is capable of doing a job without the help of others. Anxiety here is focused on the fear of applying a technology. Attitude refers to the overall affective reaction to using a technology.

It should not be forgotten that the researchers working in the tradition of TAM were aware of the possible impact of the *context* in which a new technology is adopted. Gender, age and the experience of participants, among other variables, are often used in order to attain a fuller explanation of the adoption process. The significance of these variables for the development of ICT is very well presented in the theory of digital differentiation. Van Dijk and Hacker (2003) criticise the theory of the digital divide. This theory divides society into segments having access to ICT or not, and using ICT applications or not, on the basis of clear divisions between groups, e.g. men and women. In the theory of digital differentiation, not only access and use of ICT are taken into account, but also the way in which people interpret ICT and its use in terms of their own background and position. This interpretative process leads to differences in ICT use, but not in terms of clear-cut groups that can or cannot handle the complexity of ICT. Information is an asset that is scarce for some people but present in abundance for others. People who belong to a social network have more opportunities to get the necessary information than do those excluded from this network. In order to understand why some people have more chance to work with ICT it is not only necessary to know the instrumental and information skills they possess to handle ICT, but also their strategic skills (i.e. "the ability to use digital means to improve one's position in society"). In such a society there is no strict digital divide, but people will assess the situation depending on their position in society. Instead of creating a digital divide and believing in the disappearance of it because of the development of technology, stress is put on the interpretation of the situation by the participants. Therefore we can speak of a digital differentiation in society (see also Van Dijk 2006; Peter and Valkenburg 2006). The

use of ICT is not simply determined by its availability, but is the result of the interpretation of the ICT made by the participants. For example, whether women at universities will be more interested in and use more ICT-applications than their counterparts outside universities depends on the meaning they give to ICT within the framework of studying at a particular moment. Situations are interpreted by the participants.

In this research we mainly apply TAM and digital differentiation for our theoretical background. With regard to TAM, it could be said that the subject of this research is not so much about the adoption of a new technology, but about the growing application of a technology already known to the participants. Indeed, freshmen are already acquainted with PCs and the Internet when they arrive at a university. Nevertheless we have seen in former research that the use of computers and the Internet at universities has expanded. Moreover, we hypothesise that a model explaining the adoption of a new technology might also contribute to the explanation for a wider application of ICT among freshmen. Nevertheless, we have expanded TAM with some variables that have proved to be successful in explaining why participants apply some ICT techniques. We will therefore refer to our model as TAM+. Next to this, we will look at the meaning of five contextual factors: 1) the motivation for study as preparation for a profession; 2) the possible doubt of the participant that he or she chose the correct study trajectory; 3) the domain of study; 4) gender and; 5) the socio-economic status of the student's parents.

Motivational factors might have some influence on the knowledge and use of ICT technology. We may expect that when students are interested in the professional fulfilment of what they want to attain through study, and/or when there is a fit between the technology for which the task is used and the task itself (McGill and Klobas 2009), that ICT might take an important place in their lives. Today it is hard to imagine that a university trained professional could work without basic ICT knowledge. If we take this as a hypothesis for the further analysis of our data, it will be acceptable also to hypothesise that students who have ambivalent feelings about the course they have chosen might be less interested in mastering ICT. They might be more pre-occupied with questions about why they chose a subject they do not like, or how to get out of the system. Indeed, research (Van Bragt et al. 2011) has shown that university students who score high for ambivalence will obtain fewer credits and are more likely to drop out than other students.

Depending on the area of study, students might meet different expectations concerning their knowledge of ICT and their capacity to use it. For instance, for students of architecture it might be more obvious to use ICT than it would be for students of philosophy, and teaching in architecture might highlight more the advantages of computers and the Internet than might the teaching of philosophy. The situation of students in architecture might lead them to a different pattern of behaviour in the use of computers than that of students in philosophy.

Broom et al. (1984) discern three important divisions in society: 1) age and gender; 2) minorities and; 3) strata and classes. In this research no attention will be paid to age and minorities to explain the digital differentiation, because these variables can only play a minor role. Most of the students in our samples are about 18 to 19 years old, and the proportion of minorities among these freshmen is very small.

Gender has always been seen as an important factor dividing people. For many years, research has stressed that women or girls used less ICT and consequently developed fewer skills to work with it than did men (Sutton 1991; Volman and van Eck 2001; Losh 2004). Currently this divide is often described as less wide than a decade ago. In spite of this change it still is worthwhile to check whether women are differentiated from men as far as ICT use is concerned, depending on their interpretation of the meaning of ICT.

Society is also divided into different social strata depending on profession, income, education and the like. Research has shown that differences among the social strata have had a tremendous impact on access to ICT and the use of it (van Dijk and Hacker 2003; Empirica 2007). Poverty, a low level of education and doing manual work do not contribute to easy access to ICT and the daily application of technology. We will check whether students from less privileged families act differently towards ICT than do others.

Led by TAM + and the theory of digital differentiation we will check the predictive quality of the following variables:

- perceived usefulness of ICT (with the hypothesis being a positive contribution: the more useful students find ICT, the higher their ICT competences and frequency of computer use will be);
- perceived ease of use or control of ICT (positive effect);
- anxiety when using ICT (negative effect);
- study-oriented ICT behaviour (later called "behaviour") expressing a positive attitude towards ICT (positive effect);
- ICT experience in secondary school and at university (positive effect);
- study motivation (positive effect of vocational orientation, negative effect of ambivalent orientation);
- area of study at university (students of humanities will have a lower self-perception of competences and frequency of use than will science and bio-medical students; science and bio-medical science students are offered more courses in which consistent use of ICT may be found);
- gender (female students will have a lower self-perception);
- social status (working class students will have a lower self-perception).

We also will check whether the self-perception of ICT skills and the frequency of computer use among freshmen are higher in 2009 than in 2005, given that the use of ICT among youngsters increased in Belgium between 2005 and 2009. We hypothesise that freshmen in 2009 will assess their ICT competences and frequency of computer use as being higher than those of their counterparts of 2005, because they have had more opportunities to get acquainted with ICT.

We will carry out an explorative analysis with regard to the variables that can explain such a change between 2005 and 2009.

3 Methodology

Since we wanted to assess whether freshmen in 2009 were more proficient in some basic ICT competences and used the computer more than their counterparts of 2005,

we needed two samples of students. Both samples were taken in a large Belgian university (about 35,000 students; among them about 5,000 foreign students, most of them at graduate level) and comprised students taking a wide variety of courses in humanities, sciences and bio-medical sciences. The university is situated in a small town (about 96,000 inhabitants) where a large proportion of students live in rooms in the private rental sector and a smaller proportion live in university dormitories or at home. Most of the relevant rooms in the town have a high-speed broadband connection and in many buildings the university has put PCs at the disposal of the students and has provided Internet access through many "hotspots". Teaching in this university is supported by a digital learning platform, which might provide additional motivation to learn the necessary ICT skills.

