ICT Competence in Social Sciences: Designing Digital Resources for Teaching and Learning Cultural Heritage

Ana Luisa Martínez Carrillo
University of Granada, Spain, anamartinez@ugr.es

Abstract: Currently, the use of technology in education has become more popular. Special attention has been given to the adaptation of computer technology into the teaching-learning process for effective learning and increasing students' achievement. In recent years, it has been realized that there is an immense benefit in applying computer technology in the social studies classroom in the context of the high school. The first purpose of this study is to investigate the degree of application of these technologies in the social studies classroom, specifically it application in the discipline of archaeology. The second purpose is to show the use of different technologies in order to replace the traditional process of archaeological documentation with a digital one. In this contribution it is presented the methodology used for recording archaeological data in the excavation and in the laboratory, which consist on online database system for field recording and photogrammetry as a means of graphical documentation for the development of the excavated trenches.

Keywords: novel technologies, archaeological documentation, digital resources, high education

Introduction

There is an increasing research on the efficiency and profit of the implementation of computer technology in education in the last years. Sheffield (1996) stated that as a result of the recent evolutions in technology, computers and the Internet have become more relevant teaching instruments in the social studies classroom. As Vanfossen (2001) points out, some of the benefits of technology integration in the classroom could be the ability to break down the classroom's physical limitations and the spread of the students' experiences, the development of students' exploration and analytical skills and the extension of the students' experiences with visual devices. For that, it is considered that technology is the most important support for the students learning progress and the computers are the main technology support for effective learning and teaching process (Isman et al., 2004; Usun, 2004).

Furthermore, computer technology helps to change the traditional role played in the classrooms. Nowadays the process of teaching and learning should be centered on acquiring, constructing and producing knowledge in accordance with emergent needs and not in the memorization of a huge and ever-increasing volume of information. The use of information and communication technologies in higher education presupposes the use of information technologies in order to change what to teach and how to teach, i.e. content and methods of teaching within the traditional face-to-face form. Information technologies, as noticed Zhaldak (2003), can be considered as a sum of methods and technical means of collection, organization, storage, processing, delivery and presentation of information that extends human knowledge and develops their opportunities to control technical and social procedures.

Nevertheless, there are many problems with ICT competence formation that deal with the process of informatization, the building of a properly system of teacher's work with students, the teaching methods and the provision of learning process with courses and learning resources (Chen et al., 2017). Thus, the main purpose of this paper is to show a case of study for teaching and learning Social Sciences through the use of novel technologies for designing digital resources. This is focused on students of high education of the degree of Archaeology and History, but also might be extended to students of teacher training degrees.

Carrillo, A. L. M. (2020). ICT Competence in Social Sciences: Designing Digital Resources for Teaching and Learning Cultural Heritage. In V. Akerson & I. Sahin (Eds.), *Proceedings of IConSES 2020-- International Conference on Social and Education Sciences* (pp. 16-25), Chicago, IL, USA. ISTES Organization.

This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

ICT in Social Sciences

Digital competence is the most brand new concept relating to technology expertise. In the last years, several terms have been purposed to define the skills and competence of implementing digital technologies, such as ICT skills, technology skills, information technology skills, 21st century skills, information literacy, digital literacy, and digital skills. These terms are also often adopted as synonyms; e.g. digital competence and digital literacy (as an example, see Adeyemon, 2009; Krumsvik, 2008; Ilomäki, Kantosalo & Lakkala, 2011; Namyssova et al., 2019). The extensive collection of terms shows not only the quick development of technologies but also diverse areas of interest, such as library studies or computer science (Jones-Kavalier & Flannigan, 2008).

In the most extensive definitions, based on policy-related papers and reports, digital competence consists on digital skills and social and emotional features for using and understanding digital tools. The European Commission (see Punie & Cabrera, 2006) has defined digital competence as involving the certain and essential use of Information Society Technology for work, leisure and communication. Digital competence is composed of basic skills in ICT, i.e. the use of computers to retrieve, assess, store, produce, present and exchange information, and to be in touch and to take part in collective networks through the Internet (Dockstader, 1999).

