THE SUBJECTIVE COMPUTER EXPERIENCE OF UNIVERSITY STUDENTS

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Abstract

The subjective computer experience (SCE) construct is defined as a private psychological state reflecting the thoughts and feelings that a person ascribes to some previous or existing computing event. Information and communication technologies are currently increasing their influence in the field of education, so the SCE of teacher-treaining students is an interesting subject for analysis. The present study examines the SCE of a sample of 176 university students with different academic profiles, including a sample of students from teacher training colleges. The results show not only differences between students from different fields of knowledge, but also that participating in the design of teaching models based on the use of ICTs is related to distinct SCE profiles.
Key words: *ITCs, Computer use; Computer experience; Teacher training, web 2.0.*

Introduction

The use of information and communication technologies (ICTs) in education is currently the focus of considerable attention.

On the one hand, these technologies provide new, innovative virtual environments that stimulate the learning process by facilitating information handling, encouraging processes of communication between teachers and students and providing tools to foster creativity and initiative (Toral, Barreroa & Martínez-Torresa, 2007; Mioduser, Nachmias, Lahav & Oren, 2000 & Conlon, 1997).

On the other hand, ICTs are seen as key elements in the education and training processes of students, since knowledge acquisition and technological skills are considered as decisive factors in learning processes and future careers (Cabero, 2006).

As a result, education systems are introducing targets for the acquisition of basic skills in the use of ICTs at all levels of compulsory education (Fuentes, 2007). Article 14 of the Spanish Education Act (LOU, 2006) stresses the need to make an early start on the teaching of ICT-related skills in infant education. Article 17 sets the target of initiating primary school pupils in the use and learning of ICTs, and Article 23 sets the objective of ensuring that students have a basic grounding in the field of ICTs in compulsory secondary education.

In this context, the training of teaching staff in the use of ICTs as a resource for education is a priority area in today's knowledge-based society if these technologies are to be fully incorporated into the education system and the public are to attain full computer literacy (Albirini, 2006; Martínez, 2006; Sanabria, 2006; Tejada, 2006; Colás et al., 2004).

Emotional and psychological responses by teaching staff to the use of technology are considered to be a key element for the successful implementation of ICTs (Rodríguez, Almerich & Gargallo,

2006; Brown, 2002; UNESCO, 2002). Within that field, the subjective experience of individuals in regard to the use of new technologies and computers is seen as a determinant factor in the way in which they are then used (Huggard & Mc Goldrick, 2006; Garland & Noyes, 2004).

Although it is not an easily identified psychological construct, subjective experience is considered as a private dimension around which the individual organises his/her feelings and thoughts in regard to past and present computer experience (Smith, Caputi & Rawstorne, 2007).

This paper seeks on the one hand to establish an initial comparative approach to the characteristics of subjective computer use among a sample of students from two teacher training colleges dependent on the University of the Basque Country (Spain); and on the other hand to determine how subjective experience changes when the subjects take part in the design of a teaching model based on ICT use.

Methodology of Research

Participants

The study involved 185 students from the Vizcaya and Alava campuses of the University of the Basque Country (Spain) in the first term of academic year 2007-2008, who completed the SCES questionnaire indicated below.

Questionnaires not completed in full were discarded. In all, 176 valid questionnaires were collected, 121 of which were completed by women and 55 by men. Most participants were aged between 20 and 30 ($N = 108$) although a significant number of 18 and 19 year-old students also took part ($N = 66$). Only seven participants were aged 30 or older.

49 of these students were enrolled on scientific and technical degrees (IT, Engineering, Pharmacy and Dietary and Nutrition Studies) and 127 on degrees in the field of humanities (Philology, Teacher Training, Physical Education and History).

For the purposes of the study presented in this article, the group of humanities students was split into three subgroups:

- "*Teacher Trainees with Computers*": teacher trainees who were taking a subject in which they were developing a teaching model based on the use of ICTs as a fundamental tool for classroom activities in the same term when the study was carried out ($N = 34$).
- The characteristics of this teaching model are explained below.
- "*Other teacher trainees*": students at the teacher training college who had not taken that subject ($N = 25$).
- "*Other humanities students*": students taking other degrees in the field of humanities ($N = 68$).

