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Computers & Education 43 (2004) 299–312

COMPUTERS & EDUCATION

www.elsevier.com/locate/compedu

Domains and determinants of university students' self-perceived computer competence

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Received 3 September 2002; accepted 1 September 2003

Abstract

The first aim of this study was to develop an instrument of self-perceived computer competence and to assess differences among university students. For this purpose, two instruments were developed: 'quantity of computer applications' (16 items) and 'quality of application use' (30 items). Questionnaires were administered to two samples of first-year university students in psychology, education and andragogics. The results indicated a high correlation between the two computer competence scales.

The second aim was to identify possible determinants of self-perceived computer competence and to test the impact at an individual level. The results from a path model demonstrated that self-perceived computer competence (quality of application use) was affected by four factors: computer confidence, computer experience expressed in time, intensity of computer use and home access to a computer. The four variables accounted for a significant proportion of the variation (54%) in the self-perceived computer competence variable.

1. Background

Despite continuous pressure at all educational levels to use computer technology in classrooms, the rate of integration and the effectiveness of technology use are still considerably lower than could have been anticipated 15 years ago. '*Some education experts even stress the lack of benefits that computers have brought to education. Teachers at all levels of schooling have used the*

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doi:10.1016/j.compedu.2003.09.006

new technology basically to continue what they have always done: communicate with parents and administrators, prepare syllabi and lectures, record grades, assign research papers. These unintended effects must be disappointing to those who advocate more computers in schools' (Cuban, 2001, pp.178–179). Also Fabry and Higgs (1997) state that in spite of huge investments made in acquiring technology for schools, a gap still exists between actual and expected computer use. In an attempt to account for this remaining gap, Fabry and Higgs reviewed the literature and pointed to teachers' attitudes, resistance to change, concerns about funding, training deficiencies and inadequate access to computer technology. Zammit (1992) also showed that inadequate hardware, software, time and trained personnel are the main constraints on the use of computers in schools. All these factors appear to be strengthened by financial constraints. At the level of teachers, Marcinkiewicz (1993–1994) points to the degree of innovativeness as a significant determinant of teachers' computer use. Van Braak elaborated the concept of technological innovativeness and demonstrated its effect on teachers' use of computers in class (van Braak, 2001). In Marcinkiewicz's survey, a second and more significant determinant of computer use was the degree of self-perceived computer competence. A high degree of computer competence among teachers is a major condition for instructional computer use. Not only teachers should master a wide variety of computer competencies. Students too should acquire strong computer competencies to be successful in many academic careers in the future (Furst-Bowe, Boger, Franklin, McIntyre, Polansky, & Schlough, 1995). However, the question is: What computer knowledge and skills should university students possess when they enter and leave university?

Two instruments of self-perceived computer competence are developed in this study: 'quantity of computer applications' and 'quality of application use'. The two scales can be described as the minimum basic computer knowledge and skills which all university students should possess in order to be able to assimilate technology efficiently for various study-related tasks.

Firstly, the development of the two scales will be described. Secondly, the results yielded by the two scales will be presented for two different samples of university students. Thirdly, the determinants of self-perceived computer competence will be identified using path analysis.

2. Literature on computer competence, confidence and experience

Computer competence is a broad concept and is closely related to similar concepts such as computer experience, computer proficiency, computer achievement, computer skills and computer literacy. Corston and Colman (1996) measure computer competence on the basis of a respondent's self-rated level of confidence with computers. Similarly, for a sample of teachers Marcinkiewicz (1993–1994) defines self-competence as a self-rated level of capability when using computers for teaching. Campbell and Williams (1990) measure the level of computer proficiency by a respondent's selection of an item listing five levels of increasing proficiency ranging from 'I have no experience with a computer' to 'I am proficient in programming in one or more computer languages'. This concept of computer proficiency clearly indicates the temporal nature of conceptualisation. Whereas one decade ago strong computer competence was perceived as being able to master one or more computer languages, nowadays computer competence is observed more as being able to handle a wide range of varying computer applications for various purposes. Both Furst-Bowe et al. (1995) and Flowers and Algozzine (2000) apply a more profound and broader operationalisation of the computer competence construct. Furst-Bowe et al. (1995) distinguish 40 computer competencies, subdivided into six dimensions (basic computer skills, word processing skills, spreadsheet skills, database skills, graphics/multimedia skills and information skills). Flowers and Algozzine (2000) developed a Basic Technology Competence for Educators Inventory. The scale consists of 45 different items, separated into nine domains, ranging from basic computer operation skills to knowledge of social, legal and ethical issues. Bradlow, Hoch, and Hutchinson (2002) constructed a basic computer proficiency test among a large sample of Internet users, including 27 items and assessing knowledge of computer terminology, file management, word processing, spreadsheets, databases, printing, e-mail, Internet and information search.

