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2.4 EVALUATING DIGITAL COMPETENCE IN SIMULATION ENVIRONMENTS

1. DIGITAL COMPETENCE

Universities nowadays are facing new challenges largely as a result of two contextual factors: the knowledge society and the European Area of Higher Education. One of these challenges is to update the so-called traditional model of education and to implement a new model adapted to the new times and focusing on transparency and student learning.

According to Uceda (2011), this new model has eight characteristics, among which are the following: (1) focus on the ability to solve complex problems and multidisciplinary orientation, (2) generalised use of ICT, (3) student centred, (4) learning centred, and (5) the development of general competences in a structured way.

The digital competence is a part of this new educational model because of its inherent characteristics: it is multidisciplinary in the sense that it integrates cognitive, relational and social abilities from different disciplines; it is sensitive to the sociocultural context; and it is technological because it is involved in the use of technologies and production by means of technologies.

Digital competence is regarded as a key competence for lifelong learning. The European Parliament and Council define the competence as involving the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (European Commission, 2006).

One of the first definitions of digital competence was put forward by Paul Gilster in 1997. He defined it as the ability to understand and use information in numerous formats from a wide variety of sources when it is presented through computers (Lankshear and Knobel, 2008). From this point on many authors and institutions have provided their own definitions, creating a terminological chaos caused by the number of terms and concepts used (Pasadas, 2010). The fact that the first definitions are often in English, and these are then translated into other languages with varying degrees of success, has also contributed to this chaos (Ferreiro, 2011).

It is for this reason that we believed it was necessary to draw up a definition of digital competence to act as a reference framework in our research. After a descriptive, comparative and statistical analysis of regulations, standards and models, we arrived at the following definition of digital competence (Larraz, Espuny & Gisbert, 2011):

Digital competence makes it possible to cope with the problems raised by the knowledge society from all areas of our learning ecosystem (personal, professional and social).

Digital competence is multidimensional and involves the integration of cognitive, relational and social abilities that we have grouped in four literacies:

- *Informational literacy: management of digital information.*
- *Technological literacy: treatment of data in various formats.*
- *Multimedia literacy: analysis and creation of multimedia messages.*
- *Communicative literacy: participation, public spirit and digital identity.*

On the basis of this definition, we shall determine the criteria that should guide how digital competence is evaluated.

2. THE EVALUATION OF DIGITAL COMPETENCE

As an intrinsic part of the teaching-learning process, evaluation requires a systematic procedure of data collection and proof of the level of acquisition of the student. On the basis of the data collected, teachers will be in a position to be able to take decisions on the accreditation of the planned level of competence.

Above all, the evaluation of competences should be based on the genesis of the competence itself. With this in mind we consider Perrenoud's definition of competence (2004:11): a competence is the ability to mobilise various cognitive processes to cope with situations. Within this framework, five aspects can be established that must be taken into account when evaluating competences:

1. Competences mobilise and integrate knowledge, abilities and attitudes, which must be worked on and evaluated in an integrated fashion.
2. Competence is complex and, therefore, needs to be made concrete in identifiable and tangible product, which can be used as a reference to demonstrate that it has been acquired (Martínez & Echeverría, 2009: 144). These products are known as the learning outcome and it can be described gradually by means of the indicators that show the extent to which the competence has been acquired.
3. Mobilisation is only relevant in one particular situation, so learning situations must be designed that represent approximations to reality.
4. Learning situations must allow for and require the following four mechanisms (adapted from Zabala, 2008: 46-47): (1) an analysis of the complexity of the situation, (2) a review of the most appropriate action plans learned, (3) selection of the most appropriate action plan, and (4) action: that is to say, adapting the plan to reality and putting it into practice in a flexible fashion.
5. Evaluation requires information to be collected using instruments that must be varied, complex and, above all, aligned to purpose (Biggs, 2005:45).