In order to compare student opinions and behaviour between 2005 and 2009 we rely on two samples. The first sample comprises 714 freshmen who responded to two online questionnaires; one in September–October 2004 (1,827 of the 4,960 registered freshmen) and another in March–April 2005 (2,212 of the same 4,960 freshmen).[1] This first sample is referred to as the 2005 sample later in this text. The second sample consists of 1,529 freshmen who answered an online questionnaire in 2009. A selection of questions was given in both the 2005 and the 2009 questionnaires, allowing a direct comparison of ICT-related attitudes and behaviours.

For each sample separately, a weighting variable was constructed which harmonises the sample and population distribution of gender, housing and field of study.

Based on our hypotheses and our theoretical reflections, the following explanatory model was developed (Fig. 1).

We hypothesise that the key variables of the Technology Acceptance Model, together with study motivation and some context variables, will explain a substantial part of the variance in the self-perception of ICT competences and the frequency of computer use for some tasks among freshmen. Since we are mainly interested in changes in the self-perception of ICT competences and of the use of computers among freshmen, we will confine this analysis to the study of ICT skills and types of computer use that have significantly changed between 2005 and 2009. Regression analysis will be applied to detect the main predictors of the self-perception of ICT skills and the use of computers.

3.1 Dependent variables

Although the majority of current students are involved in social networking sites (SNSs) (Bruneel et al. 2011) and seem to be familiar with the special ICT procedures linked to these SNSs, we focus in this article on more basic ICT competences. This option was taken because in 2004–2005, SNSs were not as popular as they are currently. Further, because our main interest was in collecting information about what is called by the Committee on Information Technology Literacy (National Research Council 1999), "the information technology skills needed to attain a fluency with information technology", for example: using basic operating system

[1] This design allowed us to study changes in students' ICT-related opinions and behaviours during the first 6 months of attending an academic institution (Verhoeven et al. 2010).

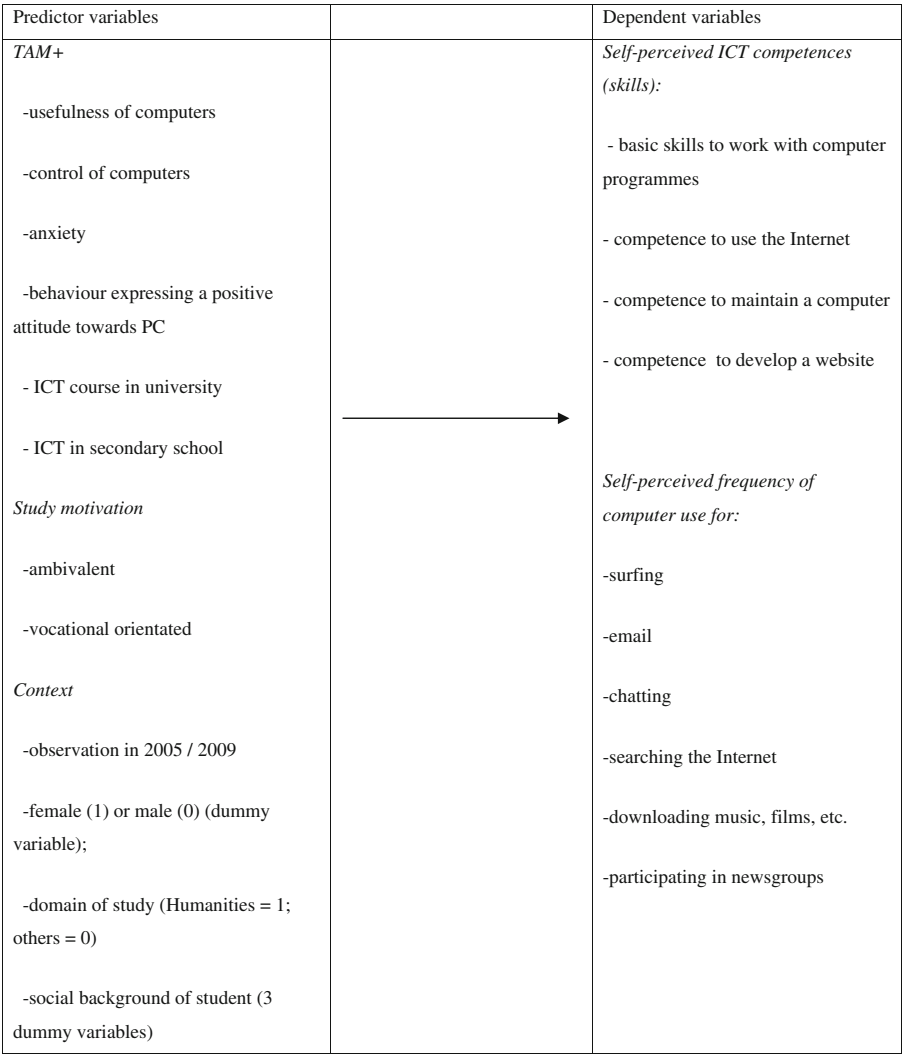

Fig. 1 Explanatory model

features, using a word processor, using a graphics and/or artwork package to create illustrations, slides, etc., connecting a computer to a network, using the Internet to find information, using a computer to communicate with others, using a spreadsheet, etc. Therefore the variable self-perception of ICT competences is composed of 19 different forms of ICT skills based on research by Van Braak (2004). Four categories of ICT competences were included in this variable: 1) the basic skills to work with computer programmes (e.g. applying a spell checker, creating a database, making a graphic with a spreadsheet, etc.); 2) the ability to use the Internet (e.g. downloading files, making a bookmark, using a search engine, etc.); 3) the competence to maintain a computer (e.g. installing a virus scanner, installing other software, using a file manager, etc.) and; 4) the competence to develop a website (e.g. FTP, use of web design software, etc.). For each ICT competence interviewees had to assess

statements such as: "I can use an automatic spell checker". The statements could be answered with: this is totally untrue for me (score = 1); this is rather untrue for me (score = 2); this is more or less true for me (score = 3); this is rather true for me (score = 4) or; this is totally true for me (score = 5). See Table 1 for the other statements.