In the 1980s, Loyd and Gressard (1984) and constructed the Computer Attitude Scale (CAS) as a reliable instrument to measure different types of attitudes toward learning about and using computers: computer liking, computer confidence, computer anxiety and perceived usefulness of computers. The latter subscale was added to the original CAS in 1985 (Loyd & Gressard, 1984). Researchers found computer confidence to be associated with computer usage (Al Khaldi & Al Jabri, 1998; Gardner, Dukes, & Discenza, 1993). Levine and Donitsa-Schmidt (1998) found a strong effect of computer confidence on computer knowledge. In the present study, the impact of computer confidence on computer competence will be investigated along with other computer-related background variables such as computer experience and intensity of computer use.

3. Method

3.1. Development of the instruments

Questionnaires were used as the method of data collection.

Based on an examination of the computer applications most commonly used by university students and a review of the existing literature on computer competence (Furst-Bowe et al., 1995; Flowers & Algozzine, 2000), two different scales were developed identifying self-perceived computer competence. The first scale assessed the number of computer applications students reported that they were familiar with. It included 16 common computer applications and used a 2-point scale ($0 = \text{no}$; $1 = \text{yes}$). The sum of the scores was labelled as the *quantitative index*.

The second self-perceived computer competence scale was a *qualitative index*. This index was not concerned with the number of different applications used, but rather with the in-depth knowledge of three important IT skills: operating system skills, word processing skills and web skills (WS). Within each of the three domains, respondents were asked to indicate their knowledge of 10 basic operations. In a further section, the three subscales will be presented at item level.

The computer confidence subscale of the Computer Attitude Scale (CAS) (Loyd & Gressard, 1984; Loyd & Loyd, 1985) was used as an instrument to measure the degree of confidence in the ability to use or learn about computers. The 10 items used a 4-point scale, ranging from strong agreement to strong disagreement. The sample items include: 'I'm no good with computers', 'I'm not the kind of person who is at home with computers', 'I could get good grades in computer courses', 'I feel very confident when it comes to working with computers'.

Two computer experience measures were included in the survey. A first measure of computer experience was individuals' experience of computing, expressed in time (number of months). A second measure of computer experience was the intensity of computer use, i.e., the total number of hours a week individuals spent working with a computer.

Finally, two background variables were identified as having a possible effect on computer competence. The first background variable was gender. Research has demonstrated the effects of gender on computer attitudes and use (Kirkpatrick & Cuban, 1998; Chua, Chen, & Wong, 1999; Whitley, 1997). The second background variable was availability of a computer at home. Hypothetically, access to a computer at home is positively associated with measures of computer competence and confidence.

3.2. Sampling

Two different samples were used for this study. The main reason for including two samples was that computer competencies among university students appear to develop rapidly over time. For the two samples, the psychometric qualities of the research instruments will be analysed, and the two samples will be used to test the theoretical model of determinants associated with the dependent computer competence measure.

The data for the first sample were collected in January 2001 from 137 first-year students of andragogy, psychology and education science. For practical reasons, the first sample will be referred to as the '2001 sample'. Most of the participants were female (89.1%). The average age was 18.23 years (SD = 1.78).

The data for the second sample were gathered in January 2002 among 114 students within the same field of study. In this sample, 82.5% were female and the average age was 18.29 years (SD = 0.83).

4. Results

4.1. Students' computer background

Although the data were collected from two groups with identical population characteristics (age, study level and field of study), the data showed considerable differences in computer background between the two samples.

The average time of reported computer experience was 4 years and 10 months in the first sample. The reported length of computer experience in the second sample was 6 years and 7 months, which is significantly higher than in the 2001 sample ($F(1,249) = 28.11$, $p < 0.000$).

Furthermore, the frequency of computer use was significantly higher in the 2002 sample ($X^2 = 36.6, p < 0.000$). Of the respondents in the first sample, 13.9% used the computer on a daily basis, 34.3% a few times a week and 51.8% once a week or less. In the second sample, 33.3% used the computer on a daily basis, 48.2% a few times a week and 18.4% once a week or less.