Social Science investigation consists on the methodical procedure of finding a solution to a problem (Bhattacherjee, 2012). This task involves the moving back and forth between theory and observation in the science of people, behaviors, societies and economies. In this sense to document a specific site properly through graphical and textual data is crucial for the advance of scientific theories and to justify and to give meaning to an archaeological context. Archaeological artifacts and their explanation are the basis of the archaeological discipline. In this way, the 3D reconstruction of a context includes the textual and graphical information of the records.

Social Sciences deal with social phenomena that are sometimes difficult to express, explain and describe effectively without the support of pictorial, graphic, audio and audio-visuals. In view of the limitations of the traditional method of teaching social science subjects which leaves no opportunity for learners' active participation in the classrooms, social science educators and researchers are deeply concerned about producing teachers who are inadequately prepared for challenging integrative and active teaching (Thornton, 2001). Van Hover, Berson and Swan (2006) remark that social science educators tend to use the same teaching technique (textbooks, lecture method and body language) over the years and yet expect to experience unprecedented positive changes in learning outcomes, whereas the input has not changed to ensure improvement in such expected output.

ICT have effects on many aspects of social science investigation. They can be divided into three groups which include: ICT application in pre-data analysis (how ICTs are used in activities of social science research before reaching the state of data analysis), in data analysis (how ICTs are applied on activities during the stage of data analysis and can be divided into quantitative data analysis and qualitative data analysis), and in post-data analysis. ICT application in pre-data analysis refers to examples (how ICTs are applied on activities of social science research after completing the stage of data analysis which covers: references and bibliography compilation, article and thesis / dissertation's discussion among researchers, supervisors, plagiarism detection and journal manuscripts submission).

This work focuses on developing new tools and methods to register, model, and visualize archaeological work not only the field, but also in the laboratory in order to create digital resources used for learning purposes. So that, following the previously classification ICT is applied on pre-data analysis activities as well as on data analysis activities.

Method

The Forvm MMX Project and the Archaeological Site of Castulo (Linares, Jaén)

These actions have been taken within the framework of the projects *Forvm MMX (2010-2014)* and *Cástulo Siglo XXI (2014-2020)*, which they have conceived from the perspective of the field of Humanities, combining the team´s particular interest in historical and archaeological research and our professional commitment to the preservation and interpretation of historic heritage assets using different disciplines (conservation, museology, architecture and history). At the same time, as the practice of archaeology has social and symbolic dimensions and it is always materially composed, the team has planned to include researchers from the physical and biological sciences. Moreover, as we expected to deal with particularly complex documentation, we have explored different possibilities afforded by information technology. Since 2011, these projects have mobilized additional resources around research and conservation of heritage assets, their activities have been marked by public and private convergence, creativity, and efficiency.

Its scientific goals are centered on the historical reconstruction of a relevant historical period, the constitution of the Roman Empire, which in its day meant the cultural and political union of a considerable region around the Mediterranean Sea. The recovery of the forum (the public square) of the Ibero-Roman city of Cástulo informs directly about this cultural heritage.

At the socio-political level, these projects rely on the cooperation of many scientists who come to perform studies of materials excavation activities and to be personally responsible for the development of the research. At the same time, a large part of the citizens of the city of Linares have been especially active as “volunteers for culture” in recent years in the realization of these archaeological tasks. Therefore, the reconstruction through research of the physical space of the forum will also involve the recovery of this heritage for the citizens of the 21st century, and in fact give exceptional value to the archaeological records.

The fortified settlement of Cástulo is one of the largest known from the Iberian Peninsula in antiquity. Its extent has been estimated at more than 50 ha. The settlement is located on a hill facing south, situated above the right bank of the Guadalimar River. This archaeological site includes an extensive suburban environment estimated at more than 1.800 ha., where cemeteries, roads, workshops and a port from the Ibero-Roman period (ca. 700 BCE – 300 CE) have been found, in addition to other settlements belonging from the Prehistoric until the Middle Ages.

