Factors that Influence Student E-learning Participation in a UK Higher Education Institution

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Abstract

E-learning involves the use of information and communication technologies to deliver teaching and learning and is becoming increasingly important in the delivery of higher education. An online questionnaire survey was designed to gather information on students' participation and opinions of the use of e-learning in a UK higher education institution, and the results show that different student groups are more likely to participate regularly in certain types of study activities than others. An exploratory factor analysis reveals three underlying factors which may be used to classify the different types of e-learning activities, namely, information and communication use, general educational use, and the use of specialised software. These three factors which represent the different applications of e-learning should be considered individually in terms of design, delivery, and management of e-learning support systems, and provision of training for both staff and students.

Keywords: E-learning Participation, Information and Communication Technologies, Higher Education.

Introduction

E-learning is a concept derived from the use of information and communication technologies (ICT) to deliver teaching and learning. A common definition states that e-learning in higher education is a technique to enhance learning and teaching experiences and is used to educate students with or without their instructors through any type of digital media (Christie & Ferdos, 2004). E-learning has also been defined as learning and teaching facilitated online through network technologies (Garrison & Anderson, 2003) and described as utilising many ICT technologies (Kahiigi, Ekenberg, Hansson, Tusubira, & Danielson, 2008; Laurillard, 2004). E-learning can either be used to replace traditional face-to-face teaching completely, or only partially, for example, the use of ICT is sometimes introduced as an additional resource alongside traditional teaching methods. A major advantage of ICT is that accessing online learning resources is flexible and fast and has no geographical barriers (Concannon, Flynn & Campbell, 2005; Sivapalan & Cregan, 2005). According to Dalsgaard (2008), e-learning technology offers a wide range of opportunities for development of education, and the major advantages of the use of e-learning are independence of time and space and individuality, e.g., courses can be adapted to the individual student and materials can be reused or rearranged.

The higher education sectors have been concentrating on increasing the use of

Editor: Alex Koohang

online applications of e-learning by using the internet to enhance education (Arabasz & Baker, 2003). With the rapid growth of e-learning, computers are now used by students in many different educational processes and are considered to be valuable tools to enhance learning in higher education. Wenger (1998) has argued that participation is an intrinsic part of learning; hence a key challenge for e-learning is to enhance student participation (Bento & Schuster, 2003). It is believed that learner participation may be enhanced by the use of computer-mediated media in both traditional and e-learning settings (Haythornwaite, 2002; Leidner & Jarvenpaa, 1995). Online learner participation has been defined as a process of learning by taking part and maintaining relations with others, a complex process comprising doing, communicating, thinking, feeling and belonging, which occurs both online and offline (Hrastinski, 2008). Hrastinski (2009) provides a review of the literature in the area of online learner participation and claims that participation and learning are intricately interrelated and that, in order for learners to take full advantage, the participation experience needs to be satisfactory.

Davies and Graff's (2005) study measured students' access to communication areas and the group area and used this measure to represent the degree of participation. Their findings concluded that students who failed in at least one module interacted less frequently than students who passed all their modules. Another study by Sivapalan and Cregan (2005) found that students who demonstrated an active participation in online activities scored better marks. It has also been suggested that participation has a positive influence on learner satisfaction (Alavi & Dufner, 2005) and retention rates (Rovai 2002).

Vonderwell and Zachariah (2005) found that online learner participation is influenced by technology and interface characteristics, content area experience, student roles and instructional tasks, and information overload.

The literature shows that online participation is associated with student achievement, and the motivation behind this study is to try to determine if particular groups of students are not making sufficient use of online learning, so that these groups of students may be further encouraged to use online activities in order to enhance their overall learning experience.

The aims of this study are (1) to describe students' usage of various types of e-learning activities in higher education; (2) to investigate whether any demographic or study-related factors impact on how regularly students participate in e-learning activities; (3) to determine underlying constructs or classifications of the different types of e-learning participation; and (4) to determine which demographic or study-related student characteristics are independently associated with the underlying constructs of e-learning participation.

Methods

A questionnaire survey was designed to gather information on students' experiences and opinions of the use of E-learning. Ethics Approval was sought from Edinburgh Napier University Business School and was granted in October 2009. The survey was piloted firstly to a small group of staff and students at the university, in order to check and refine the content of the questionnaire. Following the pilot, all students enrolled for study at Edinburgh Napier University were contacted in November 2009 and were invited to participate in the survey via a pop-up window when they next logged onto the learning management system, WebCT. An invitation to participate and a link to the online survey was also posted on the student portal internet page. The online questionnaire survey was administered using SurveyMonkey.com (http://www.surveymonkey.com). In an attempt to maximise the response rate, students were contacted by email two weeks after the start on the survey. Students were thanked if they had already responded to the questionnaire and were reminded of the invitation to take part if they had not already done so. The survey responses were collected over a three-week period during November 2009.