The self-perception of the frequency of use of a computer for some tasks was split up into six statements, each referring to the time the respondent used a computer for surfing the Internet, sending or receiving email, chatting, searching the Internet, downloading music or pictures and participating in news groups. The following answers could be given: daily (score = 6); two or three times a week (score = 5);

Table 1 Average scores of self-perceived ICT competences (2005 and 2009)

ICT competences	Average score in 2005	Average score in 2009	*F*-value	*p*-value
3) I can attach a file to an email.	4.86	4.86	0.01	0.9274
15) I can search for web pages on the Internet using a search engine (e.g. Google, AltaVista, Botje, etc.).	4.90	4.86	6.66	0.0099
9) I can talk to someone using a chat program (e.g. Messenger, IRC, etc.).	4.86	4.84	0.73	0.3923
11) I can prepare a short lecture or presentation using a presentation program (e.g. PowerPoint).	4.13	4.76	280.36	<.0001
18) I can play a computer game myself.	4.57	4.60	0.62	0.4298
13) I can upload and download files using a web browser (e.g. Internet Explorer, Netscape, etc.).	4.37	4.59	34.02	<.0001
1) I can use the automatic spellchecker.	4.59	4.47	10.59	0.0012
14) I can make bookmarks or favourites with a web browser (e.g. Internet Explorer, Netscape, etc.).	3.89	4.36	86.63	<.0001
16) I can change the resolution of my monitor myself.	4.28	4.28	0.01	0.9186
17) I can connect a computer and install software myself.	3.82	4.01	10.73	0.0011
19) I can install my virus scanner myself (e.g. McAfee, Norton, etc.).	4.12	3.99	4.89	0.0271
6) I can make a graph in a spreadsheet program (Excel, Lotus, etc.).	3.74	3.96	17.53	<.0001
7) I can make simple calculations in a spreadsheet program (Excel, Lotus, etc.).	3.80	3.94	6.66	0.0099
12) I can organise files on a computer using a file manager (e.g. Explorer).	3.65	3.78	4.18	0.0410
2) I can make a back-up or reserve copy of data on my hard disk.	3.67	3.67	0.01	0.9371
8) I can automatically make a table of contents for a report with a word processor.	3.06	3.32	17.95	<.0001
5) I can create a new, simple data base and put in data using database software (e.g. Access).	2.39	2.73	32.54	<.0001
10) I can create my own home page using web design software (e.g. FrontPage, Dreamweaver, etc.).	2.36	2.32	0.40	0.5270
4) I can publish a website on the Internet (FTP).	2.27	2.28	0.04	0.8391

weekly (score = 4); monthly (score = 3); less than once a month (score = 2) or; never (score = 1).

3.2 Independent variables

For our project of 2004–2005 we had already invested in the construction of some scales of TAM (Verhoeven et al. 2010), relying on the scales developed by Selwyn (1997).The items for the variables constructed by Selwyn (1997) were translated into Dutch and presented to the students. Using confirmatory factor analysis (CFA), three Likert type scales (usefulness of the PC, control of the PC and anxiety) were introduced into the analysis, although not all the items from the original Selwyn scale found a place in these scales. In order to compare the results of 2005 with those of 2009 we used the same instrument in 2009 and checked whether the same structure could be found as in 2005. If items did fit in the scales of 2009 but did not fit in the scales of 2005, these items were omitted. Factor analysis has shown that the items from Table 2 could be kept for further analysis.

These scales had the following Cronbach α for respectively 2005 and 2009:

1) anxiety (factor 1): 0.75 and 0.62;
2) usefulness (factor 2): 0.84 and 0.81;
3) behavioural component (factor 3): 0.72 and 0.67 and;
4) control (factor 4): 0.66 and 0.63.

Table 2 Rotated factor pattern for anxiety, usefulness of PC, behavioural component, and control (standardised regression coefficients) (factor loadings >−.25 and <.25 and items not included in the scales of 2005 are omitted)

Items	Factor 1	Factor 2	Factor 3	Factor 4
10. I hesitate to use a computer for fear of making mistakes I can't correct	0.66	–	–	–
1. I hesitate to use a computer in case I look stupid	0.6	–	–	–
9. Using a computer does not scare me at all[a]	0.49	–	–	–
4. Computers make me feel uncomfortable	0.48	–	–	–
6. Computers make it possible to work more productively	–	0.81	–	–
7. Computers can enhance the presentation of my work to a degree which justifies the extra effort	–	0.77	–	–
5. Computers help me organise my work better	–	0.62	–	–
3. Computers can allow me to do more interesting and imaginative work	–	0.45	–	–
11. I only use computers at college/school when told to[a]	–	–	0.65	–
14. I avoid coming into contact with computers in college/school[a]	–	–	0.64	–
17. I could probably teach myself most of the things I need to know about computers	–	–	–	0.58
2. If I get problems using the computer, I can usually solve them one way or the other	–	–	–	0.57

[a] Scores of these items are reverse coded

Our model also includes some facilitating factors. These are not those perceived by students, but some objective ones. It can be assumed that freshmen who had more chance to work with computers in secondary school and who have to attend university classes in which computers play a role, will use computers more and will make themselves more familiar with different computer skills. The following dummies were constructed. If a student had at least 1 hour a week of ICT lessons in the last year of secondary school, he or she scored 1. If not, he or she scored 0. We considered this factor rather important, because there is a big difference between schools in Belgium as far as the teaching of ICT is concerned. Most students (81% of our sample in 2005 and 92% in 2009) did not attend ICT-related classes in their last year of secondary school. If students at the university had to take a course linked to ICT knowledge they scored 1, the others scored 0.

The motivation of students to succeed in a particular route of study might also be an important factor in mastering ICT skills and using computers in daily life. Computers today hold such an important place in professional life that gaining the necessary ICT skills is important in order for students to succeed later in their professional lives. Two scales developed by Vermunt (1994) are used in this research: 1) the scale "ambivalent attitude of students towards study choice" contains items such as "I doubt whether this is the right subject area for me; I have little confidence in my study capacities" and; 2) a scale to measure the extent to which a student is "vocation directed" with items such as "what I want to acquire above all through my studies is a professional skill; the main goal I pursue in my studies is to prepare myself for a profession, etc". Factor analysis of the 2005 data confirmed these two Likert type scales in our data (Cronbach α=0.72 for vocation directed and 0.78 for ambivalent) and also in 2009 (Cronbach α=0.71 for vocation directed and 0.81 for ambivalent).