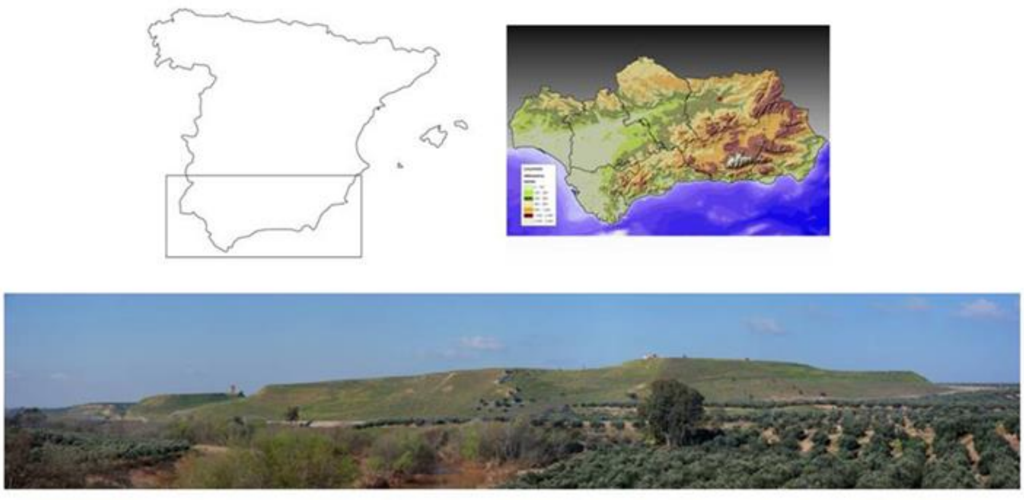

Figure 1. Location of the Ancient City of Cástulo

The importance of Cástulo is exceptional. It was the most frequently mentioned Iberian city in classical texts after Tarraco (modern Tarragona). Also, it was one of the most important mining centers of Hispania, and the last fluvial port on the route from the Mediterranean coast (García-Gelabert and Blázquez 1994). This archaeological site is significant because also lies in its origins and in the continuity of occupation over more than a thousand years. This is due mainly to its strategic location that gives it clear visual control of the Guadalquivir valley and the north area. The intensity of occupation through the centuries, and the various archaeological interventions carried out in recent years, together give us a great deal of knowledge of its successive phases of occupation (Martínez-Carrillo *et al.*, 2012).

Registration of the Textual Information and Its Associated Graphical Information: The Creation of a Data Base and a GIS

The documentation produced by the archaeological works can be of different classes: fieldwork data, analytical documentation, administrative reports and scientific publications (Sprague, 1982). From these, the data collected in the fieldwork must be highlighted as the basis for building the others. Fieldwork documentation usually includes sketches of the investigated area, maps and plans at different scales, inventories of materials, structured forms to describe their relationships, forms to describe the stratigraphy, photographs, videos, etc. These documents contain contextual and relational data needed to construct the historical sequence and to test scientific hypotheses, and are therefore of vital importance in archaeological research.

The practical nature of the fieldwork often means doing something else at the same time as recording data. Usually, this activity is intimately connected with the observation or measurement itself. Archaeological observation proves to be very complex to model in database terms as it presents a broad variety of analytical objects, concepts and actions that are related in an extraordinary variety of ways (Madsen, 2003). During the research process, both relationships and object definitions require re-adjustments as new conceptual categories (e.g. a broader stratigraphic group or phasing) emerge during the interpretive process. Furthermore, typological constraints and uncertainty about basic material properties (e.g. colour or chronology), caused either by the differences in excavation recording methods or simply the subjective nature of archaeological description by different team members, make the task of defining archaeological units and their characteristics even more complex.

For this reasons, the implementation of an excavation data model within a georelational data framework requires advanced linkages between textual and graphical information (D'Andrea, 2003). Fieldworkers need to spend as much time as possible in observation, and have only a limited capacity of attention to deal with recording, be it on a paper form, a tape recorder, a camera or a handheld computer.

Once excavation units are geometrically modeled, it is possible to refer them within a trench or the entire archaeological site; to handle them in various ways (zoom, rotation, translation); to perform 3D spatial analysis on them, such as volumetric calculus or intersection computation; to make various kinds of queries, such as to find out excavation units that have a certain number of artifacts; to generate sections anywhere in the 3D model; and, finally, to publish it. In addition to improving data analysis techniques, if this 3D modeling operation can be done during the excavation, it can greatly help archaeologists to plan their daily excavation strategy more efficiently.