Questionnaire

Students were asked to provide some demographic information, such as age, gender, and some details regarding their studies, e.g., school of study, year of study, and type of degree. The questionnaire included a section on computer use, consisting of questions asking students whether they have access to a computer outside the university, the internet, and a high-speed internet connection.

Respondents were asked to estimate the number of hours spent per week on computer and internet use, in total and for educational purposes only. The next section on the questionnaire asked students to provide details of how often they used a computer or the internet for various tasks related to their studies, e.g., for preparing essays or using certain types of software, and how often they used the internet, e.g., for contacting lecturers and tutors or to participate in online discussions, etc. The data for these questions were collected using a five-point Likert scale with the options never, occassionally, sometimes, quite often and regularly.

The results presented in this paper are part of a larger questionnaire study which also gathered information on informatics skills, satisfaction with university ICT provision, and attitudes and opinions on the use of e-learning.

Data Analysis

Summary statistics are presented to describe the sample of responents; this includes a breakdown according to age, gender and the level of study, type of degree, and school of study. Mann-Whitney tests and Kruskal-Wallis tests were used to test for differences in the number of hours spent per week using a computer and the internet for all puposes and for educational purposes only, in order to search for differences between student gender, age group, school, and level of undergraduate study. Chi-square tests for independence were carried out to test for associations between student gender, age group, school, and level of undergraduate study with student usage of the various applications of e-learning at university.

An exploratory factor analysis (Everitt & Dunn, 2001), with the principal components method of extraction, was used to identify any underlying themes or classifications of the different types and usages of e-learning. The purpose of the exploratory factor analysis was to reduce the data set to a smaller set of summary variables or factors such that each factor comprises multiple e-learning measures that contribute to the same e-learning construct or theme.The Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity were calculated to assess the suitability of carrying out a factor analysis on these data.

This was followed by logistic regression modelling (Hosmer & Lemeshow, 2000) to determine which student characteristics are associated with regular use of each of the underlying constructs or themes of e-learning participation as determined by the preceding factor analysis.

Statistical analysis was carried out using SPSS version 16, and in each part of the analysis or for each statistical test, all available data were included, i.e., respondents were excluded from the analysis only if they had a missing value on at least one of the variables included in that particular component of the analysis.

Results

Questionnaire Response

A total of 746 students responded to the online questionnaire survey. Several students did not fully complete the questionnaire survey and appear to have suffered from respondent fatigue towards the end of the questionnaire. Only 19 students (2.5%) did not provide their age, and four

students (0.5%) chose not to provide their gender. Approximately 10% of students who started the questionnaire did not answer the questions asking students to estimate how many hours per week they spend using a computer and on the internet for all purposes and for educational purposes only. Around 13% did not respond to questions asking how often they use a computer or the internet for a range of tasks connected with their university studies, e.g., 13.1% did not answer how often they use a computer for writing essays, reports, or other types of written papers.

Descriptive Statistics: Sample Respondents

The median age of respondents was 23 years (25th percentile = 20 years; 75th percentile = 29 years). The youngest respondent was 16 years of age, and the oldest aged 80 years. The majority of respondents were female (64.3%) (Table 1).

Table 1. Sample Statistics

	Median (25th, 75th percentiles)
Age	23 (20, 29)
	n (%)
Gender: Male	265 (35.7%)
Female	477 (64.3%)
Faculty: Engineering, Computing & Creative Industries	207 (27.8%)
Health, Life & Social Studies	269 (36.2%)
Business School	268 (36.0%)
Mode of Study: Full-time	638 (86.4%)
Part-time	100 (13.6%)
Level of Study: Postgraduate	134 (18.1%)
Undergraduate	607 (81.9%)

Two hundred and seven respondents (27.8%) were participating in programmes of study within the School of Engineering, Computing and Creative Industries; 36.2% within the School of Health, Life and Social Studies; and 36.0% within the Business School. Most respondents were studying at undergraduate level (81.9%), of which 27.8%, 24.2%, 27.3% and 20.6% of undergraduates were in years 1, 2, 3, and 4 respectively. The majority of students were studying full-time (86.4%), and the remaining 13.6% of students were studying part-time.