In the 2002 sample, 95.6% of the respondents said they had access to a computer at home, compared with 94.9% in the first sample ($X^2 = 0.72$, $p > 0.05$).

The intensity of computer use per week was 4.53 h (SD = 4.34) in the 2001 sample and 6.75 h (SD = 6.24) in the 2002 sample. With a difference of over 2 h a week, the intensity of computer use was statistically higher in the second sample ($F(1,249) = 10.96$; $p < 0.001$).

4.2. Computer confidence scale

Individual item statements are presented in Table 1. All the statements are four-point Likert items (strongly disagree, disagree, agree, strongly agree). Item indexes ranged from 0 (strongly disagree) to 3 (strongly agree).

The means, standard deviations, differences in item means using Mann–Whitney statistics and internal reliability using Cronbach alpha were calculated for the two samples.

Mann–Whitney statistics on the data showed substantial differences between the two samples. The means for 8 out of 10 statements were statistically different when the two samples of students were compared. Students in the 2002 sample reported that they were more confident with computers. This is confirmed by comparing mean scores for the entire scale. The index score for the computer confidence scale was rescaled into a 0–100 range. The higher the mean scale score, the higher the degree of computer confidence. The alpha coefficient for the computer confidence scale was for both samples high (2001 sample: $\alpha = 0.88$; 2002 sample: $\alpha = 0.87$).

Table 1
Computer confidence: individual item statistics and comparison between the 2001 sample and the 2002 sample

	2001 sample	2002 sample	Mann–Whitney	
	M (SD)	*M* (SD)	*Z*	*p*
I'm no good with computers[a]	1.60 (0.89)	1.15 (0.94)	3,91	***
Generally, I feel OK when faced with a new problem on the computer	1.58 (0.86)	1.84 (0.94)	−2,40	*
I don't think I'd be able to work with computers at an advanced level[a]	1.70 (0.98)	1.46 (0.93)	2,02	*
I'm sure I could work with computers	1.47 (0.81)	1.79 (0.75)	−3,13	**
I'm not the kind of person who is at home with computers[a]	1.86 (0.91)	1.49 (0.93)	3,15	**
I'm sure I could learn a computer language	1.75 (0.81)	1.82 (0.72)	−0,71	-
I think using a computer would be very hard for me[a]	1.37 (0.91)	1.06 (0.87)	2,65	*
I could get good grades in computer courses	1.30 (0.73)	1.61 (0.84)	−2,98	**
I don't think I could handle a computer course[a]	0.88 (0.73)	0.82 (0.76)	0,84	-
I feel very confident when it comes to working with computers	1.38 (0.79)	1.68 (0.90)	−2,71	*

[a] Item score reversed before scaling.
[-] $p \geqslant 0.05$.
[*] $p < 0.05$.
[**] $p < 0.01$.
[***] $p < 0.001$.

Compared to the 2001 sample, the students in the 2002 sample reported to be more computer confident. With a mean score of $M = 50.19$ (SD = 19.40) for the 2001 sample and $M = 59.21$ (SD = 19.40) for the 2002 sample, the results of the univariate analysis of variance yielded significant differences ($F(1, 249) = 13.50$; $p < 0.001$).

4.3. Computer competence: Quantity index

The quantity index was developed to assess students' knowledge of basic computer applications. Table 2 gives an overview of all the computer application items.

Word processors, operating systems and e-mail programs came out as the most popular computer applications. Relatively few respondents in the two samples reported that they were familiar with security software, databases, HTML tools and Internet tools such as Telnet and/or File Transfer Protocol.

With the exception of computer games, students in the second sample reported greater knowledge of all the distinct computer applications. On seven applications, the differences between the groups were statistically significant.

The respondents' scores on all the applications were summarised to form a quantity index. The mean score on this index (ranging from 0 to 100) was $M = 49.32$ (SD = 21.30) for the 2001 sample and $M = 59.05$ (SD = 22.67) for the 2002 sample. As might be expected from the data at item level, univariate statistics revealed statistical differences between the two groups ($F(1, 249) = 12, 25$; $p < 0.001$), with the 2002 sample reporting on average a higher familiarity with the set of computer applications.