First we are interested in recording an archaeological excavation in progress, where different teams are working at the same time in different areas of the site (see Figure 2). For that, we have designed a field inventory system called *Imilké* (the Iberian princess who married with the Carthaginian general Hannibal). The main objective of this system for recording information in the field is to systematize and standardize the information that can be obtained from an archaeological intervention. The importance of standardizing the information lies in the need for it being reinterpreted retrospectively, allowing data to be accessed by different researchers and enabling the development of new hypotheses about the same historical space. This system allows the capture of textual and related graphical information during the fieldwork. For this task, different forms have been designed for recording aspects such as the type of deposit, the documented materials and the excavation process.

The first unit defined is the volume. A volume is defined by coordinates (X, Y) to which levels are associated with a vertical coordinate (Z), which are formed by strata in their different sequential levels. This formula distinguishes the various documented volumes as surface levels, division by construction, and complete or arbitrary division of space. To each of the registered levels it is possible to associate an image of the same. The X,Y,Z data capture is carried out using a total station.

The surfaces that make up the volumes can also be described in this system. The information collected from them is the associated volumes and levels and a graphical scheme that offers a first approach to its shape. The surfaces are also defined by measurements and photographs and serve to define the exact position of the layer within the volume.

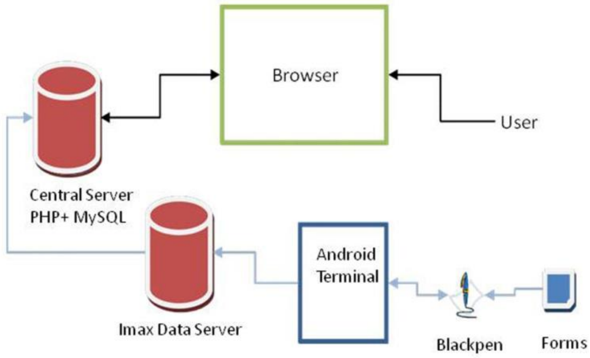

Figure 2. *Imilké* Computing Approach Schema

The computerization of the data collected in these forms is carried out as follows: data are collected on paper forms which are completed with Black Pad, using a digital scanning pen, and sent via internet to be interpreted by OCR and stored in a database where the data are available for consultation, edition and export for use in external applications. Therefore, for this data-collection work in the field, traditional inventory sheets of paper are replaced by electronic tokens stored on a mobile device. Through the use of computerized data on a mobile device the majority of the information is codified and structured, thus streamlining data collection in the field. The stored information goes directly into a database accessible online, allowing the correction of erroneous records and the combination of data from different teams working simultaneously in one excavation area (Hofer & Swan, 2008).

Recording Materials in the Laboratory: DM Codes and 3D Models

Recording material from sites is an essential task in archaeological work (Renfrew & Bahn 1991). The need to identify each artifact individually is a standard practice for archaeological sites. One advantage of having identifiers for every archaeological item is that by using techniques such as artifact refitting in the horizontal and/or vertical directions, the resolution and internal coherence of archaeological contexts can be analyzed and inferences about formation processes or activity areas can be made.

The identification of each object and its manual description involves a considerable investment of time and work in the inventory of an assemblage, especially when it consists of thousands of pieces. Errors habitually occur in the course of this manual process which, although difficult to quantify, must affect any subsequent research. In order to limit problems of this kind, we use a system of recording using digital systems, specifically data matrix (DM) codes. Labeling, that is, the application of codes, which identify each individual artifact, is a fundamental step in this research strategy, since the accurate definition of an archaeological level depends to a great extent on the proper identification of the elements that it comprises.

Codification of the site name, provenance unit, and inventory number supplies a complex network of data from which contextual information about the artifact can be recovered. Its temporal, cultural or material attributes and implications can be evaluated and eventually possibly even be refuted by subsequent studies. The lack or loss of this codification deprives us of basic information that could lead to the formation of new hypotheses or to evaluate the validity of old inferences. If the archaeological item lacks an individual label, the artifact irretrievably loses much of its explanatory potential (Martínez-Moreno *et al.*, 2011).