The questionnaire was distributed in classrooms at the university teacher training colleges in Bilbao and Vitoria and in the computer rooms of the Alava campus of the University of the Basque Country to be completed anonymously on a voluntary basis three weeks before the end of the term.

Subjective Computer Experience Scale

Subjective computer experience was measured using the SCES questionnaire (Smith et al., 2007), initially comprising 31 items.

The items are presented using a five-point Lykert type scale ranging from 1 (strong disagreement) to 5 (strong agreement). Statements may be positive or negative in nature. Scoring for negative items was reversed, so the higher the score the better the subjective experience.

The SCES questionnaire comprises five subscales:

- *Anxiety-frustration:* feelings of insecurity, unease and isolation arising from the use of computers.
- *Autonomy-assistance:* predisposition to request assistance when a problem arises in the use of computers.

- *Training-education:* how the subject sees his/her learning process in the use of computers.
- *Enjoyment-usefulness:* positive experiences in the use of computers and in the advantages attributed by individuals to their use.
- *Negative performance appraisal:* negative feelings generated linked to the individual's own skill in using computers.

After a detailed study of the consistency of the scale using a sample of Australian first-year psychology students, Smith et al. (2007) reduced the questionnaire from 31 to 25 items.

To cater for any differences between the original study population and the group used in this investigation, it was decided to include all 31 initial items and check whether the adjusted questionnaire matched the reduced, 25 item version.

Finally, the questionnaire used in this study also asked respondents to indicate their age, their gender and what they were studying.

The Teaching Model Based on the Use of ICT's

34 of the 176 questionnaires used for the study came from a subgroup of students whose studies in the first term of academic year 2007-2008 included the subject "Mathematical Thought and Its Teaching I" as part of their infant education course under the syllabus of the Alava Teacher Training College of the University of the Basque Country.

The subject was designed to be taught in such a way as to involve numerous techniques and tools requiring computer use in the context of the new concept of ICT use known as *Web 2.0* (Graham, 2007; Mason & Rennie, 2007; Kloos, 2006).

This teaching model was first developed during academic years 2005-2006 and 2006-2007 (Villarroel, 2007a & 2007b) and implemented by the author of this article with the following three objectives in mind:

a. To establish an effective way of guiding students during their learning process.
b. To programme new, motivating teaching activities to facilitate the use of the subject content.
c. To increase the value placed on the time that students spent in the classroom by encouraging tasks that entail significant use of information from the subject under study through information search and processing activities, the creation of learning resources and collaboration-based activities.

To achieve the first of these objectives, it was attempted to ensure that students had access via the Internet at all times to:

a. the objectives, methods, bibliography and resources for the subject (bibliography, notes, audiovisual material);
b. the current status of the subject, i.e. the activities already carried out and those scheduled for specific times, the development of classroom sessions and the status of their contents, subject resources (bibliography, notes, audiovisual material), news, forms, etc.;
c. continuous assessment results.

To that end, students were presented with a blog (Blog, 2007; Roig, 2006; Castaño, Maiz, Palazio & Villarroel, 2008) that served as an explanatory core for the subject. This blog contained all the information indicated above, along with learning support tools such as encyclopaedias, translators, dictionaries, photo banks, videos, software, etc. For other examples of blogs used in education, see Boulos, Maramba & Wheeler, 2006; Sauer, Bialek, Efimova, Schwartlander, Pless & Neuhaus, 2005 & Bravo, 2005.

The blog used is called *Ikastorratza* (http://ikastorratza.civiblog.org). It is written in Basque, as this is the language in which students were taking the subject. It was developed thanks to an initiative by the Citizen Lab of the University of Toronto (Hall, 2006).

In pursuit of the second and third objectives, students were set a number of tasks linked to the subject content, which they had to present via a wiki type publication online (Roig, 2006; Wiki, 2007;

Castaño et al., 2008). In general terms, each student was responsible for his/her own wiki, though in exceptional cases students were permitted to work in pairs on the same publication. For other examples of the use of wikis in education, see Bravo, 2005; Saber et al., 2005 & Parslow, 2005.