Table 2
Quantitative index: variety of known computer applications (2001 and 2002 samples)

Computer application	2001 sample	2002 sample	X^2	p
Word processing programs	95.6%	99.1%	3.18	-
Operating systems	93.4%	94.7%	0.19	-
E-mail packages	78.1%	93.9%	13.29	***
CD-ROMs (e.g., encyclopaedias)	71.5%	73.7%	0.14	-
Spreadsheets	56.2%	73.7%	8.39	**
Chat programs	45.3%	65.8%	10.69	***
Graphics software	51.8%	58.8%	1.21	-
Computer games	56.9%	51.8%	0.67	-
Statistical packages	49.6%	57.0%	1.36	-
Web browsers	51.1%	53.5%	0.14	-
Specific CD-ROM/DVD software	35.0%	48.2%	4.49	*
Presentation software	29.9%	47.4%	8.06	**
Security software	24.1%	44.7%	11.95	***
Databases	20.4%	29.8%	2.94	-
HTML tools	16.8%	27.2%	3.40	-
Telnet and/or FTP	13.1%	25.4%	6.18	*

- $p \geqslant 0.05$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 3
Quality index: operating system skills

	2001 sample	2002 sample	X^2	p
Start a computer and shut it down	99.3%	100.0%	1.21	-
Create a new folder on the computer	69.3%	77.2%	1.56	-
Change file names	85.4%	87.7%	0.29	-
Format a diskette	55.5%	78.9%	15.73	***
Add an icon to the desktop	43.1%	68.4%	16.38	***
Copy a file to a diskette	82.5%	92.1%	5.26	*
Remove files and folders from the hard disk	79.6%	83.3%	0.58	-
Search for a file on the disk	89.8%	94.7%	2.16	-
Change the screen resolution	62.0%	72.8%	3.29	*
Install a printer and a scanner	51.8%	59.6%	1.55	-
Scale mean (SD)	71.8 (23.0)	81.5 (22.4)		

- $p \geqslant 0.05$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

4.4. Computer competence: Qualitative index

The responses to the qualitative computer competence questionnaire assessed the level of respondents' basic computer skills. These skills were subdivided into three main categories: operating system skills, word processing skills and web skills.

Table 3 shows all 10 items on the operating system skills subscale. Only 10 of the most basic operating system skills were included in the instrument. It is noteworthy that not all skills display the same importance in terms of functionality of computer use. The ability to copy a file to a diskette for example, is a more functional skills compared to the ability of adding an icon to desktop.

Surprisingly, not all students reported that they were confident with all the basic skills. The most difficult basic operations were 'adding an icon to the desktop' and 'installing a printer and a scanner'. The students in the 2002 sample reported a higher overall familiarity with all 10 basic operations than the 2001 sample. Statistically, this was confirmed for four out of the 10 basic skills. The differences were also statistically significant at the scale level ($F(1,249) = 11.21$; $p < 0.001$).

Table 4 gives an overview of the reported word processing skills. Most respondents are familiar with these basic word processing skills. In the two samples, the most difficult skills were creating and modifying a style. The 2002 sample reported that they were more familiar with word processing skills ($F(1,249) = 14.79$; $p < 0.001$).

Most respondents did not acquire all web skills (Table 5). Few respondents said they could create and publish web pages. The most important finding was the presence of major differences between the two sample groups, both at item level (8 out of 10 skills) and at subscale level ($F(1,249) = 29.35$; $p < 0.001$).

A computer competence quality index was then computed based on the three subscales (operating system skills, word processing skills and web skills). According to the statistics at subscale level, the mean sample scores on the quality index differed statistically ($F(1,249) = 25.10$; $p < 0.001$). The mean scores were $M = 63.3$ (SD = 20.6) for the 2001 sample and $M = 75.5$ (SD = 17.6) for the 2002 sample.

Table 4
Qualitative index: word processing skills

	2001 sample	2002 sample	X^2	p
Create a new file and save it	97.1%	99.1%	1.45	-
Modify the font type and size	99.3%	100.0%	1.21	-
Create a table and modify the number of cells	68.6%	85.1%	9.59	**
Create columns and change the column width	77.4%	89.5%	6.66	**
Apply different styles in a document	92.7%	93.9%	.13	-
Create a new style and modify a style	32.1%	42.1%	2.67	-
Generate a table of contents	35.8%	50.9%	5.82	*
Import data from other applications into a document	54.0%	78.1%	16.23	***
Modify margins and paper size in the page setup	86.1%	91.2%	1.61	-
Set a specific language and use the spellchecker	81.0%	93.0%	8.04	**
Scale mean (SD)	72.4 (21.4)	82.3 (18.7)		