We have used a method based on the use of DM codes to label archaeological pottery material in the laboratory. These codes have a two-dimensional structure consisting of square cells that store numeric and/or alphanumeric data. The quantity of information that they can contain depends on their size, but is sufficient to identify an artifact. In our study, this information corresponds to the codes for the site name and the inventory number. These identifiers enable reconstruction of the spatial positioning of the recovered artifact once its context has been excavated. DM codes can be different sizes. They can be attached directly both on to a bag and to the surface of individual pottery sherds, thus reducing the possibility of loss or errors while handling objects during analysis, or mixing identification codes on containers. DM codes also support advanced coding systems that allow all information to be recovered from the code even if part of it is damaged.

In our case we have use two different sizes of DM codes (see Figure 3):
- DM codes of 3 x 3 cm. for identifying the bags which contain ceramic material.
- DM codes of 1x1 cm. for identifying the fragments of pottery findings.

Figure 3. Types of DM Codes Used and Their Applications in Bags of Materials and Pottery Fragments

On the other way, although 3D digitization is commonly addressed today in the archaeological domain, research efforts are still focused on establishing affordable and efficient pipelines for producing digital 3D replicas of artifacts. Based on the requirements, specifications, and the financial plan of a digitization project, various methodologies can be applied. All of them involve the use of hardware and software. The usability and quality of the 3D data in terms of geometrical and colour information are only some of the key factors that lead a project team to select a particular digitization methodology. In this sense, image-based 3D-digitization methodologies offer the option of reconstructing an object by a set of unordered images that depict it from different viewpoints. As their hardware requirements are narrowed down to a specific digital camera and a computer system, they arrive at an attractive 3D-digitization approach (Gonizzi Barsanti & Guidi, 2013).

Over the last years numerous image-based 3D-reconstruction solutions have been made available. Some of them are based on combining Structure-From-Motion (SFM) with a Dense Multi-View 3D Reconstruction (DMVR) algorithm. This is a relatively new approach and it is purely based on the continuous increase of the average computer's processing power. The SFM algorithm reconstructs a sparse point cloud of a stationary scene or object that was captured from an arbitrary number of unordered images taken from different viewpoints. SFM mainly uses the corresponding features that are visible in different images that depict areas from different viewpoints, in order to calculate the intrinsic and extrinsic parameters of the digital camera (Dellaert, 2000).

Agisoft LCC created PhotoScan, which provides a SFM–DMVR solution that is able to automatically align unordered image datasets and reconstruct the content of the dataset in 3D by merging the independent dense depth maps of all images (Koutsoudis, Vidmar &Arnaoutoglou, 2013). The data processing has been carried out with the Agisoft Photoscan package, a semi-automatic software in which both the camera orientation and the internal calibration are made, requiring little input from the user. Some choices can be made during image orientation, where the operator may set: alignment accuracy level, possible control points and image masking for hiding possible misleading portions of the area surrounding the main subject.

At the mesh-generation stage, the software permits the selection of the accuracy and the polygon count of the final 3D model. The software implements image orientation and mesh generation through methods and dense multi-view stereo-matching algorithms. After processing with Agisoft, the models are saved with image texture in .obj format. The result is then imported into Blender software to correct possible topologic errors and to close gaps and lacking data omitted due to the environmental constraints.

Table 1. Digitized Objects Using Photogrammetry

Heritage asset	Material	Measurements (length-width max)	Nº Photographs
Lion sculpture	Stone	51cm - 28 cm	108
Pendant	Quartz	3,6 cm -2 cm	60
Key	Iron	8,4 cm - 2,9 cm	72
Tool	Bone	4, 5 cm- 1,3 cm	40

Moreover, the realization of these three-dimensional models has been used to test our proposed methodology on different types of materials. Thus, we have digitized objects of different sizes and materials to understand the limitations of this methodology.