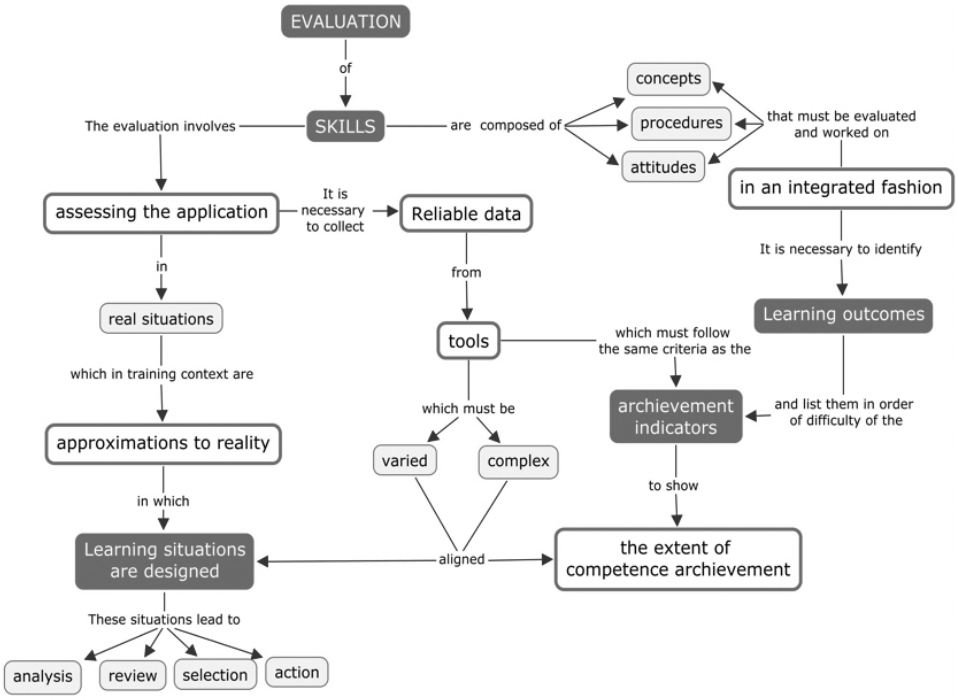

Figure 1. The evaluation of competences

Evaluation strategies and instruments must, then, be correctly chosen to ensure that data are collected and guarantee the acquisition of the set learning outcomes.

2.1 A variety of tools

In recent years a wide variety of tools have been designed for evaluating digital competence or some of its components. In the framework of the project Digital Competence: Identification and European-wide validation of its components for all levels of learners, Ala-Mutka (2011:36) states that three main types of tool are used to evaluate digital competence: (1) questionnaires, which are used to collect data from the users themselves about use, knowledge, perception, opinion and self evaluation, (2) analysis of digital tasks to measure performance and behaviour while carrying out the tasks, and (3) collection of secondary data, which is used to collect information about the availability and uses of digital tools, analysis of national policy documents, funding principles, details of curricula, etc.

Several authors (Prades, 2005; Van Deursen, 2010 and Ala-Mutka, 2011) have already spoken of the difficulties involved in the two types of tool that are most appropriate for our research into evaluating the digital competence of university students: questionnaires and drawing up digital tasks that enable competences to be evaluated through observation.

To understand which tools are most commonly used to accredit digital competence or some of its components, we analysed three studies on this issue:

- The first study, by Esteve et al (2011), analysed five instruments (INCOTIC-GRAU[1], iDCA[2], ICDL[3], PISA[4], ISkills[5]) using five indicators: author or institution, type of instrument, educational level for which the instrument is designed, evaluation strategy, elements evaluated and main literacies evaluated. The main conclusion drawn by this study is that the types and features of the instruments are quite varied. Some of them are simply on-line questionnaires, while others also include simple web or desk-top simulations that require respondents to carry out some sort of activity. These instruments often put greater emphasis on the technological and informational aspects of the literacies than on the multimedia or communicative aspects.
- The second study, by Larraz et al. (2012) analysed 22 instruments (to the five analysed in the study mentioned above it added ACTIC,[6] BEBRAS,[7] C2I,[8] CABRINI,[9] COBADI,[10] ECDL,[11] ISKILLS,[12] IC3, iDCA, INCOTIC-GRAU, ICPE,[13] ILAS,[14] ILS,[15] ILT,[16] ILTo,[17] ISST,[18] IEAd,[19] OFCOM,[20] SAILS[21] and VAN[22]). This study uses the five indicators designed by Esteve et al. and adds four more: availability, standards, types of question and times. The main conclusions of the study are that the tools do not respond to the needs for accrediting digital competence since they do not measure in the same way all the components of digital competence (informational literacy, technological literacy, multimedia literacy and communicative literacy) and neither do they work on them simultaneously.
- The third study, by Ferrari (2012), analysed 15 digital competence frameworks, of which 9 incorporate criteria or tools for the evaluation of digital competence (ACTIC, BECTA,[23] CML,[24] DCA, ECDL, IC3, ISKILLS, NCCA[25] and ILPScotland[26]). The main conclusion of