Respondents were asked where their family or permanent home was situated; the majority were from Scotland, 28.2% from Edinburgh and 30.2% from elsewhere in Scotland. Only 7.8% stated that their family homes were elsewhere in the UK, and one third (33.7%) were from families based outside the UK. Almost half of respondents (47.9%) live in their family homes during term time and travel to and from university on a daily basis.

Usage of ICT

The vast majority of respondents said they had unlimited use of a computer or laptop at home (97.5%), and 96.9% had internet access at home. Of those who had internet access at home, only 8 students (1.2%) had dial-up internet access, whereas all the others had a high speed internet connection, for example, via broadband or cable.

Respondents were asked to estimate how many hours per week they spend on a computer, excluding internet use and also using the internet. Summary statistics for full-time students are presented in Table 2. Nonparametric Kruskal-Wallis or Mann-Whitney tests were carried out to determine whether any differences exist in the numbers of hours spent using a computer between full-time students according to their university school, year of study, age group, and gender.

Male students spent significantly longer per week ($p < 0.001$) using a computer, excluding the internet, for all purposes (median = 15 hours) compared to females (median = 10 hours); however, the length of times spent per week excluding the internet for educational purposes did not differ significantly between males (median = 10 hours) and females (median = 8 hours). When considering internet use only, no significant difference was found in the number of hours per week spent on all purposes between the genders; however, female students spent longer per week on the internet for educational purposes (median = 10 hours) compared to males (median = 8 hours) ($p = 0.030$).

Students aged 25 years or over spent significantly longer using a computer, excluding the internet, for all purposes (median = 15 hours per week) than the younger students (median = 10 hours per week) ($p < 0.001$). Students in the oldest age group also spent significantly longer using the computer, excluding the internet, for educational purposes only ($p < 0.001$), and spent on average 10 hours per week compared to an average of 9 hours for those aged 21 – 24 years, and only 6 hours for those aged 16 – 20 years. When comparing the time spent on the internet for all purposes, students in the 21 – 24 year age group spent longer per week (median = 20 hours) compared to those students aged 16 - 20 years (median = 15 hours) and those aged 25 years or over (median = 15 hours) ($p= 0.001$). When using the internet for educational purposes, students in the youngest age group spent less time (median = 7 hours per week) than the older age groups (median = 10 hours per week for both groups) ($p = 0.001$).

Differences exist across the three faculties in the number of hours spent per week using a computer, excluding internet use, for all purposes ($p = 0.001$); students based in the School of Engineering, Computing and Creative Industries spend longer on average (median = 15 hours) compared to those in the Business School (median = 12 hours) and the School of Health, Life and Social Studies (median = 10 hours). However, there was no significant difference in the number of hours spent, excluding internet use, for educational purposes between the three faculties. When using the internet for all purposes, students in the School of Health, Life and Social Sciences spend less time per week (median = 15 hours) than those in the other two schools who spent 20 hours on average per week ($p = 0.022$). However, no significant difference was found in the length of time spent by students on the internet for educational purposes ($p = 0.092$); students in Engineering, Computing and Creative Industries reported spending 8 hours a week on the internet for educational purposes on average, whilst students in the other two schools spent 10 hours a week on average.

When comparing the four undergraduate years of study (Table 2) for full-time students only, no significant differences were found in the length of internet use and the use of a computer for educational purposes only. However, excluding internet use, fourth year undergraduates reported spending longer on a computer for all purposes (median = 14 hours per week) compared to a median of 10 hours per week for years one, two, and three ($p = 0.010$).

Chi-square tests for independence were carried out to investigate if any differences exist in the frequency of computer and internet usage for particular study activities between genders, age groups, faculties, and level of study. Respondents were asked to rate how often they used a computer for each activity on a five-point scale labelled never, occasionally, sometimes, quite often and regularly. Although these tests were calculated over the 5 categories of response, for brevity, only the percentages who regularly used a computer for each activity are reported in Tables 3 and

4. Since this scale is subjective and doesn't quantify the time spent on each activity, both full-time and part-time students are included in the analysis of results presented in Tables 3 and 4. Since numerous chi-square tests have been carried out, the potential for Type I error is increased, therefore a Bonferroni correction will be applied when considering the results. To achieve an overall 5% significance level over all tests presented in Tables 3 and 4, only results when $p \leq 0.001$ will be considered as statistically significant.