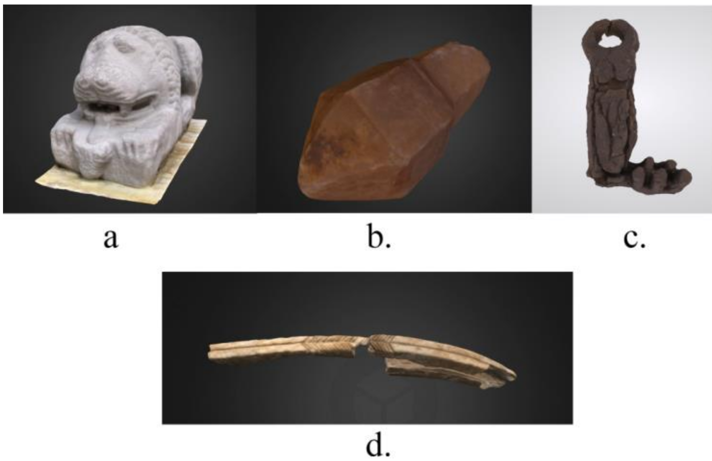

Figure 4: 3D Model Generation in Agisoft Photoscan

The final phase of our work consists of transforming 3D models into a format that is accessible to users via Internet. For dissemination purposes of these models we have chosen an online viewer, Sketchfab, which allows annotations for a better understanding of the model. Nevertheless, we are exploring other online viewers such as p3D.in. Another way to obtain an open and standardized format in which visualize 3D models is the PDF format. Since 2005 (Acrobat 7) Adobe has been expanding the 3D capabilities of its Acrobat suite.

Results

The first point of note is the importance of documentation and preservation of information during the registration work in the field. *Imilké* registration system has been designed so that information from an archaeological intervention is made simpler and more objective. Through this system we can obtain a highly accurate graphical description of the components that form the archaeological context (volumes, surfaces, layers of materials and records). This detailed recording enables further 3D virtual reconstruction, since the exact positions of the elements have already been noted. Another advantage of this system is its easy accessibility. All data can be readily accessed by researchers over the Internet.

This work shows not only the importance of recording of the spatial features in archaeological fieldwork, but also the creation of a computer system for unifying all the contextual information (textual as well as graphical).
The evolution of computing plays an important role here, since in the fieldwork phase it can accelerate the registration and processing of data and, at the same time, the information collected can be applied to the overall strategy of the excavation. For the subsequent laboratory work, the new methodology allows easy control of the recorded data and a qualitative improvement of the general entries. On the other hand, an improvement in the analysis of data makes the relationship between various data sets easier. In short, computerization of archaeological records preserves a certain dynamic in the excavation files and ensures their conservation at the level of document archives.

A common instructional strategy used among social studies teachers is database development. According to Berson (1996), databases are especially useful for managing the extensive knowledge base in the social studies; they also foster students' development of inquiry strategies through the manipulation and analysis of information. Likewise, Rice & Wilson (1999) states that "database development aids constructivism by encouraging collaboration in problem solving, the use of higher-order thinking skills to develop and test hypotheses, the construction of knowledge by the students who relate learning to their own experiences". As Garcia & Michaekis (2001) assert, making databases help to build skills in locating, organizing, indexing, retrieving, and analyzing information.

Although teachers have become more capable in using the database software programs, it is still not enough for teachers to integrate these programs into their classroom (Vanfossen, 2001). In fact, a national survey in the United States indicated that only 11.3% of social studies teachers listed databases as a mainly used teaching strategy among computer-based strategies (Northup & Rooze, 1990). Likewise, Pye and Sullivan (2001) did not find a significant increase regarding social studies teachers' database use. Although there is a significant improvement in software technology in the last decades, the data showed that there is only a slight increase (approximately 3.5 %) in social studies teachers' database use.

The study showed that only 14.7 % of social studies teachers used databases in their classrooms. Thus, it seems that teachers still are not proficient enough to apply these programs into their classrooms. Concerning the use of DM codes for cataloguing material with, the present study demonstrates that use of this system is viable in terms of parameters such as its speed, reliability, and its compatibility with fieldwork routines. Furthermore, the current evaluation has found that these digital systems are not subject to the habitual errors that commonly occur in manual labelling, and which lead to the irreversible loss of contextual information.

Moreover, DM codes can be used as part of a wider procedure related to artefact recovery, recording, analysis, and storage. With the help of the appropriate instruments and purpose-made software, it is possible to link, on a more reliable basis than traditional procedures, objects with their contextual information, both for their study and permanent storage. From this viewpoint, DM codes are a major advance, and should be considered an important alternative, not only for archaeological fieldwork, but also for the provenance and management of collections held in museums and archaeological storage facilities.