The length of the questionnaire did not allow development of a complex observation instrument for characteristics of the students' social backgrounds. Therefore we used rather simple instruments. First, we differentiated between students with at least one parent having the position of a legal worker (working class student = 1) and students not in that position (others = 0). Second, students with both parents workers (working class student = 1) and other students (= 0). In order to examine a different characteristic of social class, we also included the level of education of the parents. Parents having attended higher education might look differently at what their children need, materially, intellectually and culturally, than might parents who did not attain that level of education. Two dummy variables were used in further analysis: 1) Father attended higher education = 1, or did not = 0 and; 2) Mother attended higher education = 1 or did not = 0.

ICT is probably more relevant for science and bio-medical students (score = 0 for the dummy Humanities) than for humanity students (score = 1 for the dummy Humanities). However, it cannot be denied that computers have also achieved an important position in humanities. Nevertheless we suppose that students in these different domains of study will look differently at ICT skills and computer use.

In the next paragraph a description will be given of the change in access to computers and the Internet between 2005 and 2009. Second, a paragraph follows describing the change to the self-perception of ICT skills and of computer use. Third, we will look for some predictors of the self-perception of ICT skills. Fourth,

predictors will be tested for the self-perception of computer use. Fifth, a discussion and a conclusion will be offered.

4 Results

4.1 Access to computers and the Internet

Before we turn to the actual hypotheses, in this paragraph we sketch the situation of the research population regarding access to computers and the Internet. In 2005, 30% of the students had a PC at home for their sole use, 69% shared a PC with family members and 1% did not have a computer at home (N=715.28). These figures changed significantly (χ^2=241.62; df=2; p<.0001) for 2009; respectively 65%, 34% and 1% (N=1523.68). 95% of the students living in rooms in the university town in 2005 had a computer in their room for their sole use, 1% had to share a computer and 4% had no computer in their room (but had one at home). The situation has slightly changed for 2009: most students (99%) had a computer in their room and less than 1% had to share a computer or did not have one. In 2009 students used laptops more than before: 94% of the computers used by students in their room at the university were laptops, whereas in 2005 only 40% of the students had a laptop. In 2009 the major proportion (60%) of students also used a laptop at home.

Not only was access to computers very easy for these students, but also access to the Internet was very open and did not show big changes between 2005 and 2009. In 2005, 99% of the students had access to the Internet at home, whereas in 2009 access was almost 100%. Most students in 2005 (93%) as well as in 2009 (90%) had broadband Internet access at home, respectively 5% and 2% had a connection that was charged according to the time the Internet was used and respectively 2% and 8% did not know what kind of connection they had. At the university these figures were respectively, 91% and 98%, 0% and 0%, and 9% and 2%.

This almost unlimited access was accompanied by a growing expansion in the use of social network sites (SNSs) such as Facebook, Netlog and Twitter. We have no comparative data for 2005 (SNSs were rather new at that time), but the figures for 2009 show that computers and the Internet take an important place in the life of young students: 95% of the freshmen were convinced that they could create an account on SNSs and 92% were convinced that they could manage that account later on. This last cohort also had more contact with computers during their studies in secondary school. In 2009 the average score for using a computer for study in secondary school was 5.08 (Std Dev = 0.86), meaning that these students used a computer between two and five times a week for study. In 2004 this figure was 4.24 (Std Dev = 1.03), meaning that on average a computer was used only once a week for study. The PC had clearly (t=20.14; df=1; p<.0001) attained a more accepted position in the lives of the students. This does not mean that the computer attained a more favourable position in the classroom: in 2004 as well as in 2009, 95% of the respondents answered that a computer was used for study mainly at home, and only 3% of the students stated that a computer was used for study mainly at school. In spite of this rather poor place of computers as an educational tool in secondary schools, schools supported the development of access to computers and the Internet.

4.2 Change of ICT skills and computer and Internet use

An overall view of the changes between 2005 and 2009 is presented in Tables 1 and 3. These tables show the average scores in 2005 and 2009, and present the results of a statistical test designed to determine whether the change is statistically significant (repeated measures model).

Overall, the level of 12 of the 19 ICT skills changed significantly between 2005 and 2009 (see Table 1). Nine ICT competence levels increased significantly, with the most marked increases being in the areas of preparing a (PowerPoint) presentation and bookmarking web pages. Remarkably, three ICT skills seem to have decreased over the years. Two of these (spell checking and using a search engine) already had very high scores in 2005, meaning that the decrease could simply be the result of a ceiling effect. However, installing a virus scanner did not have such a high score in 2005, so it appears that the level of this basic ICT skill really is deteriorating.

Table 3 shows that all but one Internet related activity has significantly increased in frequency between 2005 and 2009. Students more frequently surf the Web, send emails, search for information on the Internet, download music or other files and participate in news groups. The most pronounced increases are in Internet surfing and searching. Chatting seems to be on the decline.

Scanning the absolute values of the average scores in Tables 1 and 3, it is clear that although the computer and the Internet are not used as intensely for all types of activities, it is obvious that the surveyed population consists of "digital natives" (Prensky 2001).

4.3 Predictors of ICT skills

Table 4 presents the standardised parameters of a set of linear regression analyses with 11 main effects and up to 10 interaction effects. The interaction effects are all two-level interactions of each main effect with the "year of observation". All non-significant interaction effects were left out of the results, because a significant interaction effect complicates the interpretation of the related main effects. A significant main effect which is not involved in an interaction effect can simply be interpreted as a "global" effect, i.e. an effect that is true for both 2005 and 2009. However, a significant main effect which is involved in an interaction effect needs to

Table 3 Average score of self-perception of frequency of computer and Internet use in 2005 and 2009 (score 1 to 6)

Computer used for	Average score in 2005	Average score in 2009	*F*-value	*p*-value
Surfing the Internet	5.22	5.82	328.33	<.0001
Emailing	5.23	5.57	86.47	<.0001
Searching on the Internet	4.76	5.46	315.67	<.0001
Chatting on the Internet	4.99	4.75	12.48	0.0004
Download music or pictures from the Internet	2.72	3.42	87.38	<.0001
Participating in news group on the Internet	1.86	2.49	85.40	<.0001

Table 4 Predictors of self-perception of ICT skills (standardised regression coefficients, R^2 and F)