1. http://redalyc.uaemex.mx/redalyc/src/inicio/ArtPdfRed.jsp?iCve=56717469006
2. http://www.digitalcompetence.org
3. http://www.icdlus.org
4. http://www.oecd.org/document/57/0,3746,en_32252351_46584327_48265529_1_1_1_1,00.html
5. http://www.ets.org/iskills/
6. http://www20.gencat.cat/portal/site/actic
7. http://www.bebras.org
8. https://www2.c2i.education.fr/
9. http://www.cabrini.edu/Library/literacypretest/
10. https://spreadsheets0.google.com/viewform?formkey=dGhDX2RYeGRaTW9PZnBObk5jdUxVUGc6MQ
11. http://www.ecdl.org
12. http://www.ets.org/iskills/
13. http://www.topsy.org/ICAP/TestSpecs.pdf
14. http://web1.desales.edu/assets/desales/library/survey3.htm
15. http://informationr.net/ir/15-3/paper436.html
16. http://www.madisonassessment.com/
17. http://www.nilrc.org/IMLS/assessment_instrument.asp
18. http://www.jmu.edu/gened/info_lit_general.shtml
19. http://edutec.rediris.es/Revelec2/Revelec35/pdf/Edutec-e_n35_Carrera_Vaquero_Balsells.pdf
20. http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/media-lit-2010/adult_questionnaire.pdf
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24. http://www.medialit.org/cml-framework
25. http://www.ncca.ie/uploadedfiles/publications/ict%20revised%20framework.pdf
26. http://caledonianblogs.net/nilfs/

this study as far as evaluation tools are concerned is that most of them are designed to accredit the use of particular computer tools. And there are very few tools designed to develop digital competence, critical capacity, thinking skills and cognitive approaches at a level that is more advanced than the simple use of a particular technology.

The review of the three studies enabled us to establish the criteria and requisites that an instrument designed to evaluate digital competence must comply with. They are the following:

1. The instrument must allow complex learning situations to be designed so that:
   a. The three components of any competence –knowledge, procedures and attitudes – can be evaluated.
   b. The four components of digital competence –informational literacy, technological literacy, multimedia literacy and communicative literacy– can be evaluated in an integrated fashion.
   c. The performance of a particular student in the processes of analysis, review, selection and execution of the activity can be evaluated.
   d. Individual and collective processes can be evaluated.
2. The instrument must be sufficiently flexible to:
   a. Create various situations in which digital competence can be developed.
   b. Adapt the context in such a way that it is meaningful for students on different degree courses.
   c. Allow students to take different routes to achieve the final objective.
   d. Allow different final results.
3. The instrument must collect reliable data that can be compared and contrasted with the acquisition indicators.
4. The instrument must make it possible to design learning situations.

On the basis of the above analysis of the existing instruments for evaluating and accrediting digital competence, of their potential and shortcomings, and of the criteria and requirements that an instrument must have if it is to correctly evaluate the acquisition of the competence in accordance with the complexity of our definition, we now go on to examine a set of technological 3D simulation environments that can respond to this situation.

3. 3D SIMULATION ENVIRONMENTS FOR EVALUATING DIGITAL COMPETENCE

3D simulation environments such as Second Life or OpenSimulator are on-line communities that simulate physical spaces in three dimensions. They may be real or not and they enable users to interact with one another through their avatars, and use, create and exchange objects. Atkins (2009) points out the following features of these environments: (1) they are environments that involve immersion, since they give the sensation of being present in a simulated environment, (2) they are interactive and users can communicate in writing or orally, in real time, and also listen to multimedia items by streaming, (3) they can be personalised by users, who can add or construct new features, scenarios or objects by themselves or in a group, (4) they are readily accessible because the tools are free and open, and(5) they can be programmed; they are not games that have a particular set of instructions but allow users to establish their own rules and schedule their own objectives.