At the end, the implementation of 3D models in this information system clearly shows that multimedia technologies significantly influence on students' learning by broadening their scope of learning and knowledge. Three-dimensional models have served to disseminate unique materials to the general public, but can also be used for research purposes, since they are performed at a high resolution. In the light of above, it is said that multimedia technology can provide an alternative to the traditional teacher-centered learning and it enables students to enjoy a richer constructivist learning environment. It can support students to become active learners rather than memorizing knowledge and display their ideas and information in terms of the multimedia format and use their higher order thinking skills like analysis, synthesis, and evaluation (Mai Neo & Ken Neo, 2003).

In this sense, Hobbs (1998) proposed using audiovisual media relevant to the subject of the discipline, with activities specifically designed to force students to analyze the content as 'text', using reasoning and debates based on questioning that help students to see critical eye multimedia resources. So that, integrating three-dimensional virtual worlds, educational platforms and web 2.0 tools in university training tasks currently plays an important role in the teaching-learning process, as is shown by studies and recent experiences in strategies and educational action in immersive worlds 3D (Chau, Sung, Lai, Wang, Wong, Chan & Li, 2013). This registration system has been taught to volunteers' students who have been collaborating during the summer excavation campaign.

Conclusion

This contribution aims to cope with the definition and uses of some ICT concepts in order to diversify the meaning of digital competences. In this approach ICT competence has been implemented in archaeological documentation, which is composed of the use and management of data bases, the recording and labeling archaeological materials through DM codes and the graphical registration of the material through 3D models.

All these actions can improve accuracy and completeness of an archaeological research as evidenced in this ICT application areas e.g. qualitative data collection and analysis as well as in the field documentation.

Nevertheless there is still need for research in the field of technology and social studies, particularly how the usage of new and innovative ways of integrating technology into the classroom impacts outcomes of learning. Also, to implement the methodology carried out in Cástulo into the curriculum of Archaeology and Humanities degrees plays a crucial role because until now we only have been taught in an informal way. In conclusion, technology integration requires teachers' read incessant, flexible ability to incorporate technology into teaching activities with a high level of teaching skills based on curriculum knowledge, knowledge of students' abilities, students' needs and reasonable level of technology literacy.

Acknowledgements

We acknowledge the information provided by *FORVM MMX and Cástulo Siglo XXI* projects, funded by the Ministry of Economy, Innovation, Science and Employment of the regional government of Andalucía and with the support of the Provincial Council as well as private sponsorship.

References

Adeyemon, E. (2009). Integrating digital literacies into outreach services for underserved youth populations. *Reference Librarian*, 50(1), pp.85-98.

Bhattacherjee, A. (2012). *Social Science Research: Principles, Methods, and Practices*. 2nd Edition: USF Open Access Textbooks Collection.

Berson, M.J. (1996). Effectiveness of computer technology in the social studies: A review of the literature. *Journal of Research on Computing in Education*, 2 (4),pp. 486-499.

Chau, M.; Sung, W.-K.; Lai, S.; Wang, M.; Wong, A.; Chan, K. W. Y. & Li, T. M. H. (2013). Evaluating students perception of a three-dimensional virtual world learning environment. *Knowledge Management & E-Learning*, 5(3). pp. 323–333.

Chen, F., Gorbunova, N. V., Masalimova, A. R. & Bírová, J. (2017). Formation of ICT-Competence of Future University School Teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(8), 4765-4777. https://doi.org/10.12973/eurasia.2017.00963a

D'Andrea, A. (2003). Analisi spaziali intra-site. Soluzioni GIS per lo scavo archeologico. *Archeologia e Calcolatori* 14, pp. 329-335.

Dellaert, F. (2000). Structure from motion without correspondence. *Proceedings of the Computer Vision and Pattern Recognition,* South Carolina, USA, June 13–15, pp. 557–564.

Dockstader, J. (1999). Teachers of the 21st Century Know the What, Why and How of Technology Integration. *T.H.E. Journal*, 26(6), pp. 73-74.

Garcia, J., & Michaelis, J. U. (2001). *Social studies for children*. By Allyn & Bacon. Needham Heights, MA: A Pearson Education Company, 264-292.

García-Gelabert, Mª P. & Blázquez, J.M. (1994). La importancia de Cástulo (Linares) en la Alta Andalucía. *Actas del II Congreso de Historia de Andalucía*. Córdoba, pp.331-343.

Gonizzi Barsanti S. & Guidi, G. (2013). 3D digitization of museum content within the 3dicons projects. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume II-XXIV International CIPA Symposium, 2 – 6 September 2013, Strasbourg, France.