The instructions for these tasks were given via the blog, indicating which points would be most highly rated in the grading of the work. Among the points most stressed were the customisation of information (points were awarded for the presentation of conceptual maps or schematics, and copying was penalised), simplicity of presentation (including photos, animations and different forms of lettering) and ease of browsing (links, external references and browser menus).

During the term in which the subject was taught around 60 wiki publications were posted on-line in a form accessible to all users, including other students and the lecturer teaching the subject. These wikis can be seen at http://txomin.pbwiki.com. They are all in Basque, the language in which the subject was taught.

The activities proposed for the wikis were oriented towards the rewriting and transformation of subject information, specifically:

a. Production of conceptual maps using *CmapTools* (Canas, Carff, Hill, Carvalho, Arguedas, Eskridge, Lott & Carvajal, 2005; Villarroel, 2006), a free software package developed by the Institute for Human and Machine Cognition of the University of Florida which is extraordinarily valuable as a teaching tool and enables on-line conceptual maps to be generated.
b. Preparation of knowledge assessment questionnaires, using the *Hot Potatoes* free software package (Hot Potatoes, 2007), which enables four different types of activity to be drawn up and published.
c. Exposition of teaching designs for the subject content via slideshow type presentations in the wiki itself.

The ultimate objective was for the learning process not to be linked exclusively to memorising, but rather for students to use the wiki to draw up their own workbook in which they could record the results of their learning activities. This could then be used as the basis for continuous assessment.

It must be stressed that both the wiki publications and the software packages used were free of charge and easy-to-use, so neither lecturers or students were required to spend much time on them before starting to work: it as possible to give students the necessary instructions on how to publish their work practically as they went along.

However, these software packages were unfamiliar to all students, so classroom activity was highly intense and closely monitored. It comprised a mixture of theoretical points concerning course content and practical activities to carry out the tasks set.

The final result of the teaching model was a system very similar to "blended learning", and most of the classroom hours devoted to the subject were spent using computers in the computer rooms of the Alava campus of the University of the Basque Country. For other examples of blended learning, see Ruiz, Mintzer & Issenberg, 2007 and Scholze & Wiemann, 2007.

Results of Research

Adjustment of the SCES Questionnaire

To examine the structure of the scale, a preliminary factor analysis was conducted using the maximum likelihood extraction method on the 31 items on the original questionnaire. To facilitate the interpretation of factors, orthogonal rotation was used, via the Varimax procedure (Kaiser, 1958). Finally the Cronbach (1951) alpha statistic was used to check the consistency of each scale.

Table 1 shows the loading for each item on the corresponding subscale proposed in the original work by Smith et al., 2007. It can be seen that seven items (27, 31, 30, 1, 4, 14 10) loaded less than 0.3 on the scales to which they belong, and two items (15 and 2) which were initially discarded by the above authors because they loaded less than 0.3 on their scales showed clearly more significant loads (0.73 and 0.53 respectively).

These data suggest that the original questionnaire should be restructured to eliminate items with

loads of less than 0.3 and re-include items 15 and 2, which were initially rejected.

Table 1 also shows the final stability of the scales with the new groupings of items via Cronbach's alpha. For the questionnaire as a whole, with the changes in items indicated, the statistic was 0.84.

Table 1. Descriptive & Exploratory Statistics for SCES.