Predictor	Spell check	Database	Graph	Calculations	Table of contents	Presentation	Download	Bookmarks	Search engine	Virus scanner	Install	File manager
Useful	0.12 ***	0.14 ***	0.10 ***	0.13 ***	0.16 ***	0.23 ***	0.08 **	0.03	0.02	0.06 **	0.06 *	0.07 **
Control	0.17 ***	0.23 ***	0.20 ***	0.19 ***	0.22 ***	0.15 ***	0.22 ***	0.29 ***	0.10 ***	0.35 ***	0.36 ***	0.32 ***
Anxiety	−0.13 ***	0.02	−0.10 ***	−0.11 ***	−0.06 *	−0.12 ***	−0.22 ***	−0.14 ***	−0.08 *	−0.13 ***	−0.12 ***	−0.05 *
Behaviour	0.01	0.03	0.02	0.02	−0.05 *	0.06 **	0.05 *	0.09 ***	0.07 **	0.02	0.04	0.05 *
ICT course in university	0.00	0.06 **	0.02	0.03	0.05 *	−0.01	−0.01	−0.00	−0.02	0.03	−0.00	0.01
ICT in secondary school	0.00	0.19 ***	0.10 ***	0.09 ***	0.10 ***	0.03	−0.01	−0.02	−0.00	0.02	0.02	0.02
Ambivalent	−0.02	−0.04	−0.05 **	−0.05 *	−0.03	−0.02	−0.01	−0.01	−0.06 **	−0.02	0.02	−0.01
Vocational	0.01	0.05 *	0.05 *	0.04 *	0.03	0.11 ***	−0.03	−0.00	0.00	0.12 ***	0.03	0.01
2005–2009	0.03	0.04	0.05 **	0.02	0.05 *	0.88 ***	0.09 ***	0.07 **	0.16 **	0.22 *	0.03	0.00
Female	0.04 *	−0.16 ***	−0.08 ***	−0.08 ***	−0.02	−0.12 ***	−0.07 ***	−0.22 ***	0.02	−0.20 ***	−0.22 ***	−0.14 ***
Humanities	−0.04	−0.01	−0.16 ***	−0.12 ***	−0.05 *	−0.01	0.00	0.01	0.02	0.03	0.01	−0.06 **
2005–2009 * useful						−0.47 ***						
2005–2009 * control												
2005–2009 * anxiety									−0.27 ***			
2005–2009 * behaviour												
2005–2009 * ICT course in university												
2005–2009 * ICT in secondary school												
2005–2009 * ambivalent	−0.17 *											
2005–2009 * vocational						−0.28 **				−0.34 ***		
2005–2009 * female		0.08 *				0.20 ***		0.15 ***				
2005–2009 * Humanities												
Adj. R-square	0.13	0.20	0.21	0.20	0.16	0.25	0.23	0.27	0.12	0.31	0.33	0.22
F	27.15 ***	44.49 ***	49.24 ***	46.40 ***	35.31 ***	50.01 ***	56.80 ***	63.48 ***	23.34 ***	78.75 ***	94.62 ***	54.43 ***

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

be interpreted as the difference in the dependent variable when the other variable is set to zero (due to the dummy coding of the time variable, this means the difference in 2005).

In what follows, we look at the prediction of first, basic ICT skills, second, Internet-related skills and third, computer maintenance.

4.3.1 Basic ICT skills

With regard to the use of the automatic spell check function in a word processor, one significant interaction effect and four significant main effects are observed. The interaction effect implies that students who score higher on the ambivalence scale have become less skilled in the use of this function in 2009 compared with 2005. This group of students may be partly responsible for the observed overall decline in the skill of using the spell check function in a word processor which was noted in Table 1. The main effects signify that students who score higher on the anxiety scale are less skilled in the use of this function (both in 2005 and in 2009). Conversely, students scoring higher on the control scale and the usefulness scale, and female students, are more skilled at using this function (again, both in 2005 and in 2009).

Working with databases was not a skill that had been mastered by most students in 2005, and while this situation had improved in 2009, most students still shied away from databases. Interestingly, students who see computers as useful and those who feel that they have control over computers are more skilled at using database technology. ICT classes in secondary school and at university also stimulate these skills, and students who are more strongly vocationally motivated also seem to be more skilled database users. However, for gender there is an interaction effect. While females scored much lower than males in 2005, the positive interaction effect suggests that females made up part of the deficit in 2009.

Spreadsheets are an important tool for many professionals. Making graphs and simple calculations is a skill mastered more by students who think that a computer is useful, think that they have control over computers and who are not afraid to work with them. Students who took an ICT course in the last year of secondary school think that they are more capable of working with spreadsheets than those who did not take such a course. Students who have fewer doubts about their choice of course and students who are vocationally motivated are more at ease working with spreadsheets than students with more doubts and who are less vocationally motivated. This is also true for male students and for (biomedical) sciences students.

Automatically creating a table of contents is not something students have to do everyday, but the skill to do this is more widely spread in 2009 than it was in 2005. It is also better known by students who have a positive attitude towards the usefulness of computers, who have control over a computer or who are not afraid to use a computer. Unexpectedly, students who express a more positive attitude towards computers are less skilled at creating a table of contents. ICT courses in secondary school and at university have a positive effect: students with this experience are more capable of performing this task. This higher technical competence is also found more among science or bio-medical students than among humanity students.

With regard to presentation skills, seven main effects are statistically significant, as well as three interaction effects. Students who score higher on

the anxiety scale have fewer presentation skills and students scoring higher on the control and behaviour scales have more presentation skills (both in 2005 and 2009).

The significant interaction effects imply that students who score lower on the usefulness scale have made up their deficits, partly because students who score higher on the usefulness scale show a decrease in their level of presentation skills. The reason for the sharp decline in presentation skills for students with higher scores on the usefulness scale is unclear. Similarly, students who score higher on the vocational scale appear to have lost their lead over students with a lower score on the vocational scale. Students with a lower score on this scale tend to have increased their skill levels, while those with a higher score show decreased skill levels over the 5 year period. In 2005, females had a lower level of presentation skills. In 2009, the situation has changed dramatically. Females have actually acquired more skills than males. This is reflected in the statistically significant positive interaction effect of females over time.

This data also demonstrates that three core variables of TAM are powerful predictors of the command of six basic ICT skills: usefulness and having control over a PC for all six examined relationships (once in interaction with the year of observation), and anxiety for five out of six. A positive attitude towards computers expressed in behaviour could only significantly improve the predictions for two of the six relationships. Contextual variables are also interesting predictors of competency in the basic ICT skills: gender improved the predictions five times (twice in interaction with the year of observation), and year of observation and the dichotomy of humanities students versus science and bio-medical students three times out of six. Attending an ICT course at university contributed to two (out of the six) dependent variables, and having benefitted from an ICT course in the last grade of secondary school, to five. Study motivation measured as an ambivalent motivation showed two significant relations (once in interaction with the year of observation), but vocationally-oriented motivation four (once in interaction with the year of observation).