Table 2. Hours spent per week using a computer by full-time students

	Median (25^{th}, 75^{th} percentiles)			p-value
Excluding internet use:	**All Full-time Students**	**Male Students**	**Female Students**	
All purposes	10 (5, 20)	15 (8, 25)	10 (5, 20)	< 0.001 †
Education purposes	9 (4, 15)	10 (4, 18)	8 (4, 15)	0.594 †
Internet use only:				
All purposes	20 (10, 30)	20 (10, 30)	17 (10, 25)	0.154 †
Education purposes	10 (5, 15)	8 (4, 15)	10 (5, 15)	0.030 †
Excluding internet use:	**Aged 16 – 20 years**	**Aged 20 – 24 years**	**Aged 25 years or over**	**p-value**
All purposes	10 (5, 15)	10 (5, 21)	15 (7, 29)	< 0.001 ◊
Education purposes	6 (3, 10)	9 (4, 15)	10 (5, 20)	< 0.001 ◊
Internet use only:				
All purposes	15 (10, 25)	20 (12, 30)	15 (10,25)	0.001 ◊
Education purposes	7 (4, 13)	10 (5, 16)	10 (5, 15)	0.001 ◊
Excluding internet use:	**Eng., Computing & Creative Ind.**	**Health, Life & Social Studies**	**Business School**	**p-value**
All purposes	15 (7, 25)	10 (5, 19)	12 (5, 20)	0.001 ◊
Education purposes	10 (4, 20)	7 (4, 15)	10 (5, 15)	0.060 ◊
Internet use only:				
All purposes	20 (10, 30)	15 (10, 25)	20 (10,30)	0.022 ◊
Education purposes	8 (5, 15)	10 (5, 15)	10 (5, 17)	0.092 ◊
	Year of Study			
Excluding internet use:	**First**	**Second**	**Third**	**Fourth**	**p-value**
All purposes	10 (5, 20)	10 (6, 20)	10 (5, 21)	14 (7, 25)	0.010 ◊
Education purposes	7 (4, 14)	10 (5, 15)	8 (4, 15)	10 (5, 20)	0.118 ◊
Internet use only:					
All purposes	15 (10,25)	20 (10,25)	20 (12,30)	20 (10,30)	0.057 ◊
Education purposes	10 (4, 15)	10 (5, 15)	8 (4, 15)	10 (5, 15)	0.708 ◊

Mann-Whitney Test † *Kruskal-Wallis Test* ◊

Male respondents (76.5%) reported more regular use of a computer for preparing essays compared to 62.2% of females ($p = 0.001$), and 42.9% of males reported regular use for preparing presentations compared to 37.8% of females. ($p = 0.001$). However females reported more regular use for drawing (17.1%) compared to only 9.8% of males ($p < 0.001$). Male respondents reported regular use of the internet in connection with their studies more often than females; 76.9% of males regularly download department materials compared to 63.0% of females ($p < 0.001$);

40.9% of males regularly submit coursework online compared to only 25.4% of females (p = 0.001); and 27.9% of males compared to 20.4% of females regularly search for study related information (p < 0.001).

Table 3. Participation in Study Activities according to Age and Gender

	Male Students	Female Students	χ^2 test
	% regular use		*p*
Computer use:			
Essays	76.5%	62.2%	0.001
Presentations	42.9%	37.8%	0.001
Reading	53.4%	39.9%	0.025
Drawing	9.8%	17.1%	< 0.001
Spreadsheet	16.3%	18.3%	0.016
Statistics/ maths	8.4%	7.9%	0.011
Image/video	13.2%	13.6%	0.004
Internet use:			
Contact lecturers	36.2%	25.2%	0.002
Contact students	25.9%	17.0%	0.003
Dept web pages	38.2%	31.0%	0.278
Download dept materials	76.9%	63.0%	< 0.001
Additional materials	65.4%	50.4%	0.007
Submit coursework	40.9%	25.4%	0.001
Online discussion	14.2%	9.3%	0.155
Study-related information	27.9%	20.4%	<0.001