Hofer, M. & Swan, K. (2008). Zoom, Pan and Think: The Interactivity of Digital Maps. *Social Studies Research and Practice,* 3(3), 123-132.

Ilomäki, L., Kantosalo, A., & Lakkala, M. (2011). *What is digital competence?*. In Linked portal. Brussels: European Schoolnet. http://linked.eun.org/web/guest/in-depth3.

Isman, A.Caglar, M. Dabaj, F. Altinay, Z., & Altinay, F. (2004). Attitudes of students toward computers. *Turkish Online Journal of Educational Technology*. 3 (1). Retrieved July 22, 2004, from http://www.tojet.sakarya.edu.tr

Jones-Kavalier, B., & Flannigan, S. L. (2008). Connecting the digital dots: Literacy of the 21st century. *Teacher Librarian*, 35(3), 13-16.

Koutsoudis A., Vidmar B. & Arnaoutoglou F. (2013). Performance evaluation of a multi-image 3D reconstruction software on a low-feature artefact. *Journal of Archaeological Science* 40, 4450-4456.

Krumsvik, R. (2008). Situated learning and teachers' digital competence. *Education & Information Technologies*, 13(4), 279-290.
Madsen, T. (2003). ArchaeoInfo: An Object Oriented Information System for Archaeological Excavations. *Enter the Past: The E-way into the Four Dimensions of Cultural Heritage*. Vienna. Austria.
Mai, N., & Ken Neo., T.K. (2003). Developing a student-centered learning environment in The Malaysian classroom – A multimedia learning experience. *Turkish Online Journal of Educational Technology*.2(1). Retrieved July 22, 2004, from http://www.tojet.sakarya.edu.tr.
Martínez-Carrillo, A., Castro, M., Arias de Haro, F. & Serrano, M. (2012). Archaeological Documentation in the Field: the Case of the Roman Forum of Cástulo. *Archaeology in the Digital Era Volume II* ,21-29.
Martínez-Moreno, J. González Marcén P. & Mora Torcala R. (2011). Data matrix (DM) codes: A technological process for the management of the archaeological record. *Journal of Cultural Heritage* 12 134–139.
Namyssova, G., Tussupbekova, G., Helmer, J., Malone, K., Afzal, M., & Jonbekova, D. (2019). Challenges and Benefits of Blended Learning in Higher Education. *International Journal of Technology in Education*, *2*(1), 22-31.
Northup, T., & Rooze, G.E. (1990). Are social studies teachers using computers? A national survey. *Social Education* 54(4), 212-214.
Pye, J. & Sullivan, J. (2001). Use of computer-based instruction in teaching middle school social studies. *The International Journal of Social Education,* 15(2), 92-102.
Punie, Y. & Cabrera, M. (Eds.) (2006). *The Future of ICT and Learning in the Knowledge Society*. Luxembourg: European Commission.
Renfrew C. & Bahn, P. (1991). *Archaeology, Theories, methods and practice*. Thames and Hudson Ltd.
Rice, M. L., & Wilson, E. K. (1999). How technology aids constructivism in the social studies classroom. *Social Studies,* 90 (1), 28-33.
Sheffield, C.J. (1996). An examination of self-reported computer literacy skills of pre-service teachers. *Action in teacher Education* 17(4), 45-52.
Sprague, R. (1982). The Preservation of Written and Printed Archaeological Records. *Northwest Anthropological Research Notes*, nº 16 (2): 206-211. Moscow.
Thornton, S. (2001).Educating the Educators: Rethinking Subject Matter and Methods. *Theory into Practice*, 40(1), pp. 72-79.
Vanfossen, Phillip J. (2001). Degree of Internet/www use and barriers to use among secondary social studies teachers. *International Journal of Instructional Media* 28(1), 57-74.
Van Hover, S.D., Berson, M.J., Bolick, C.M. & Swan, K.O. (2006). Implications of Ubiquitous Computing for the Social Studies Curriculum (Republished). *Contemporary Issues in Technology and Teacher Education*, 6(2), pp. 275-283.
Zhaldak, M. I. (2003*). Computer in mathematics lessons: a Manual for teachers*. Moscow: RNC "DINIT".