4.3.2 Internet related skills

What about the use of the Internet? For most students the Internet was more accessible in 2009 than it was in 2005. This is also visible in their capacity to be able to download files from the Internet. The more students believe that they have control over a computer, find computers useful, act positively towards computers or the less they are afraid of computers, the more they use a file manager. Just as in 2005, working with a file manager belongs more to the world of male than of female students.

Working with bookmarks might also contribute to easier use of the Internet. In 2009 students could work better with a web browser than in 2005. Students who think that they have control over a PC and those who express a positive attitude towards computers in their behaviour will more likely work better with bookmarks than other students. Students who have reservations about computers will score lower here. Besides these main effects, there is an interaction effect between the year of observation and the gender. This interaction effect means that females have almost

completely caught up with their male counterparts. While females scored lower in 2005, they have reduced the gap with male students in 2009.

In comparison with 2005, search engines have lost a bit of their popularity among students in 2009. But we can still say that students in 2009 as well as in 2005 who have control over a computer and show a positive attitude towards computers in their behaviour, think that they can work better with search engines. This is not so for students who have an ambivalent opinion about their choice of study. The interaction effect between the year of observation and the level of anxiety towards computers tells us that while students with a low anxiety level use search engines more in 2009 than in 2005, students with a higher level of anxiety over computers actually use search engines less in 2009 than in 2005.

Further, Table 4 shows that three core variables of TAM are good predictors for three Internet-related skills: having control over a PC, anxiety (once in interaction with the year of observation) and a positive attitude towards computers. Usefulness could only significantly improve the predictions once. Three contextual variables are also interesting predictors for these Internet-related skills: gender improved the predictions twice (once in interaction with the year of observation), year of observation did so three times, and study motivation measured as an ambivalent motivation showed one significant relation out of three. The other variables did not contribute at all to the prediction of the dependent variables.

4.3.3 Computer maintenance

Computers have to be maintained and although a lot of students score quite high for doing this, there are still apparent differences. Installing a virus scanner, for example, is less well known in 2009 than in 2005 (Table 3), but we find the same significant predictors as we do for installing a computer or working with a file manager, except that there is an interaction effect between the year of observation and the vocational motivation of students (implying a decreased skill level for more strongly vocationally motivated students in comparison to less vocationally motivated students). The more students find computers useful, have the feeling that they can control them or the less fear they have about using a computer, the more they think that they are able to install a virus scanner, install other software or work with a file manager. Data in Table 4 also shows that these three techniques are better known by men than by women. Here it should also be mentioned that more vocationally motivated students in 2005 were less capable of installing a virus scanner, and students with a low score on vocational motivation are more capable in 2009 of installing a virus scanner than were similar students in 2005. Working with file managers seems also to be a technique that is more popular among science and bio-medical students than among humanity students, and among students who express a positive attitude towards computers in their behaviour.

Adding three variables related to the social background of the students' parents (at least one of the parents is a blue collar worker; father completed higher education or not; mother completed higher education or not) to the model in Table 4 did not contribute to a significantly better explanation of these skills, except for the skills of setting up a computer and installing new software. Here we see an interaction effect between the year of observation and the education level of the parents. While in

2005, students whose father completed higher education were less able to install a computer than their fellow students whose father did not complete higher education, this situation has reversed in 2009 (standardised b=0.12; p<.01). Similarly, students whose mother completed higher education were more able to install a computer than their fellow students in 2005 whose mother did not complete higher education, while this situation has reversed in 2009 (standardised b=−0.11; p<.05). Why this is so, needs more research. However, the global results of this analysis suggest that working class students in general consider they have the same ICT skills as do other students. In this respect there is more equality between both categories.

In accordance with former observations, this data confirms that three core variables of TAM are good predictors of three competences for maintaining a computer: usefulness, having control over a PC and anxiety. A positive attitude towards computers expressed in behaviour could only significantly improve the predictions for one of the three relations. Gender improved the predictions three times, but year of observation and the dichotomy of humanities students versus science and bio-medical students only once. Motivation expressed as vocationally-oriented motivation offered a better prediction only once. All other variables did not contribute to a prediction.

4.4 Predictors of computer and Internet use

Our model is best suited for explaining the variance in computer and Internet use for surfing (R^2=0.23) and searching on the Internet (R^2=0.22). The R^2 value for downloading music or pictures is slightly lower (0.16) as are the results for the other ways of using a computer: participating in newsgroups (R^2=0.10), mailing (R^2=0.08) and chatting (R^2=0.06) (Table 5).

As Table 3 shows, surfing the Web is the single most frequent behaviour engaged in by the students. Still, some students surf more often than others: students who think that they have control over a computer, who show a positive attitude in computer-related behaviour and who are less afraid of working with a computer, surf more frequently than others. The results also show that male students spend more time surfing than do female students. Moreover, students who have doubts about their study choice also spend more time surfing the Web than do other students. For this group surfing may well be an escape from worrying about their study choice.

Emailing still is very popular with students, and this behaviour was, and in 2009 still is, exhibited more by students with a positive attitude towards the use of computers. Students in the field of humanities have caught up with students in the (biomedical) sciences. While these students emailed significantly less often than students in the (biomedical) sciences in 2005, this is no longer the case in 2009.

Although chatting was rather popular among students in 2005, this custom had a relapse in 2009. There is more frequent chatting between students who consider computers useful, who express a positive attitude towards computers in their behaviour or who have ambivalent study motivation. For the latter, chatting could be a way to escape from a course they have doubts about. Besides these main effects, three interaction effects are observed. First, students attending an ICT course at university show a very marked decrease in chatting intensity between 2005 and 2009 (with students who did not attend an ICT course in university showing no change

Table 5 Predictors of self-perception of frequency of PC and Internet use for six tasks (logistic regression analysis; standardised regression coefficients and R^2)