	Age Group in Years			χ^2 test
	16- 20	21 - 24	25 or over	
	% regular use			*p*
Computer use:				
Essays	66.5%	73.1%	75.1%	0.365
Presentations	40.7%	42.1%	41.4%	0.104 1
Reading	43.4%	53.0%	50.0%	0.229
Drawing	11.5%	13.0%	12.3%	0.183
Spreadsheet	12.1%	17.1%	20.8%	0.143
Statistics/ maths	8.8%	10.3%	5.1%	0.001
Image/video	11.5%	19.1%	10.2%	0.001
Internet use:				
Contact lecturers	21.4%	36.6%	37.1%	0.010
Contact students	17.6%	25.5%	24.5%	0.020
Dept web pages	28.2%	34.9%	42.6%	0.257
Download dept materials	72.5%	72.2%	72.9%	0.828
Additional materials	50.0%	63.3%	65.4%	0.022
Submit coursework	27.6%	35.7%	41.7%	0.090
Online discussion	7.7%	11.2%	17.4%	0.001
Study-related information	20.3%	25.9%	28.8%	0.209

Table 4. Participation in Study Activities according to School and Year of Study					
	Eng., Comp. & Creative Ind.	**Health, Life & Social Studies**		**Business School**	**χ^2 test**
	% regular use				***p***
Computer use:					
Essays	58.1%	74.9%		78.3%	< 0.001
Presentations	36.3%	34.7%		51.7%	< 0.001
Reading	37.3%	55.9%		49.6%	0.008
Drawing	23.5%	6.8%		9.6%	< 0.001
Spreadsheet	16.8%	16.0%		18.3%	< 0.001
Statistics/ maths	8.0%	10.1%		6.5%	0.087
Image/video	15.6%	11.4%		14.0%	< 0.001
Internet use:					
Contact lecturers	29.1%	38.1%		28.7%	0. 219
Contact students	18.4%	24.3%		24.3%	0.025
Dept web pages	27.5%	42.7%		34.4%	0.055
Download dept materials	55.3%	78.2%		78.3%	< 0.001
Additional materials	53.4%	63.6%		61.3%	0.157
Submit coursework	26.0%	48.7%		28.6%	< 0.001
Online discussion	8.9%	20.9%		6.5%	< 0.001
Study-related information	19.0%	29.4%		25.7%	0.019
	Year of Study				
	First	**Second**	**Third**	**Fourth**	**χ^2 test**
	% regular use				***p***
Computer use:					
Essays	68.5%	76.0%	68.3%	71.8%	0.382
Presentations	39.9%	41.9%	46.9%	33.6%	< 0.001
Reading	46.9%	51.2%	43.4%	51.8%	0.253
Drawing	9.1%	10.1%	13.1%	17.3%	0.007
Spreadsheet	14.0%	17.1%	22.1%	11.8%	< 0.001
Statistics/ maths	5.6%	14.7%	8.4%	7.3%	< 0.001
Image/video	15.4%	13.2%	15.2%	12.8%	0.243
Internet use:					
Contact lecturers	28.0%	31.8%	33.8%	35.5%	0.089
Contact students	18.2%	24.0%	26.9%	22.7%	0.836
Dept web pages	32.2%	39.4%	37.9%	40.7%	0.927
Download dept materials	76.1%	72.9%	74.5%	66.4%	0.837
Additional materials	48.3%	62.8%	60.4%	61.8%	0.210
Submit coursework	34.5%	34.6%	33.6%	34.5%	0.504
Online discussion	11.9%	12.5%	12.4%	6.4%	0.748
Study-related information	25.4%	23.3%	29.0%	25.5%	0.666

When comparing computer and internet study activities between age groups, the 21 - 24 year age group reported more regular use of mathematics/ statistics packages (10.3%) and for image/ video processing (19.1%) compared to those aged 16 - 20 years (8.8% and 11.5% respectively) and those aged 25 years or over (5.1% and 10.2% respectively) ($p = 0.001$). However, those aged 25 years or over reported more regular participation in online discussions (17.4%) compared to those aged 16 - 20 years (7.7%) and those aged 21 - 24 years (11.2%) ($p = 0.001$).

Eight of the chi-square tests comparing participation in study activities between the three faculties are significant ($p < 0.001$) (Table 4). Respondents studying in the School of Engineering, Computing and Creative Industries reported more regularly using a computer for drawing (23.5%) and image or video processing (15.6%), but for preparing essays and downloading departmental materials less often than those in the other faculties. Students in the Business School reported regular use of a spreadsheet (18.3%) and for using a computer to prepare presentations (51.7%) more often than students based in the other two schools ($p < 0.001$). Students in Health, Life and Social Studies used the internet more regularly for submitting coursework (48.7%) and participating in online discussions (20.9%).

There were very few significant differences in the use of ICT between the different years of study at undergraduate level, although those in third year of study reported more regular use of a computer to prepare presentations (46.9%) and using a spreadsheet (22.1%), and second year students reported more regularly using mathematics or statistic software (14.7%) (all three results statistically significant at the 0.1% level).