Nº	Subscale & item content	Factor loading	α	M	SD
	Factor 1: Anxiety-Frustration		**0.82**		
06	I USUALLY GET FRUSTRATED WHEN USING A COMPUTER.	0.58		2.6	1.18
11	I USUALLY GET FRUSTRATED WHEN USING CERTAIN SOFTWARE	0.55		3.2	1.28
07	IN THE PAST I HAVE FELT ANXIOUS WHEN REQUIRED TO USE CERTAIN SOFTWARE.	0.73		4.3	1.11
18	I OFTEN FEEL SCARED WHEN USING A COMPUTER.	0.33		3.6	1.23
27	*I often feel isolated from other people when using a computer.*	< 0.1		3.4	1.32
	Factor 2: Autonomy-Assistance		**0.56**		
16	INSTEAD OF ASKING FOR ASSISTANCE WITH A COMPUTER-RELATED PROBLEM, I PREFER TO TRY AND SOLVE IT MYSELF.	0.44		3.2	1.24
12	I WOULD PREFER TO LEARN A NEW COMPUTER SOFTWARE PACKAGE ON MY OWN.	0.54		3.4	1.1
08	I AM RELUCTANT TO ASK FOR HELP WHEN USING A COMPUTER	0.54		4.2	1
31	*When I encounter a computer-related problem that I cannot resolve myself, I feel comfortable about asking an expert.*	0.25		4.3	1
30	*I feel more at ease using a computer when alone than with a group of people.*	0.2		3.1	1.24
01	*When using a computer I prefer to learn through trial and error.*	< 0.1		3.4	1.08
	Factor 3: Training-Education		**0.77**		
29	IN THE PAST, COMPUTER TRAINING HAS IMPROVED MY ABILITY TO USE COMPUTER SOFTWARE.	0.58		3.1	1.150
22	THE TRAINING I HAVE RECEIVED IN CMOPUTER USAGE HAS BEEN VERY BENEFICIAL.	0.82		2.5	1.151
25	IN THE PAST, COMPUTER TRAINING HAS FACILITATED MY UNDERSTANDING OF COMPUTER SOFTWARE CAPABILITIES.	0.52		3	1.036
15	I HAVE NOT RECEIVED SUFFICIENT TRAINING AT THE COMPUTER	0.73		2.7	1.26
	Factor 4: Enjoyment-Usefulness		**0.82**		
09	I ENJOY EXPLORING NEW APPLICATIONS/USES FOR THE COMPUTER OR SOFTWARE	0.82		3.4	1.13
03	I HAVE GENERALLY ENJOYED LEARNING HOW TO USE COMPUTER SOFTWARE.	0.71		3.3	1.15
13	I AM USUALLY CURIOUS TO USE THE LATEST VERSION COMPUTER SOFTWARE.	0.77		2.8	1.23
02	IN THE PAST, COMPUTERS HAVE MADE MY TASK(S) FAR SIMPLER.	0.53		3.7	1.17
04	*In situations where I have had to learn how to use a computer system, I have found the operating manuals difficult to understand.*	0.15		2.8	1.04
14	*Computer support staff talk in computer jargon with which I am unfamiliar.*	0.14		2.4	1.13

Nº	Subscale & item content	Factor loading	α	M	SD
	Factor 5: Negative Performance Appraisal		**0.8**		
21	I FEEL INCOMPETENT WHEN HAVING TO ASK FOR COMPUTER ASSISTANCE.	0.45		3.7	1.08
19	WHEN I SEEK ADVICE ABOUT A COMPUTER-RELATED QUESTION I FEEL STUPID WHEN I AM TOLD THAT THE ANSWER IS SIMPLE.	0.7		3.1	1.32
23	WHEN I CANNOT UDERSTAND HOW TO USE COMPUTER SOFTWARE I EVALUATE MY OWN PERFORMANCE IN A NEGATIVE WAY.	0.5		3.3	1
10	*Other people seem to be more skilful at using a computer than myself*.	0.2		1.4	0.8
20	I OFTEN FEEL CONCERNED THAT I MIGHT DO DAMAGE TO THE COMUTER IF I MAKE A MISTAKE.	0.3		3.2	1.48
24	I FEEL QUITE POWERLESS WHEN I AM BEING INSTRUCTED TO USE A COMPUTER OR COMPUTER SOFTWARE FOR THE FIRST TIME.	0.73		3.5	1.22

Analysis of Links between SCES Scores & Academic Profile

Table 2 shows the descriptive statistics for the analysis of the scales on the SCES questionnaire for each type of student. Differences were analysed using ANOVA variance analysis, and the results show significant differences for the subscales of *anxiety-frustration* (F (3.87) = 57.6; $p < 0.01$), *enjoyment-usefulness* (F (2.88) = 37.02; $p < 0.05$) and *negative performance appraisal* (F (4.9) = 100.6; $p < 0.01$).

