Social Science Teachers' perspective, purposes and benefits of the Cybermuseum VIRGO 1.1 as a cognitive tool for learning history

M. P. Rivero and H. Flores-Hole

***Abstract*— This research is the assessment of an authoring and cybermuseum tool, VRIGO 1.1. The assessment was undertaken by Spanish and Latin-American Social Sciences Teachers who took part in a virtual group discussion. Results were analysed through the underlying principles of mindtools proposed by Jonassen and Carr. Results showed that: VIRGO 1.1 can only be used under a constructivist perspective; empowers students in their process of representing their knowledge; support students' reflective thinking; challenges learners; is a simulation of a real museum; being an authoring tool, students develop an intellectual partnership where their cognitive process is distributed.**

***Keywords*— Museum; History education; VIRGO; Cognitive tool; ICT resources**

I. Introduction

Creating a cybermuseum involves adapting all or most of the actions that are needed to create a real exhibition, or at least a temporary one in a physical museum. Therefore we need to adapt them to the characteristics of cyberspace, an artificial space developed through information technology. Through VIRGO 1.1 (VIrtual Generator and Organiser), as a tool, we want productive action to be carried out directly on line by users and through this, promote constructive learning whilst mounting a virtual exhibition.

In cybermuseology, the most innovative trend nowadays is to achieve a constructive online learning. This means to include collaborative research, an educational approach that has already shown its effectiveness in school settings [1]. On a digital format, these activities arise mainly as WebQuest or project work which aim to develop a final product [2] [3], and aimed at different audiences, diluting progressively the boundary between formal and informal learning due to the increased role that virtual museums are acquiring in lifelong learning [4] [5].

However, none of the education proposals in cybermuseology project work focused on the process of creating an exhibition taking into account all its complexity. Therefore, we believe that this proposal is a pioneer proposal on a world level considering that it makes possible, for students or users, to design a virtual exhibition in a three-dimensional digital space with displayable pieces at 360 degrees. It also includes museum tools involving actions such as: distributing objects in a display and spaces for displays, writing information for exhibition panels and notice boards, including audio-visuals, among others. In our opinion, only in this way can a user or student estimate the difficulty of mounting an exhibition and in doing so can also learn history and cultural heritage in a constructive way while preparing all mediation materials, all cognitive digital tools, and understanding what it is to create an exhibition.

II. An Overview of VIRGO 1.1

VIRGO 1.1 was designed in 2012 through the project of the ARAID Foundation, associated with educational use of Cybermuseology. It is difficult to define what type of program VIRGO is, because of its three different environments; the first one is a digital repository. Virtual repositories are used in museums on-line to organize, preserve and spread information [6]. VIRGO works with its own repository storing digital objects in 3D, catalogued with information that identifies each object (Fig. 1). The advantages with VIRGO, is that users or students can select from the main catalogue and create their own to work with [7].

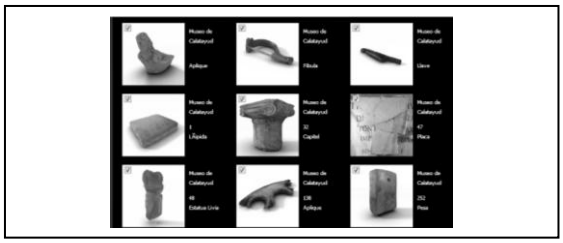

Figure 1. Example of VIRGOS's repository.

The second environment is a virtual room that works like a visualisation tool. As in [8] some of these tools can help interpret while others help to express and they are specific to a domain [8] [9]. VIRGO has been specially designed to be used in relation to history and archaeology, and helps create exhibitions, making it a useful modelling tool for musealization (Fig. 2). The exhibition room allows students to select objects just like a real museum curator would do. You can put any object on a pedestal; add information and videos [7].

This research was developed through the project: Implementation of didactic cybermuseology: creating interactive online virtual exhibitions. Fundación Aragón I + D 2010-2012.

DOI: 10.5176/2345-7163_2.1.39

Figure 2. The virtual exhibition room of VIRGO.

This second environment gives VIRGO 1.1 a more constructive perspective because it allows a high level of interaction, very much like a microworld. Once the exhibition has been built, you can see it in the third environment, where VIRGO becomes a virtual museum [10]. Here students can show their work as if it was a virtual public exhibition. Therefore, any person can go through the display just like a virtual museum, similarly to a MuseuVirtual authoring tool [11]; however VIRGO 1.1 is a VIRtual Generator and Organiser. As a result, making the exhibition becomes a learning activity which "is not limited to a visit to a museum created by a third party; rather, it consists of the actual individual or collective construction" [11]. A much more recent tool similar to VIRGO is Clark|Remix™ with uCurate

III. VIRGO 1.1 AS A CONGITIVE TOOL

Since VIRGO has the potential to allow students to build, we can describe it as a cognitive tool because it engages students in an activity that involves cognitive thinking. Cognitive tools support thinking when they are systematic, logical, formal, casual and visually structured, allowing a high percentage of constructing and investigation by the student [12] [13]. In VIRGO 1.1 this takes part in the virtual room where an exhibition can be put together. As part of a process of comprehension, with the visualisation tool of VIRGO, students have to organise and find meaning while trying to represent what they know, so that others can understand their ideas. Trying to convey their restructured mental models in a visual way requires students to think more deeply. This is more significant while building their knowledge [8].