- $p \geqslant 0.05$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 5
Web skills

	2001 sample	2002 sample	X^2	p
Use a web browser	57.7%	73.7%	7.11	**
Modify browser settings (e.g., font, font size)	29.2%	49.1%	10.49	**
Bookmark favourite web locations	43.1%	71.1%	20.14	***
Print the content of a web page	83.9%	99.1%	21.56	***
Save an image of a web page on the hard disk	55.5%	71.1%	6.52	**
Create a web page	8.8%	14.0%	1.47	-
Publish a web page on the WWW	7.3%	7.0%	0.01	-
Search for web pages using search engines	74.5%	92.1%	14.35	***
Include logical expressions when looking for web docs	49.6%	79.8%	25.30	***
Download files from the web and save them on the hard disk	46.7%	71.9%	16.56	***
Scale mean (SD)	45.6 (27.5)	62.9 (22.0)		

- $p \geqslant 0.05$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

4.5. Intercorrelations

The next question concerned the relationship between the computer competence (sub)scales being developed.

High Pearson Product-Moment intercorrelation coefficients were found among the (sub)scales (Table 6). The most remarkable finding was the significant correlation between the qualitative

Table 6
Intercorrelations among the computer competence (sub)scales (2001 and 2002 sample)

	{1} 2001	2002	{2} 2001	2002	{3} 2001	2002	{4} 2001	2002	{5} 2001	2002
{1} Computer competence quantity index	1.00	1.00								
{2} Computer competence quality index	0.75***	0.76***	1.00	1.00						
{3} Quality index: operating system skills	0.65***	0.67***	0.88***	0.86***	1.00	1.00				
{4} Quality index: word processing skills	0.58***	0.55***	0.84***	0.80***	0.68***	0.54***	1.00	1.00		
{5} Quality index: web skills	0.69***	0.68***	0.86***	0.85***	0.60***	0.60***	0.54***	0.51***	1.00	1.00

*** $p < 0.001$.

and quantitative competence measures ($r = 0.75$ and $r = 0.76$; $p < 0.001$). Also, the higher the number of different computer applications known to the respondents, the higher the likelihood that they would feel confident with the three fields of application separately ($r > 0.55$ within both samples). The high degree of shared variance between the quantitative and qualitative indices suggests that the two instruments can be employed as a measure of self-perceived computer competence.

In the next step, the qualitative index will be used as the self-perceived computer competence measure because it yields more profound and more detailed insight into respondents' actual level of computer skills and competence. The sum of the total scale (30 items) will be used as a measure of students' level of self-perceived computer competence.

4.6. Path modelling

Path modelling is a multivariate technique designed to test simultaneous interactions among observed research variables (Bollen & Long, 1993). In this section, the determinants of self-perceived computer competence as the main dependent variable will be identified. While univariate analyses are useful to differentiate between two groups, multivariate path modelling will be used to identify possible causal relationships between the dependent and independent variables. The effects of independent on the dependent variables are represented by standardised regression coefficients (beta values or βs). β-values can vary between -1 (complete relationship) and 0 (no relationship). Non-significant paths can be removed from the model. Measures of fit (GFI and Adjusted GFI) give an estimate of the fit between the theoretical model and the observed data. To accept the model, the (A)GFI should be greater than 0.90, while a value of 1 represents a perfect fit between the theoretical model and the observed data. Another fit-index is the χ^2 statistic. This index informs us of the degree to which the presumed model fits the data. If the χ^2 value is significant (<0.05), the model does not fit the data and should as a consequence be rejected. AMOS 4.0 was used to assess the overall fit of the data collected (Arbuckle & Wothke, 1999).