Table 2. Differences in SCES Answers Depending on Students' Courses.

	Students	N	M	SD
Anxiety-frustration	Teacher Trainees with Computers	34	12.1	3.8
	Other Teacher Trainees	25	13.5	4.2
	Other Humanities Students	68	13.3	4.1
	Scientific & Technical Degrees	49	15.0	3.3
	Total	176	13.6	3.9
Autonomy-assistance	Teacher Trainees with Computers	34	11.4	2.4
	Other Teacher Trainees	25	10.5	2.9
	Other Humanities Students	68	10.7	2.3
	Scientific & Technical Degrees	49	10.4	2.4
	Total	176	10.8	2.4
Training-education	Teacher Trainees with Computers	34	12.0	3.9
	Other Teacher Trainees	25	11.2	3.8
	Other Humanities Students	68	11.1	3.5
	Scientific & Technical Degrees	49	11.3	3.3
	Total	176	11.4	3.6
Enjoyment-usefulness	Teacher Trainees with Computers	34	12.0	3.4
	Other Teacher Trainees	25	12.6	4.0
	Other Humanities Students	68	12.2	3.8
	Scientific & Technical Degrees	49	14.0	3.1
	Total	176	12.7	3.6

	Students	N	M	SD
Negative performance appraisal	Teacher Trainees with Computers	34	16.4	3.8
	Other Teacher Trainees	25	15.6	5.8
	Other Humanities Students	68	16.0	4.8
	Scientific & Technical Degrees	49	18.9	3.9
	Total	176	16.8	4.7

On the other hand, table 3 shows the results for the analysis of homogenous subgroups conducted via Tukey's test for the scales of *anxiety-frustration* and *negative performance appraisal* (analysis of the *enjoyment-usefulness* scale reveals no homogenous subgroups).

Table 3. Tukey's Test for the Analysis of Homogenous Subgroups.

Anxiety-frustration	Subgroup1	Subgroup2
Teacher Trainees with Computers	12	
Other Humanities Students	13	13.3
Other Teacher Trainees	14	13.5
Scientific & Technical Degrees		15.0
• Level of significance	p<0.38	p<0.25
• Level of significance between Teacher Trainees w/Ccomputer & Scientific/ Technical Degree students	p<0.01(*)	

Enjoyment-usefulness	Subgroup1	Subgroup2
Other Teacher Trainees	15.6	
Other Humanities Students	16	
Teacher Trainees with Computers	16.4	16.4
Scientific & Technical Degrees		18.9
• Level of significance between subgrupos	0.86	0.08
• Level of significance between Other Teacher Trainees & Scientific/ Technical Degrees	p<0.05(*)	
• Level of significance between Humanities & Scientific/ Technical Degree students	p<0.01(*)	

As can be observed, on the *anxiety* subscale the main differences lie in the comparison between Teacher Trainees with Computers and Scientific & Technical Degree students. Indeed, the differences between these two groups are the only significant differences out of all the possible combinations for the four types of student considered.

On the other hand, the differences on the *negative performance appraisal* subscale are mainly between Other Teacher Trainees and Other Humanities Students on the one hand and Scientific & Technical Degree students on the other, and not between the latter and Teacher Trainees with Computers. The differences in 2 x 2 combinations are centred on the comparisons between Scientific & Technical Degree students on the one hand and Other Humanities Students and Other Teacher Trainees on the other, rather than Teacher Trainees with Computers.

Discussion

Regarding the Subjective Computer Experience Measure

The SCES originally developed by Smith et al. (2007) quantifies the private dimension of computer experience on which the thoughts and feelings of subjects in relation to past and present experience with computers are centred. According to these authors, the scale constitutes a psychometric instrument for assessing changes in this construct as a result of participation in training activities involving the use of computers.

However, in the light of the limitations inherent in the original validation of the questionnaire (which was confirmed using a highly homogenous sample of subjects) and the differences between the initial sample and the sample used in the present study, it seems advisable to consider adjusting the SCES for the population studied here.

