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1.3 THE DIGITAL COMPETENCE

1. THE DIGITAL COMPETENCE AND LEARNING IN SIMULATION ENVIRONMENTS[1]

The general competences (usually those that belong to the core curriculum) are competences that are common to most professions and have to do with the integrated application of aptitudes, personal development, educational background and other values. In general it is accepted that these competences should be worked on in environments that are as similar as possible to those in which they would be required in professional practice and it is precisely in this respect that simulation environments have started to find one of their most useful applications to date. Without a doubt, this is the main aim of the project Simul@: to assess the possibilities of a simulation environment for learning and evaluating such important general competences as self-management and teamwork.

Virtual 3D spaces such as Second Life, OpenSim or OpenSimulator are online communities that simulate three-dimensional physical spaces. They may be real or not and they enable users to interact and use, create and trade objects through their avatars. Indeed, there are spaces of immersion that are interactive, adaptable to the will of the user, readily accessible and programmable (Atkins, 2009). They also enable spaces to be created that resemble physical spaces and which have similar or alternative rules, synchronous or asynchronous exchange, etc. (Allen & Demchak, 2011). Finally, these spaces have numerous possibilities of considerable educational interest, which should not be ignored either by educational praxis nor research (Cela Ranilla et al., 2011). For all these reasons, simulations are a method of exceptional potential for learning general competences and skills which, otherwise, may be difficult to address (Gisbert Cervera, Cela Ranilla, & Isus, 2010). The fact is that these competences can only be exercised and demonstrated through action, and this requirement opens the door to the design of simulations in which users play an active role in solving problems that they can only cope with by mobilising the cognitive resources that the context requires (Esteve Mon,

1. The discussion in this chapter is based on an article submitted to the journal New Educational Review, which we qualify and extend here so that it can be included as a chapter in this work on Simul@.

Larraz Rada, Gisbert Cervera, & Espuny Vidal, 2011). In these contexts, the activity that must be carried out must be precisely designed and implemented, but we should always bear in mind that the very use of 3D software simulation is not an impediment to learning the general competences that we have decided to work on and evaluate.

As can be seen, in this process of research into simulation environments, we have encountered another general competence: the digital competence. In fact, the reflection that we make here is not aimed so much at analysing the results of the simulation experiment itself but at reflecting on the digital competence of whatever students who are chosen to take part in a learning sequence that is based on a virtual world: that is to say, we wish to pause for a moment to think of the digital competence of our informants in the project Simul@. And we wish to do so because if this teaching-learning experiment is to be as successful as possible, we believe that it is fundamental that students be competent from the digital point of view; because if they are not, we must provide them with supplementary training that makes up for these digital shortcomings. This interesting reflection is the subject of this paper.

2. WHAT DO WE UNDERSTAND BY DIGITAL COMPETENCE? DIGITAL LEARNERS AND DIGITAL COMPETENCE

There is no doubt that in recent years there has been an unprecedented technological revolution that is affecting all areas of knowledge and which, of course, has had an important effect on the educational process (Baelo Álvarez & Cantón Mayo, 2009). In this context, neither is there any doubt that university students, most of whom were born after 1980, fully belong to the so-called digital age. In this regard, we often refer to them as digital natives (Prensky, 2001), in clear reference to the fact that they are the first generation to have grown up completely surrounded by technology (Internet, video games, mobile phones, etc.) (Gallardo Echenique, 2012). And as many authors point out (Bullen & Morgan, 2011; Bullen, Morgan, Belfer & Qayyum, 2009; Gallardo Echenique, 2012), it is logical to think that for these new individuals new strategies must have emerged for accessing, managing and processing information. Likewise, it is plausible to deduce that this may also have been accompanied by new learning strategies.

However, the (academic and non-academic) reflection has focused much more on the cognitive and essential nature of these new citizens than on the consequences on their learning as digital students. For example, we found discussions on the Net.Generation (Tapscott, 1999) or descriptions of the main features of this sort of student (Oblinger & Oblinger, 2005), some of which were a certain ability to handle technology (often referred to as digital literacy), the constant use of Internet, immediacy, constant socialisation, and the ability to work simultaneously with different media. Other studies have made in-depth analyses of their wishes, preferences, habits and most frequent uses (Gallardo Echenique, 2012).