The simulations that can be carried out with this type of 3D environment are activities that facilitate learning, and create effective learning environments not only because they can

be fun but because they require the user to take frequent decisions, relate to others, make searches, solve problems and transfer knowledge (Oblinger, 2006). Simulations are a highly valuable methodology for learning general competences because they resemble working environments (Gisbert, Cela & Isus, 2010). Below we list seven reasons that justify the use of these 3D simulation environments for evaluating competences and, in particular, digital competence:

1. Competences are shown to have been acquired by action and simulators enable situations to be designed in which users take on an active role with which they solve the problems raised.
2. Competences need to mobilise cognitive resources and simulators present situations that must be managed by the user.
3. If competences are to be developed and evaluated, learning must be contextualised and simulations represent real and fictitious situations that lead to experimental learning by discovery.
4. Competences are shown to have been acquired in a variety of situations by transferring learning to particular situations. Simulators enable learning to be transferred from the virtual world to the real one (with the added advantage that situations that are not viable or too costly in the real world can be represented in the virtual world).
5. The acquisition of competences is an individual process and simulators require individual tasks to be executed.
6. Competences enable citizens to be able to take effective part in the political, social and cultural life of society, and simulators make it possible to design cooperative learning situations.
7. Any learning, competences included, is speeded up by motivation. Simulators are a game that challenges and motivates students.

In conclusion, these 3D simulation environments provide new educational possibilities for learning, experimentation and even evaluation. They enable not only knowledge but also skills and attitudes to be evaluated simultaneously, and in accordance with the complexity of the multiple literacies involved in digital competence, which we defined above. At present, there are some experiences that are beginning to examine these possibilities (for example, the SIMUL@ project, which is described in some chapters of this book. Undoubtedly, it will be interesting to continue exploring the potential of these tools.

REFERENCES

Ala-Mutka, K., (2011). Mapping Digital Competence: Towards a Conceptual Understanding, IPTS-JRC 67075, European Commission, Luxembourg.

European Commission (2006). Recomendación del Parlamento Europeo y del Consejo sobre las competencias clave para el aprendizaje permanente. (2006/962/CE). Brussel·les: European Commission. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:ES:PDF (Last accessed 16/04/2009).

Ferrari, A., (2012). Digital Competence in practice: An analysis of frameworks. JRC 25351, European Commission, Luxemburg.

Ferreiro, E. (2011). Alfabetización digital ¿De qué estamos hablando?. Educação e Pesquisa, São Paulo, 37, 2, 423-438.

Gisbert, M., Cela, J. & Isus, S.: (2010). "Las simulaciones en entornos TIC como herramienta para la formación en competencias transversales de los estudiantes universitarios". In De Pablos Pons, J. (Coord.) *Buenas prácticas de enseñanza con TIC* [on-line essay]. Revista Electrónica Teoría de la Educación: Educación y Cultura en la Sociedad de la Información, 11, 1. 352-370. [Last accessed: 15/09/2011].

http://revistatesi.usal.es/~revistas_trabajo/index.php/revistatesi/article/view/6309/6322 l

Lankshear C. and Knobel, M., (2008). Nuevos alfabetismos su práctica cotidiana y el aprendizaje en el aula. Madrid: Morata.

- Larraz, V., Espuny, C. & Gisbert, M. (2011). *Los componentes de la competència digital.* I Congreso Comunicación y Educación: Estrategias de Alfabetización Mediática, Barcelona, 11-13 May 2011.

Larraz, V., Espuny, C., Gisbert, M. and Saz, A. (2012). Las herramientas para la evaluación de la competencia digita. Análisis y componentes. Congreso EDUTEC: "Canarias en tres continentes digitales: educación, TIC, NET-Coaching. Las Palmas de Gran Canaria, 14-16 November 2012.

Martínez, P. & Echeverría, B. (2009). Formación basada en competencias. *Revista de Investigación Educativa*, 27, (1), 125-147.

Oblinger, D. (2006). Simulations, games, and learning. Educas Learning Initiative *White Paper* (May), [Last accessed: 15/09/2011]. http://mobilelearningcourse.pbworks.com/f/Games+and+Learning+ELI3004

Pasadas, C. (2010). Multialfabetización, aprendizaje a lo largo de la vida y bibliotecas. *Boletín de la Asociación Andaluza de Bibliotecarios*, n° 98-99, pp. 11-38

Prades, A. (2005). Les competències transverals i la formació universitària. Doctoral thesis, University of Barcelona.

Perrenoud, P. (2004). *Diez nuevas competencias para enseñar*. Barcelona: Graó.

Uceda, J. (2011). Un nuevo modelo educativo. In Michavila, F., Ripollés, M., Esteve, F. *El día después de Bolonia*. Madrid: Tecnos.

Van Deursen, A. (2010). *Internet Skills. Vital assets in an information society*. Enschede, the Netherlands: University of Twente

Zabala (2008) Cómo aprender y enseñar competencias. Barcelona: Ed. Graó

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