Predictor	Surfing	Email	Chatting	Search	Music etc.	News
Useful	0.07	0.16 ***	0.12 ***	0.20 ***	0.12 ***	0.01
Control	0.15 ***	0.05	−0.03	0.06 *	0.23 ***	0.07 **
Anxiety	−0.11 **	−0.05	−0.04	−0.02	−0.10 ***	0.01
Behaviour	0.16 ***	0.03	0.11 ***	0.16 ***	0.02	0.07 *
ICT course in university	−0.00	−0.02	0.13 **	−0.09 *	−0.03	−0.04
ICT in secondary school	−0.02	−0.00	−0.09 *	0.00	−0.03	−0.04
Ambivalent	0.09 **	−0.03	0.10 ***	0.07 **	0.09 ***	0.03
Vocational	0.05	−0.02	0.03	0.02	−0.04	−0.01
2005–2009	0.54 ***	0.10 **	−0.03	0.25 ***	0.45 ***	0.05
Female	−0.17 ***	−0.01	0.03	−0.12 ***	−0.18 ***	−0.12 ***
Humanities	0.06	−0.14 ***	0.03	−0.03	0.04	0.03
2005–2009 * useful						
2005–2009 * control					−0.30 **	
2005–2009 * anxiety						
2005–2009 * behaviour						
2005–2009 * ICT course in university			−0.10 *	0.10 *		
2005–2009 * ICT in secondary school			0.12 **		0.08 *	0.09 *
2005–2009 * ambivalent						
2005–2009 * vocational						
2005–2009 * female			−0.13 **			
2005–2009 * humanities		0.16 **		0.14 **		
R-square	0.23	0.08	0.07	0.22	0.16	0.10

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

between 2005 and 2009). Second, students attending an ICT course in secondary school show a strong increase in chatting frequency between 2005 and 2009 (while there is no change for students who did not attend an ICT course in secondary school). And third, female students showed a more marked decrease in chatting activity than did male students.

The frequency of searching on the Internet was significantly higher in 2009 than in 2005 (see Table 3). In general we can say that freshmen who think that computers are useful, who feel they have control over computers, who show a positive attitude in their behaviour towards computers and who have an ambivalent study motivation, were more frequently searching the Web in 2005 and this is still the case for 2009. Students who attended an ICT course in university, and students in the field of humanities, show a more marked increase in Internet searching activity than those who did not take such a course, and students studying (biomedical) sciences.

While downloading music or pictures from the Internet did not rank high in Table 3, we did find an overall increase in downloading activity between 2005 and

2009. In general, students who find a computer useful and students who are not afraid to do something wrong while working on a computer, more frequently download music or pictures. It seems also more a pastime for male students and for students with an ambivalent study motivation. Two interaction effects with time of observation are noticeable. First, students with a high feeling of control over a computer actually show a decreased intensity of downloading music and pictures from the Internet between 2005 and 2009, while students with a lower feeling of control downloaded more in 2009 than in 2005. Second, students who took an ICT course in secondary school show a more pronounced increase in downloading music and pictures from the Internet between 2005 and 2009 than those who did not take such a course in secondary school.

Freshmen are not very active newsgroup users—neither in 2005 nor in 2009. But the regression analysis does show that some students are more avid users than others. In general, a feeling of having control over a computer, having a positive attitude towards computers and being male, all contribute to a higher frequency of participating in newsgroups. One interaction effect has to be reported: freshmen who attended an ICT course in the last grade of secondary school participated more in newsgroups in 2009 than those who did not follow such a course.

Including the three variables related to socio-economic background did not contribute much to the explanation of the variance of the dependent variables, with the exception of "chatting". The frequency of using a computer for the various applications was not related to having blue collar parents, or with the parents' education level. As mentioned, for chatting some additional effects were found. In addition to the already discussed main and interaction effects of the independent variables on chatting, two additional interaction effects between the year of observation and the higher education status of the father or mother were observed. While in 2005, students whose father completed higher education chatted more than students whose father did not complete higher education, this is no longer true for 2009 (interaction effect: standardised $b=-0.19$, $p<0.01$). Similarly, while in 2005 students whose mother completed higher education chatted less than students whose mother did not complete higher education, this is no longer true for 2009 (interaction effect: standardised $b=0.19$, $p<0.01$).

With regard to four forms of computer and Internet use, the explanation for variance in the dependent variables can take advantage of three core variables of TAM: usefulness, having control over a PC (once in interaction with the year of observation) and a positive attitude towards computers expressed in behaviour. Anxiety improved the prediction for two forms out of six. Contextual variables are also good predictors of computer and Internet use. Gender (once in interaction with the year of observation) and the year of observation improved the predictions four times, but the dichotomy of humanities students versus science and bio-medical students only once (twice in interaction with the year of observation). Attending an ICT course at university contributed to two (out of six) dependent variables, and having benefitted from an ICT course in the last grade of secondary school contributed to three in interaction with the year of observation. Study motivation measured as an ambivalent motivation showed four significant relations, but vocationally-oriented motivation had no significant consequences for computer and ICT use.

5 Discussion

For studying the change in the self-perception of ICT skills and the self-perception of the frequencies of computer use among freshmen between 2005 and 2009, two groups of first year students were compared. In order to explain the possible differences between the students we applied a model which we termed TAM+. It is composed of 11 variables: four core variables of TAM (Davis 1989), two facilitating factors, two types of study motivation and three contextual variables as suggested in the theory of digital differentiation (van Dijk and Hacker 2003). In addition, the interaction between ten of these variables and the moments of observation in 2005 and 2009 were included in the analysis. We also extended this model by integrating three variables related to the social background of students. To answer our research questions, multiple linear regression analysis and multiple logistics regression analysis was applied. Research has shown before that most of these variables are fruitful in explaining ICT skills and frequencies of computer use (Verhoeven et al. 2010).

We confined our analysis of ICT skills to the use of basic ICT skills (such as the use of a spell checker, the use of database software, etc.), Internet use (for instance, attaching a document to an email, publishing a page on the Internet, etc.) and maintenance of a computer (e.g. installing a virus scanner, installing other software, etc.). Currently, many will say that studying ICT skills should also include an immense degree of participation of students in SNSs, because a lot of ICT skills must be applied in using these services. We did, however, not include them because, firstly, in 2004–2005 SNSs were less popular than they are now and secondly, we were interested in the basic skills students need to work on a computer and use the Internet. Indeed, research has shown that students do not always master more knowledge of basic ICT skills in spite of the increasing presence of ICT in the world and in schools (Kaminski et al. 2009; Strømsø et al. 2004).

This research was conducted in one major university in Belgium. It cannot be claimed that the results of this project answer the questions relating to all freshmen in Belgium, nor for other countries, because of cultural differences and differing levels of ICT accessibility. On the other hand, it is not unacceptable to say that similar developments could be expected in countries that are culturally and economically not too dissimilar and that have comparable access to ICT.

6 Conclusion

At the beginning of this article we suggested that because ICT has gained a more prominent place since 2005, in society in general and in education in particular, it would be likely that in 2009 freshmen would have developed more skills to work with computers and the Internet. Our data partly confirms this statement, but also denies parts of it. The self-perception of 19 ICT skills among freshmen in 2005 and 2009 has been checked: 12 skills changed significantly, but six did not. Ten skills showed a significant increase in 2009, but two decreased (use of a spellchecker and installing a virus scanner). The highest increase between 2005 and 2009 is observed in the competence of students to work with presentation software and to make bookmarks.