Nevertheless, as yet there is no consensus on the nature of these new citizens, which contributes to the debate remaining focused on their essence rather than on the educational implications it may have. Some authors, in fact, even dare to deny that there is such a radical separation between the subjects of the digital age and their predecessors (Selwyn, 2005). And, along these same lines, some believe that this traditional distinction between Prenski's digital natives and immigrants limits the real possibilities of the information and communication technologies (ICT) in teaching-learning processes, and not only from the perspective of the student but also from that of the teacher.

In this plethora of opinions, several authors point out the need to review the literature to determine whether the academic work done on the students of the Net.Generation has provided sufficient empirical evidence that this natural ability in technological environments (which above we have referred to as digital literacy) really helps students to learn more and more efficiently which, after all, should be our main concern as educators (Bullen et al., 2009; Bullen, Morgan, & Qayyum, 2011; Gallardo Echenique, 2012; Gisbert Cervera, Espuny Vidal, & González Martínez, 2011a; González Martínez, Espuny Vidal, & Gisbert Cervera, 2010). For example, ECAR (Salaway, Caruso & Nelson, 2008) shows that 80% of high-school students in the USA own a lap top, but they only use it in the traditional fashion in both their academic and personal lives. This undoubtedly supports the hypothesis just mentioned that their unquestionable ability to handle technology in general does not necessarily lead to learning of greater scope or with less effort. In other words, although we accept that our university students are digital natives, their digital competence is not so clear (Gallardo Echenique, 2012; Gisbert Cervera et al., 2011a).

At this point we find another of the main foci of academic reflection on the educational use of technology: the very concept of digital competence. In this regard, we accept the usual descriptive comparisons of the concept, the most common standards and the analyses of digital competence that our group has been making for some time now (Gisbert Cervera et al., 2011a; Gisbert Cervera, Espuny Vidal, & González Martínez, 2011b; González Martínez et al., 2010), and we establish the following definition of digital competente (Esteve Mon et al., 2011; Larraz Rada, Espuny Vidal, & Gisbert Cervera, 2011):

> Digital competence can solve the problems of the Knowledge Society in all areas of our learning environment (personal, professional and social). This digital competence is multidimensional and involves integrating cognitive, relational and social skills in four different groups of literacies:
>
> - Informational literacy: Digital information management.
> - Technological literacy: Ability to treat data in different formats.
> - Multimedia literacy: Analysis and creation of multimedia messages.
> - Communicative literacy: Participation, public spirit and digital identity.

On the basis of this definition, we accept the reservations about the ability of digital natives to learn better (Bullen & Morgan, 2011; Bullen et al., 2009, 2011) and we can evaluate all the issues that we have mentioned in the introduction to this chapter: the students that take part in the Simul@ experiment generally belong to the Net.Generation, but it has yet to be proved that this means that they have an acceptable and desirable level of digital competence. And there is no evidence in the literature to suggest that they can in fact use technology to learn more and more effectively. In an attempt to make up for this lack, we propose using the tool INCOTIC-Grado to measure their digital competence at the beginning of the experiment and determine what training, and how much, students need if they are to be able to take maximum advantage of simulation environments to acquire the other general competences.

3. INCOTIC-GRADO, AN INSTRUMENT FOR DETERMINING THE INITIAL LEVEL OF DIGITAL COMPETENCE

3.1 INCOTIC-Grado: The instrument for data collection

The tool that we used to make the first diagnosis of students' digital competence is the self-perception questionnaire entitled INCOTIC.Grado, whose design process (González Martínez et al., 2010) and final validation (Gisbert Cervera et al., 2011a) have already been communicated to the academic community.

As we know, the teaching of the digital competence contains an inherent and specific challenge: it is difficult to plan and evaluate, it is complex to design the teaching-learning processes that will make students feel secure in this competence, etc. In this context, INCOTIC-Grado aims to improve these processes by implementing the fundamental initial action of getting university students to diagnose their own digital competence. This initial step, which must be carried out before the teaching is planned, will enable us to determine what knowledge students consider they have already acquired at the beginning of their university degree. Thus, the general objectives of the tool are the following:

1. To obtain systematic information about the perception students have of their level of digital competence.
2. For first-year students to make a self-diagnosis of their level of digital competence.