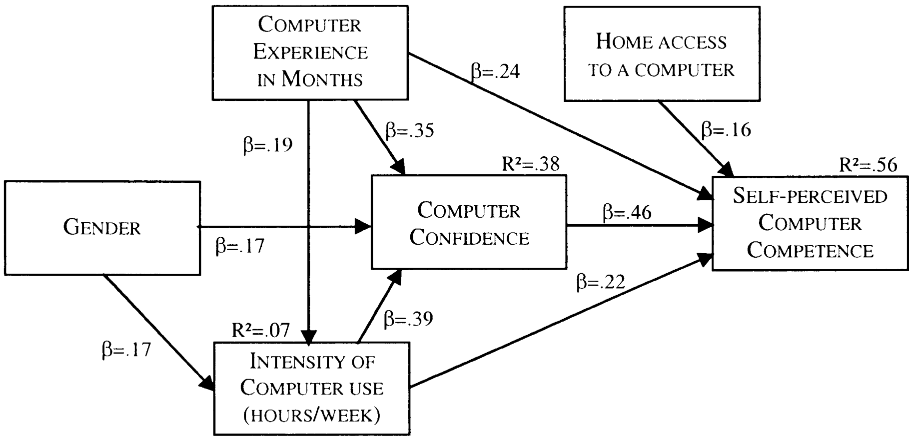

Fig. 1. Path model of the 2001 data: determinants of self-perceived computer competence: beta weights and explained variances ($n = 137$).

Fig. 1 shows the results of the first path model. All dependent and independent variables have been included, and individual paths between variables and beta weights (β-coefficients) are depicted. The levels of explained variance for the endogenous variables are indicated at the top of the variable rectangles (R^2).

The goodness of fit index (GFI), adjusted goodness of fit (AGFI), χ^2/degrees of freedom and probability level were used as measures for goodness of fit. For all indexes, the first model (Fig. 1) provides a good fit to the data: χ^2/degrees of freedom = 0.80, GFI = 0.99, AGFI = 0.96 and $p = 0.57$.

The model shows that the self-perceived computer competence measure is affected by four key factors. The explained variance for the computer competence measure was 56%. The most significant contributor to computer competence was computer confidence ($\beta = 0.46$; $p < 0.001$). The computer background variables contributed to the prediction of computer competence: computer experience expressed in time ($\beta = 0.24$; $p < 0.001$) and intensity of computer use ($\beta = 0.22$; $p < 0.01$). The two computer background measures affected computer competence not only directly but also indirectly (through computer confidence). The two measures, together with gender, accounted for 38% of the computer competence measure. A fourth factor with impact on computer competence was home access to a computer ($\beta = 0.16$; $p < 0.01$). At a univariate level, moderate gender differences were found on the computer competence measure. One-way analysis of variance revealed that girls reported a lower degree of computer competence than boys ($F(1, 135) = 4.09$; $p < 0.05$). However, if controlled for the other determinants in the path model, the impact of gender on computer competence became non-significant. The impact of gender on computer competence is entirely mediated through the intensity of computer use and the degree of computer confidence.

In the next step, the same research model will be tested on the 2002 sample in order to evaluate the stability of the results yielded by the 2001 sample.

The second path model provides a good fit to the data for all indexes: χ^2/degrees of freedom = 1.50, GFI = 0.97, AGFI = 0.92 and $p = 0.15$.

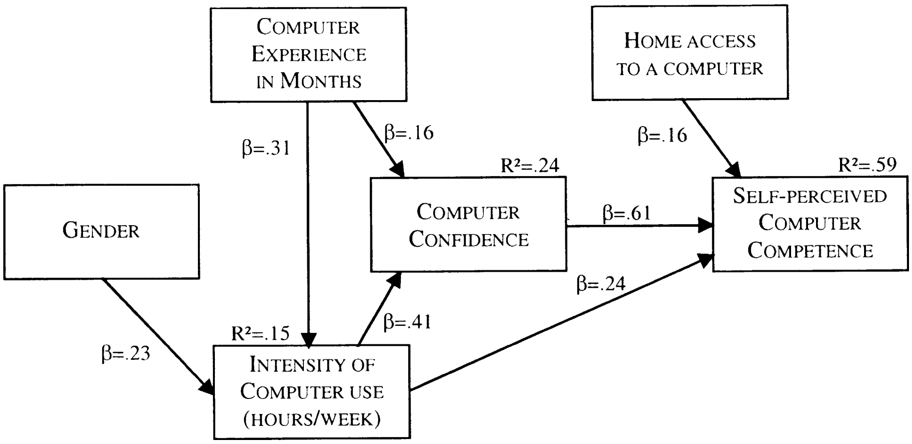

Fig. 2. Path model on the 2002 data: determinants of self-perceived computer competence: beta weights and explained variances ($n = 114$).