Factor Analysis

A factor analysis was carried out on the fifteen e-learning participation scores (as listed in Tables 3 and 4) to determine any underlying factors or themes which make up the overall student participation in educational usage of computer and internet applications. The Kaiser-Meyer-Olkin measure of sampling adequacy (0.837) indicated that a factor analysis is appropriate, and Bartlett's test of sphericity indicated that the correlation matrix is not equal to the identity matrix ($p < 0.001$), i.e., concluding that the strength of the relationship among variables is strong, further confirming that it is appropriate to proceed with a factor analysis.

The principal components method was used to extract the three factors, each of which has an eigenvalue greater than 1, followed by a varimax rotation to aid interpretation of the components. The three factors explained a total of 51.4% of the variability in scores and can be explained as factors relating to participation in (1) information and communication technologies, (2) general educational tools, and (3) technical/ specialised computer software packages. The rotated component matrix is presented in Table 5, and component loadings greater than 0.5 are highlighted in bold.

Factor 1 can be interpreted as participation in information and communication technologies in connection with university studies and has high loadings for contacting lecturers and students, searching for information in departmental and university web pages, participating in online discussions, and submitting assessments online. Factor 2 represents the usage of general educational tools such as writing up work, preparing presentations, reading, and downloading digital teaching materials. Factor 3 represents the use of more technical or specialised software for drawing or constructing, processing images or videos, using statistical or mathematical software and using a spreadsheet. These 15 different types of computer and internet tools and applications, which are commonly used in a higher education environment, can be classified into these three distinct factors.

Student Characteristics Associated with the Three ICT Factors

Logistic regression modelling is used to determine which student characteristics are associated with regularly using (1) information and communication technologies, (2) general educational tools, and (3) specialised computer software packages. The dependent variable is the factor score, which has been converted onto a binary scale and coded as zero (0) if the factor score was less than 0, representing less regular use, and categorised as one (1) if the factor score is greater than or equal to 0, representing regular use of the corresponding factor theme. Since the factor scores

were standardised to have mean 0, this ensures roughly equal numbers of students in each of the two categories. The three final logistic regression models are presented in Tables 6 - 8.

Table 5. Loadings for each of the three factors retained

Participation in activities in connection with university studies	Factor		
	1	2	3
writing essays, reports, other papers	0.012	**0.736**	0.152
preparing presentations	0.039	**0.534**	0.455
reading digital education materials	0.133	**0.680**	0.175
software for drawing/ constructing	0.027	-0.042	**0.754**
using spreadsheet	0.116	0.153	**0.710**
statistical or math software	0.072	0.091	**0.680**
image / video software	0.101	0.065	**0.645**
contact lecturers	**0.599**	0.358	0.139
contact students	**0.647**	0.273	0.102
search for information on dept web pages	**0.517**	0.451	0.013
download materials from webCT or lecturer's webpage	0.293	**0.628**	-0.099
find additional teaching materials or info	0.364	**0.617**	-0.009
submit coursework or assessments	**0.673**	0.022	0.016
online discussions connected to studies	**0.817**	-0.054	0.128
find study-related information	**0.634**	0.286	0.113

Student age, gender, and school of study were found to be independently associated with regular use of a computer for information and communication purposes in connection with university studies (Table 6). Compared to students aged between 16-20 years, older students have a significantly increased odds ratio (OR) of reporting regular information and communication usage; those aged 21 – 24 years have an OR of 2.56 (95% confidence interval is 1.65 to 3.97) ($p < 0.001$), and those aged 25 years or over have an OR of 2.17 (95% confidence interval is 1.43 to 3.31) ($p < 0.001$). Males are significantly less likely than females to use a computer for information and communication purposes (OR = 0.40; 95% confidence interval is 0.21 to 0.79) ($p = 0.008$). Students based in the School of Health, Life and Social Studies have an increased odds ratio (OR = 1.86; 95% confidence interval is 1.02 to 3.41) of reporting regular information and communication usage compared to students based in the School of Engineering, Computing and Creative Industries. An interaction term between school and gender is also included in the model. Although males generally report less regular usage of information and communication, this is not the case for male students based in the Business School; these male students are more likely to report regular usage.