3.2 Procedure

Students access the INCOTIC-Grado questionnaire using Google Spreadsheets. This system not only made it easier for them to respond but also to analyse and systematise the resulting data. As a tool for the self-diagnosis of digital competence, then, INCOTIC-Grado complies with the requirement of being integrated into the Web 2.0 interface, with all the advantages that this has. In our case, the questionnaire was hosted in the forum of one of the basic subjects (and therefore done by all students) on the first-year degree course in Infant and Primary Education at the Terres de l'Ebre Campus of the Universitat Rovira i Virgili.

The sample consisted of 47 informants, which was 61.8% of the population analysed, who responded to the INCOTIC-Grado questionnaire at the beginning of the Simul@ experiment in which they were taking part and which we have already mentioned above (first week in May 2011).

3.3 Questionnaire structure

As we have mentioned above, we restructured the tool on the basis of the rubric of the C2 and C3 competences approved by the Universitat Rovira i Virgili, Storey's general reflections (2002) about the usability of IT tools, the usual consideration in relation to the process of European convergence and the ICT (Esteve Mon, 2009) and the general definition mentioned above of digital competence (Larraz Rada et al., 2011), which is understood to be an aggregate of several components (namely, informational literacy, technological literacy, audiovisual literacy and communicative literacy.)

We shall now go on to give a more detailed description of the content of the questionnaire:

- **First part.** Identification, resources and use of ICT:
    - Section A: Personal details
    - Section B: Access and availability of digital resources
    - Section C: Use of general ICT and ICT specific to students
- **Second part.** Digital competence and attitudes to IT:
    - Secton D: Specific training in IT
    - Section E: Digital competence: technological literacy; incidence of IT in our training as "competent" citizens; competence in the use of IT as a tool at the service of intellec-

tual work; competence in the use of IT as information tools; competence in the use of IT as communication tools
- Section F: Attitudes to IT

Now that we have briefly described the content and the structure of the tool, we move on to describe and appraise the data provided by this first use of INCOTIC-Grado with our first-year students studying the degree in Infant and Primary Education.

4. SOME DATA ON DIGITAL COMPETENCE IN SIMUL@

Now we can proceed to analyze the self-assessment indicators of digital competence. As stated in a previous report (Gisbert Cervera et al., 2011b) the tool enables various aspects of digital competence to be tested: technological literacy, communication and intellectual work among other things (further information about this calculation processes can be checked in our INCOTIC validation paper (Gisbert Cervera et al., 2011a)). So the general digital competence index (INCOTIC), with a range from 1 to 5, can be used as an initial reference. In turn, this indicator can be broken down into less important indicators with the same range: Multimodal Literacy Index, Intellectual Working Tools Index, Information Managing Index and Communication Index (see block E of the questionnaire). Finally, it will be very interesting to bear in mind the Attitudes towards ICT Index, from Section F of this questionnaire (also scored between 1 and 5).

	Mean	St. Dev.
Techological literacy	3.3932	0.69497
Instruments	3.5006	0.52042
Info. management	3.4255	0.61171
Communication	3.2911	0.73804
Attitudes	3.233	0.6637
INCOTIC	**3.3691**	**0.56386**

Table 3. Indicators of digital competence used in Simul@.

As can be seen, the students participating in the simulation experiment rate themselves using the central values of the scale, perhaps as a result of bias centrality. They can be seen to feel more competent in the technological literacy component, since the value of the indicator of technological tools is highest (3.50 points). On the other hand, they feel less competent in the communication component, which has one of the lowest values (3.29 points). It is especially interesting to see that the lowest value recorded is for the attitudinal component, when in previous uses of the same instrument it was clearly the highest, with values close to 4 as shown below (Espuny Vidal, González Martínez, & Gisbert Cervera, 2010; Gisbert Cervera et al., 2011a, 2011b; González Martínez et al., 2010). The table below indicates some of the significant differences between men and women:

		Mean	St. dev.	St. error
Attitude	*Man*	3.357	0.6841	0.1191
p-value:	*Woman*	2.939	0.5234	0.1399
< 0.05	*Total*	3.233	0.6637	0.0968

Table 4. Attitude differences by gender in Simul@

5. SOME FINAL REFLECTIONS

If the data obtained are analyzed in the light of the overall Simul@ experiment, it can be seen that they are not particularly positive, as we have subjected our students to a simulated education process in a technological environment, and they do not seem to be particularly competent in the use of new technologies, with all that this implies. Within this overall assessment, some values are especially striking because they are extremely low. We are referring, in particular, to student scores on communicative components which, in conjunction with their scores on attitude, are the lowest of all. This reveals a low level of communicative competence in a particularly demanding technological environment. If it is borne in mind that all teaching and learning activities during the Simul@ experiment are carried out in a virtual world, this communicative competence may not be enough to ensure that the learning process is fully effective.