As can be seen in the results depicted in Fig. 2, the degree of explained self-perceived computer competence is even higher compared to the model tested on the 2001 sample. The percentage of variance in the computer competence measure explained by three variables was 59%. This high degree of shared variance is mainly due to the computer confidence variable ($\beta = 0.61; p < 0.001$). As in the first model, two other variables with direct impact were intensity of computer use ($\beta = 0.24$; $p < 0.001$) and home access to a computer ($\beta = 0.16$; $p < 0.05$). Intensity of computer use also had strong impact on computer competence ($\beta = 0.24$; $p < 0.001$). Compared to the 2001 sample, computer experience no longer has a direct effect on the computer competence measure. The non-significant path could be removed from the model. The effect of gender on the computer background variables was different compared to the 2001 sample. Gender no longer seemed to impact the degree of computer confidence, but the effect on the intensity of computer use variable was slightly higher ($\beta = 0.23$; $p < 0.01$). However, in general the gender variable appeared not to be strongly associated with measures of computer background, confidence and competence.

5. Discussion

Of the university students included in our two samples, 95% had access to a computer at home. This high rate confirms the fact that computer ownership among today's university students at home has become a common phenomenon. Access to computers, however, does not guarantee that all students are equally proficient in performing computer-related tasks. It is common knowledge that computer competence is a crucial factor in today's society for expanding opportunities both in personal life and at the workplace. Therefore, the main purpose of this study was to assess the level of computer competence among university students and to explore possible determinants associated with one of the constructs being developed.

A review of the literature yielded no studies to date that had assessed the level of computer competence among university students. Both computer competence scales constructed in this study provided a review of the minimum computer skills students should possess to 'survive' in today's society. The quality index especially yields a valuable measure for assessing basic skills in three crucial computing domains. The inventory of operating system, word processing and web skills gives basic insight into the minimum skills students should acquire if computer integration for study-related tasks is desired by university staff.

The results of this study suggest that gathering cross-sectional data on students' computer competencies clearly has its limitations. With only a one-year difference between the data collection in the two samples, computer competencies among students increased visibly. Especially the familiarity with web skills had augmented over time. However, when domains of computer competence were compared, students reported less familiarity with web skills than with operating systems and word processing skills.

Given the growing importance of computer skills in today's society, an increase in computer competencies among university students may be hypothesised. A more profound finding of this research was the relative stability of the factors accounting for the determinants of computer competence over time.

The above results suggest that the models yielded good support for the major determinants of students' degree of computer competence. The two computer background measures had a considerable effect on the computer competence scale. The length of time during which students had been familiar with computers and the intensity of computer use appeared to increase the level of reported computer competence. This supports the fact observed by teachers and instructors that exposure to computers is conducive to the attainment of computer skills. A more notable finding is the impact of the computer confidence construct on computer competence. In fact, in the two samples the direct impact of computer confidence on computer competence was stronger than the two computer background measures. This finding suggests that personal, subjective feelings and beliefs toward computers have a stronger impact on computer competence than objective measures of computer experience and intensity of computer use.

Another finding in this study is that univariate gender differences in computer competence seem to disappear when controlled for computer confidence. Compared with the boys, the girls in the 2001 sample felt less confident with computers. This finding is consistent with the finding of Al Jabri (1996). Although the results suggest that personal feelings of confidence with computers were the main determinant of computer competence, a lower degree of computer confidence among girls did not affect the actual degree of computer competence. Additionally, the impact of gender on computer confidence could not be confirmed in the 2002 sample. Further research on gender and computing should not only focus on differences in computer usage between male and female students, but should also investigate whether differences in gender disappear when all youngsters are surrounded by computer technology for personal and study-related activities.

6. Conclusion

This study was designed with three aims in mind. First, two instruments to assess self-perceived computer competence were developed and tested. This led to the construction of two competence measures: the number of computer applications and the quality of application use, divided into three separate domains: word processing skills, operating system skills and web skills. Scores on all measures were found to be strongly associated. This suggests that the more applications individuals use, the more in-depth knowledge and skills they will have with the different computer programs. A high Pearson correlation coefficient between the two scales appears to confirm this trend.

The second aim of the present study was to assess the level of computer competence among undergraduates. The students in the sample said they were fairly competent with word processing programs and operating systems. They said they were less confident with web skills. The most commonly used applications were word processing programs, operating systems and e-mail.

A third, more profound aim of the present study was to identify the determinants of self-perceived computer competence. To this end, two path models were tested on two different samples in order to investigate the effect of possible determinants of self-perceived computer competence.

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