Table 6. Model 1: Factors Associated with Information and Communication Use

Factor	N	OR (95% CI)	Wald (df)	p-value
Age Group: 16 – 20 years	180	1.00	19.8 (2)	<0.001
21 – 24 years	204	2.56 (1.65, 3.97)	17.5 (1)	<0.001
25 years or over	224	2.17 (1.43, 3.31)	13.0 (1)	<0.001
Gender: Female	395	1.00		
Male	213	0.40 (0.21, 0.79)	7.0 (1)	0.008
School: Eng, Comp & Creative Ind	165	1.00	19.9 (2)	<0.001
Health, Life & Social Studies	226	1.86 (1.02, 3.41)	4.0 (1)	0.044
Business School	217	0.65 (0.35, 1.21)	1.8 (1)	0.177
School * Gender Interaction:				
Eng, Comp & Creative Ind * Female	59	1.00	6.5 (2)	0.038
Health, Life & Social Studies * Male	41	1.03 (0.39, 2.69)	0.0 (1)	0.958
Business School * Male	66	2.76 (1.13, 6.75)	5.0 (1)	0.026

Student gender and school of study were found to be independently associated with reporting regular usage of a computer for general educational use (Table 7). Males were significantly less likely to report regular usage compared to females (OR = 0.50; 95% confidence interval is 0.27 to 0.95) (p = 0.035), and students in the Business School were more than twice as likely to report usage compared to students in Engineering, Computing and Creative Industries (OR = 2.20; 95% confidence interval is 1.17 to 4.13) (p = 0.014). However, the interaction term between school and gender shows that this trend does not hold for male students based in the School of Health, Life and Social Studies, as this group of male students are more likely to report usage for general educational use.

Table 7. Model 2: Factors Associated with General Educational Use

Factor	N	OR (95% CI)	Wald (df)	p-value
Gender: Female	401	1.00		
Male	219	0.50 (0.27, 0.95)	4.4 (1)	0.035
School: Eng, Comp & Creative Ind.	169	1.00	11.3 (2)	0.004
Health, Life & Social Studies	229	1.03 (0.57, 1.87)	0.12 (1)	0.912
Business School	222	2.20 (1.17, 4.13)	6.0 (1)	0.014
School * Gender Interaction:				
Eng, Comp & Creative Ind * Female	60	1.00	6.7 (2)	0.035
Health, Life & Social Studies * Male	43	2.57 (1.00, 6.59)	3.9 (1)	0.050
Business School * Male	67	0.80 (0.33, 1.92)	0.3 (1)	0.614

Student gender and location of a student's permanent home were independently associated with regular use of more specialised software (Table 8). Males were almost twice as likely as females (p < 0.001) to regularly use specialised software (OR = 1.99, 95% confidence interval is 1.41 to 2.81). Also, students whose permanent home address is outside the UK were more likely to regu-

larly use specialised software (OR = 1.91) compared to students whose permanent home is in Edinburgh (p = 0.003).

Table 8. Model 3: Factors Associated with Specialised Software Use

Factor		N	OR (95% CI)	Wald (df)	p-value
Permanent Home:					
	Edinburgh	174	1.00	15.0 (3)	0.002
	Elsewhere in Scotland	192	0.90 (0.59, 1.39)	0.2 (1)	0.635
	Elsewhere in UK	51	1.38 (0.73, 2.61)	1.0 (1)	0.321
	Outside the UK	203	1.91 (1.25, 2.92)	8.9 (1)	0.003
Gender:	Female	401	1.00		
	Male	219	1.99 (1.41, 2.81)	15.3 (1)	<0.001

Discussion

The vast majority of students had unlimited use of a computer (97.5%) and internet access (96.9%) at home. Although males reported spending longer per week on average than females using a computer for all purposes excluding the internet, females spent longer using the internet for educational purposes than males. These findings confirm those found by Adamus, Kerres, Getto, and Engelhardt (2009) and Cuadrado-Garcia, Ruiz-Molina, M., & Montoro-Pons (2010), that although men are more prone to use computers than females, females tend to prefer communicative activities. Also, Bruestle et al. (2009) argue that e-learning, through its flexible and interactive learning approach, is most suited to women.

Student age was also associated with the length of time spent on a computer; those aged 25 years or over spent longer using a computer excluding internet use than the younger students, although those aged 21 – 24 years spent longer using the internet for all purposes and those aged 16 – 20 years spent less time using the internet for educational purposes. These differences in time spent between genders and age groups may be due to differences in motivation between genders or age groups, or these differences could be partly due to computer literacy or computing experience of the different groups of students, i.e., it may be that some students are less computer literate and therefore spend longer than more literate students to complete a similar task.