We should also draw attention to the low value of the indicator Attitude. As we have noted above, this value was higher in earlier uses of the instrument INCOTIC-Grado, and so we must ask ourselves whether any teaching action is required to bridge this gap. Certainly, the lack of a positive attitude to the use of technology is not a particularly good for an experiment like ours.

In general, as we have said, the values of all our indicators suggest that the profile of this group is quite different from that of other users of INCOTIC. If we compare our Simul@ sample with the 1st-year Bachelor of Education students analyzed in Espuny Vidal et al. (2010), our present students show a similar level of general digital competence, but significantly worse values in attitude and technological literacy. This is noteworthy because the groups are not apparently too different. On the other hand, if we compare them with the sample of 1st-year Bachelor of Education students used to pilot the tool the year before (Gisbert Cervera et al., 2011a), our Simul@ sample is less competent in all the indicators and, of course, also overall. All this can be seen in the following table, which provides the data from Espuny Vidal (2010), labeled “2010”, and Gisbert Cervera et al. (2011a), labeled “Pilot”.

	Simul@	**Pilot**	**2010**
Technological literacy	*3.39*	3.72 ↑	3.60 ↑
Instruments	*3.50*	3.71 ↑	3.36 ↓
Info. management	*3.42*	3.69 ↑	3.41 ↔
Communication	*3.29*	3.76 ↑	3.19 ↓
Attitudes	*3.23*	3.72 ↑	3.67 ↑
INCOTIC	***3.37***	**3.72 ↑**	**3.34 ↔**

Table 6. Indicators in Simul@ and INCOTIC Pilot

One of our main conclusions after evaluating these data is in line with Bullen's skeptical reflections (2009) on Prenski's assertions (2001) about the natural predisposition of the Net.Generation to use technologies. Just as the Canadian author points out, mere common sense indicates significant differences between the new students and ourselves (see Oblinger & Oblinger (2005)), but no scientific evidence confirms that they are digitally competent, that they are permanently connected, or that they always prefer experiential learning, etc. Neither is there any evidence to suggest that all this affects how they learn, which is of main interest to us as educators.

A priori, then, we doubt that our Net.Generation students have the right level of digital competence, and their own assessment does not confirm that they have. So it is reasonable to conclude that success using Simul@ is at least partially affected by students' digital competence and the degree of entrenchment they show. Therefore, our thoughts about the digital competence of our students and how it affects their learning necessarily prompted us to consider what actions should be planned to supplement the educational activities provided by the Simul@ experiment for working on core competences such as teamwork and self-management. Below we discuss some of these actions.

One of the first conclusions that emerges from our work using INCOTIC-Grado is that there is a need to enhance knowledge on how tools for educational collaboration and information access can be used. As far as collaborative working tools are concerned, a specific training program can be designed to teach students not only how these computer programs work and should be used, but also how they can improve their own academic performance in environments such as Simul@, which is our real goal. Sometimes, the challenge of competence building is often not unsolvable or even difficult to undertake, particularly if there is a clear and practical vision of two starkly contrasting situations: the initial diagnosis and the competence goal. If we can initially assess our students, and determine what we want then to be able to do, we need only focus on designing the training process. Sometimes, in addition, this process does not require new resources to be designed, but can be solved by the pure economics of existing resources (Gisbert Cervera et al., 2011b).

When students have their core competences measured in a 3D environment, a lack of digital competence can be a real problem. However, if we obtain information about our students' digital competence (that is to say, their self-assessed competence at using ICT and their attitudes towards ICT), we will be able to plan specific training (integrated modules to cover their needs). So this first step helps students to take advantage of the process designed for them to learn about self-management and teamwork skills.

Therefore, we agree with Esteve et al. (2011) and their specification of the virtues of assessing digital competence through 3D environments, since simulations provide action, active roles, learning implementation, resource selection, decision making, individual processes and relationships with others, collaborative and cooperative work, searching, problem solving and knowledge transfer. Simulations allow contextualization, because their similarity and transfer to the working world is very high, as Oblinger and Oblinger (2005) and Gisbert, Cela and Isus (2010) point out. But, since simulations take place within a technological environment, we must ensure that they have the appropriate level of digital competence.

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