In 2009, four ICT skills scored significantly higher than the other skills: attaching a file to an email, using a search engine, using a chat program and using a presentation program (scores between 4.86 and 4.76). Two of these skills belong to the skills people should know in order to work with SNSs and two are very important for study. Two skills score significantly lower than the others: using web design software (score 2.32) and publishing a website on the Internet (score 2.28). The majority of the students are not well prepared to work on the Internet, but probably are not interested either.

It was also hypothesised that although the use of computers among freshmen was already high in 2005 for some functions, this could have increased in 2009 for the same reasons as stated above. This has been confirmed for five of the six functions: computers are used more in 2009 than in 2005 for surfing, emailing, searching, downloading music or pictures, and participation in newsgroups. Computers were less used for chatting in 2009 in comparison with 2005. Surfing and searching on the Internet increased the most between 2005 and 2009.

This research also confirms that the core variables of TAM are important predictors (Carlsson et al. 2006; Chatzoglou et al. 2009; Cho et al. 2009; Lee 2010; Teo et al. 2009; Wang et al. 2009; Wu et al. 2007), not only for the acceptance of new technology, but also for the understanding of the increase in ICT skills and the frequency of use of a personal computer for particular tasks. Three predictors (usefulness of a PC, having control over a PC and anxiety when using a computer) are very successful; the fourth (a positive attitude towards ICT) is less. Usefulness improved the prediction for 14 of the 18 studied relationships (once in interaction with the year of observation), having control of a PC for 16 (once in interaction with the year of observation) and anxiety for 13 (once in interaction with the year of observation). A positive attitude towards computers expressed in behaviour could significantly improve predictions for nine of the researched relations.

It was suggested in paragraph two that students who find computers useful or think that they have control over a computer, would be more convinced that they have better ICT skills and would therefore use computers more frequently. This statement is supported in 14 of the 18 skills and functions of computer use for the variable “usefulness”, and in 16 for the variable “having control”. Anxiety about using computers clearly diminishes the capacity of students to become familiar with ICT skills (13 out of 18) and to work frequently with computers.

Among the contextual variables, gender (14 out of 18—four times in interaction with the year of observation) and year of observation (10 out of 18) contribute significantly to a better prediction of ICT skills and frequency of computer use. The dichotomy of humanities students versus science and bio-medical students did not contribute significantly to a better understanding of ICT skills and frequency of computer use (5 out of 18—two times in interaction with the year of observation). A widely held opinion is that humanities students are less interested than other students in mastering ICT skills. This statement is only confirmed by the data for four skills. As far as ICT skills and frequency of computer use are concerned, more similarities than differences were found between humanities students and other students.

Less predictive capacity than expected was observed in the two facilitating variables: attending an ICT course at university contributed to four (out of 18—twice in interaction with the year of observation) dependent variables, and having

benefitted from an ICT course in the last grade of secondary school to five (three times in interaction with the year of observation). ICT course experience at university and in secondary school shows only respectively two and four times a higher score for ICT skills and frequency of computer use in comparison with those who had not had this experience.

Study motivation measured as an ambivalent motivation showed seven significant relations (once in interaction with the year of observation) out of 18, and vocationally oriented motivation five (twice in interaction with the year of observation). Having an ambivalent motivation does not matter greatly with regard to mastering ICT skills, but it is more important in respect of the frequency of using a computer for surfing, chatting, searching the Internet and downloading music or pictures. This is also true for vocationally motivated freshmen. Vocationally motivated students only showed a better knowledge of some ICT skills three times.

Expanding our basic model with three variables referring to the social background of the students did not additionally explain much of the variance in the ICT skills and frequency of computer use. Students from different social backgrounds seem to resemble each other as far as ICT skills and frequency of computer use are concerned.

In former research we have seen that female students have a lower appreciation of their ICT skills and use computers less than do male students (see also Colley and Comber 2003; Losh 2004; Volman and van Eck 2001; van Dijk and Hacker 2003). This is confirmed ten times, but it was also shown that there was an interaction effect between gender and the years of observation. For three skills women scored higher in 2009 than did male students. Female students look differently at computers than do male students, but this difference is changing. Female students have improved in some ICT skills (the use of a database, working with presentation software and making bookmarks)

7 Implications

Although in this decade of the tremendous growth of SNSs, freshmen have learned many more ICT skills and use computers more intensively than they did 5 years ago, there are still a lot of differences between students. In this respect, this research confirms the picture in a university of the third divide as described by Molnar (2003 quoted by Mancinelli 2008). In a society where equality of opportunities is taken as an important education policy goal, all students need to master these basic ICT skills more completely. As suggested by Molnar for this period of development, there are still differences between male and female students, and differences between students with ICT training in secondary school and those without. We have also observed that students can improve in a relatively short period of time. Therefore it makes sense to invest in ICT skills training for students who are left behind. Our data has also shown that secondary schools can make a difference with regard to mastering basic ICT skills (see Table 4). Nevertheless, we should be aware that even though schools might have some degree of positive influence over mastering basic ICT skills, for many skills we see no difference between students who had ICT classes and those who did not. The same can be said for students who took an ICT-related course at

university and those who did not. Our data shows that at this university, with regard to mastering basic ICT skills, it does not make a major difference whether a student attended an ICT-related course or not. However this does not mean that a well-organised course cannot improve the ICT skills of students.

If we want a society in which communication is very open, it is not sufficient for access to new information technology to be easy; it is also necessary for all citizens to have the skills to use the technology and to be motivated to use it to communicate (Viherä and Nurmela, 2001). If this is true for a society, it is certainly true for a university. Although it is stated that some ICT competences are well developed, there are still differences between students. The data shows that these differences may be reduced by convincing students that computers can be very useful and that there is no reason to be afraid of using them. This will probably also promote the feeling of having control over computers, which will also support mastering new ICT skills.

There is no doubt that not all the ICT skills that are the subject of this study hold the same importance for a course of study or for a future profession. For example, for most students it makes sense to learn how to work with spreadsheets and databases, but not all students need to develop a personal site on the Internet.

Finally, it is shown that ICT competences and the use of computers and the Internet by freshmen can change in a period of 5 years, but can also stabilise. Moreover, it is not certain that change always means the growth of ICT competences and greater use of computers and the Internet. If universities aim for smooth ICT-based communication, they should be aware of these fluctuations, and if required provide their students with the necessary help to attain this goal.

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