As a result of that adjustment, two of the items discarded by Smith et al. (2007) were reintroduced in our study (items 2 and 15). However, seven items used on the original scale made no significant contribution in our study, and were therefore discarded (items 1, 4, 14, 10, 27, 31 and 30).

The end result is a 20-item questionnaire that measures five subscales liable to contribute to measuring subjective computer experience: *anxiety-frustration, autonomy-assistance, training-education, enjoyment-usefulness* and *negative performance appraisal*.

All the subscales except *autonomy-assistance* have a Cronbach Alpha fit of at least 0.70, which ensures an acceptable level of suitability for the object to be measured (George et al., 1995). The *autonomy-assistance* subscale also scores below 0.70 in the original study by Smith et al. (2007), which suggests that the structure of this factor should be reconsidered.

Regarding the Possible Influence of Participation in ICT-based Educational Designs on SCE

The subjective computer experience of teacher trainees does not seem to differ from that of students on other courses in regard to *training* and *assistance*.

Taking into account the limitations outlined above in regard to the *autonomy-assistance* scale, the most striking feature of these data is that students on different courses do not seem to feel differently about their training and education processes in the field of ICTs.

However, differences are apparent in regard to the levels of anxiety that they show on performing tasks that require computer use. In this context, Teacher Trainees with Computers characteristically show significantly higher levels of anxiety (in the form of lower scores) than other groups (including Other Teacher Trainees).

This seems to indicate that the need to adapt to the demands of a subject that is clearly linked to computer use generated feelings of stress and anxiety, perhaps because the teaching environment was clearly new and challenging to students.

But when it comes to appraising their own performance and efficacy in computer use, Teacher Trainees with Computers express levels of satisfaction which are significantly higher than the Other Teacher Trainees and Other Humanities Students groups and almost as high as those expressed by Scientific and Technical Degree students.

Where does this difference in appraisal of their own performance and ability with computers come from? It seems reasonable to think that, in spite of worries about adapting to the demands of the subject, the results of the learning process and the products of their activities may well be linked to this positive appraisal. Those results can be accessed at http://txomin.pbwiki.com.

This is consistent with the classroom atmosphere observed by the author of this study as the lecturer for the subject involving ICT use. Classroom sessions were characterised by strikingly high participation levels (in terms of consultations on doubts, requests for assistance and intensity of work throughout classes) and by a high level of interest among students.

Finally, it must be considered that on the enjoyment-usefulness scale Scientific & Technical Degree students have by far the highest scores.

Conclusions

The current situation in education and culture is characterised at least in part by the development of information and communication technologies and by the influence of those technologies have on the education environment. In view of this, it seems desirable for people who are being trained to teach students to use these new digital resources at the various levels of compulsory education in the not too distant future to have comparatively high (and therefore positive) levels of subjective computer experience.

However, the results of this study indicate that this is not so. The teacher trainees included in the sample who had not taken the subject and involved the use of ICTs showed significantly lower levels of subjective computer experience than students taking scientific and technical degrees.

This provides food for thought concerning the training in ICTs is being received by teacher trainees, particularly in view of the fact that the working environment for which they are being trained is clearly heading towards an ever increasing use of resources of this type (see, for instance, the legislative context of the Basic Education Act [*LOE*] of 2006 in regard to the need to educate in digital technologies).

From another viewpoint, anxiety has traditionally been presented as counter-productive for teaching and learning processes in general (Villarroel, 2002) and for computer experience in particular (Heinssen, Glass & Knight, 1987; Beckers & Schmidt, 2001).

However, the results of this study do not bear out that view. Although the group of Teacher Trainees with Computers showed higher levels of anxiety than their colleagues in Other Teacher Trainees, they also indicated a significantly better appraisal of their own activities and abilities in computer use.

This coincides with the observations of Saadé & Kiraa (2007), who conducted a study concerning the way in which anxiety in experience influences computer use. They found that the relationship between the two variables was not necessarily negative, and that the professional standards of the assistance available to students, the learning context and the design of teaching methods may condition the direction of influence in this relationship.

This opens up an interesting field of research concerning the relationship between anxiety and other psychological constructs in the field of teacher training for the use of ICTs.

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