Students based in the School of Engineering, Computing and Creative Industries spent significantly longer using a computer excluding internet use than the other faculties; this may at least be partly explained by the programmes of study within this particular school, and it is not surprising that, for example, computing students spend longer using a computer than students based in other schools. Students in the School of Health, Life and Social Studies reported spending less time using the internet; this school includes nursing students, many of whom with be involved in practical placements or studies and, hence, may have less time available to surf the internet. When comparing full-time undergraduate students, those in fourth year spent significantly longer using a computer excluding internet use than those in earlier years; it may be that fourth year students are more motivated to complete their studies with a good degree pass, and many may be working on writing up a dissertation project.

The chi-square test results (Tables 3 and 4) indicate many differences between genders and age groups in regular use of a computer for various study activities; generally males reported participating in many of the study activities more often than females, and those aged 25 years or over

tended to participate more often than the younger age groups. Differences in participation of the various activities also exist between the different schools, e.g., students in the Business School more regularly use a computer for preparing essays and presentations, and students in Engineering, Computing and Creative industries reported using a computer for drawing or image or video processing more often. Fewer differences exist between the years of undergraduate study; those students in third year reported using a computer for preparing presentations and using a spreadsheet more often, and those in second year reported using mathematics or statistics software more often than those in other years of study.

An exploratory factor analysis revealed three underlying factors which represent the overall student participation in computer and internet applications for educational use (Table 5). Although these three factors account for only 51.4% of the variability in the data, this technique has enabled the 15 individual study activities to be reduced to 3 distinct factors, each of which contain activities which are related to one another and fall within a type of participation activity. Hrastinski (2009) suggests that online learner participation moves beyond conceptualising participation as writing and should include terms such as doing and belonging, and Hrastinski emphasises that students learn both online, e.g., by computer-mediated communication with peers and teachers, and offline, e.g., by reading course literature. The three factors determined in this paper confirm that e-learning participation should not be measured by one type of activity alone and should be viewed in terms of different constructs or themes of e-learning participation, namely, information and communication, usage of general educational tools, and use of specialised software.

Logistic regression modelling was used to determine which student characteristics were associated with regular participation in each of the three distinct factors or themes (Tables 6 - 8). Students aged over 20 years, who are female or based in the School of Health, Life and Social studies were more likely to use a computer for information and communication. However, the interaction term shows that this general trend does not apply to students who are based in the Business School; since males are more likely to use a computer for information and communication than females within this school.

Female students and those based in the Business School were found to be more likely to regularly use a computer for general educational use, except for male students based in the School of Health, Life and Social Studies, who were more likely than females to report using a computer for general educational purposes.

Male students or students whose permanent home is outside the UK are more likely to use specialised software than female students or those from the UK. This finding may suggest that more male than female students choose to study modules with a high technical or mathematical content and also that students from outside the UK are more likely to study modules which involve the use of specialised mathematical, statistical or technical software.

The findings presented in this paper are based on a sample of students from a UK university and will therefore be subject to sampling variability. However, the sample includes respondents from a wide range of ages, from both genders, and from each of the Schools; hence, the sample is believed to be reasonably representative of the student population.

Although numerous statistical tests have been carried out which will increase the Type I error, a Bonferroni correction has been applied to the significance level when interpreting these tests in order to reduce the overall Type I error.

Conclusions

The descriptive statistics and statistical tests presented in this paper confirm that differences exist between students, mainly according to gender, age group, and School of study, in their participa-

tion in the different types of e-learning activities. The use of factor analysis has enabled computer usage in higher education to be classified into three types of e-learning activity: for the purposes of information and communication, general educational use, and the use of specialised software. The logistic regression models build on the initial statistical test results by confirming that usages of the different types of e-learning activities, as determined using factor analysis, are associated with faculty of study, gender, and other demographic variables.

It is proposed that all e-learning use in higher education can be incorporated into one of these three constructs or themes of e-learning activity. Providers and teachers of higher education may find it useful to consider each of these three themes of e-learning activity on an individual basis when designing, developing, or managing ICT systems and also when considering the training needs of both staff and student groups.

It is known that students who participate in online activities most often are more likely to be higher achievers in their educational studies (Davies & Graff, 2005; Sivapalan & Cregan, 2005). The findings reported in this paper will aid in targeting resources to encourage those groups of students who currently participate least often in e-learning activities, with an aim to enhancing student engagement and student learning.

Acknowledgement

I wish to thank all students who completed the online questionnaire survey, both for their time contribution and for providing information relating to their e-learning participation.

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Biography

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