Building knowledge may require a lot of basic skills, but cognitive tools are those ICT resources that make easier storing and retrievable information or calculating, (e.g. word processors, data bases, semantics networks) allowing students to organize information and identifying cognitive patterns so they can understand and conceptualise with them [8][13]. Therefore, like any thinking tool, VIRGO seeks to make effective the reasoning process. If students engage with such a cognitive tool, their learning can be more significant, because they construct their own mental representations, and "demanding" of students to clarify their ideas, also to deepen and reorganise their own thoughts. This involves collecting information (which can be done through the catalogue), solving problems (while creating an exhibition), while filling the gaps with knowledge or being able to explain any misunderstandings. It is a process that can generate new ideas and theories, all part of developing research skills [14].

By focusing on the activity at hand, working through VIRGO students are more easily involved in more complex cognitive operations [15], such as trying to understand the distribution of different time periods in a civilisation which may lead them to a conceptual change of time. VIRGO also allows teachers to view students' mental processes while they explain their exhibition in the Virtual museum or cybermuseum, also through the explanation of each object, mural information and videos chosen by them. This way history becomes alive to students and teachers, because the purpose is of visually connecting with that part of the brain that does not work with the language. Graphs, diagrams, maps, photos or 3D representations, carry sophisticated information, and this is where visual and spatial intelligence are on the same level as linguistic intelligence [16]. As a visual tool, VIRGO 1.1 seeks to support these intelligences through the visual channel, avoiding overloading the brain.

Consequently, history is easier to learn with visuals, such as maps, diagrams, photos archives (both digital and physical) and ancient artefacts or objects. However, in order to represent more abstract ideas such as the passage of time, students require one or more tools to visualise facts and concepts to build their knowledge. Mental tools or cognitive tools provide some aspects that are displayed visually which otherwise would be very difficult to observe [8] [9] [12], especially in history. For example, how do we know if students understood the conquest and assimilation in Roman Hispania? This could well be done through a Time Line with Roman artefacts of the Spanish peninsula in an exhibition with VIRGO.

If Spanish Roman time is taught through the traditional way, we may have students' just adding knowledge or filling missing spaces in their so called "concepts" [17], but rarely will history teachers see a conceptual change. On the other hand, cognitive tools will help students to model their ideas and expand the limits of their memory and thought process, in addition, have a visual way to present their ideas through VIRGO. Together with the possibility of visualising through VIRGO 1.1, students can also work with ancient artefacts without running the risk of damaging them, since it is also a manipulation environment.

A manipulation environment is an environment where students can work changing parameters or virtual objects. There are two kinds of manipulation environment: Dynamic systems or direct manipulation [8]. Dynamic systems are tools used in different fields. Direct manipulation environments are environments that are specifically designed for an area or a single purpose, such as VIRGO 1.1. Such manipulation environments allow knowledge to be built, thus, the world is not represented by the way the teacher sees it. Rather, these tools give students a space where they can get involved actively, interpreting their external world, whether that world is past history or the work of a curator in a museum while using

VIRGO. Consequently, the tool will reflect students' representations of their reality. Such manipulation tools help organize and represent what is known by the student [9], confirming its value as a cognitive tool.

IV. Method

We used cooperative research with a group of History teachers because it can be applied with small professional groups. Two small groups were created to take part in a virtual group discussion such as a forum. We chose cooperative research because it allows a systematic exploration of each individual's practice through a cycle of reflexions [18]. A total of 3 discussions with each group were needed after they had used VIRGO 1.1 to get familiar with it. The total time of using VIRGO and taking part in the discussion was done in 5 weeks.

Participants

Social Science teachers, the social network of the Faculty of Social Sciences called *CLIO en Red* located on *ning* (clioenred.ning.com), which is associated with the CLIO Project, were invited to participate in a discussion forum. Nine teachers accepted to take part. Since CLIO is a web page open to all Spanish speaking countries, two thirds of the participants were Spanish (6), and three came from Latin-America (Argentina, Mexico and Colombia). Participants were divided into two groups as they answered the e-mail to join, so it was done randomly.

V. Results

In the discussion, VIRGO was primary identified by the teachers as a practical educational/design resource that allows visualising. The use of VIRGO 1.1 requires very little previous knowledge, such as basic skills to surf the net and uploading images. Teachers also considered important basic understandings of museum management or musealization, such as locating objects to create a virtual exhibition.

To identify teacher's perspective, purposes and benefits of VIRGO 1.1, we analysed the discussion following some of the underlying principles of the use of computers as mindtools [9]:

1) Can be applied only within constructivist epistemology

Overall, teachers saw VIRGO as a tool for constructing since the word "create" was constantly associated to many of their suggestion of students' activities, for example: creating exhibitions which represent a group of elements from a civilisation. As a result, activities are visual and/or formal, where students can understand/visualise fundaments of past cultures and civilisation in a certain historical time. Work can also be done in a collaborative manner, so students in history have a tool that will motivate them to inquire and find information on a particular historical time, developing an interest and respect for cultural beauty and art.

Some of the activities that teachers suggested with the exhibition were:

- As a group activity, a catalogue can be created. Students then have to explain to their fellow students their criteria and the steps they took to put it together. The other students will assess the strengths and weaknesses of each catalogue.
- Students can compare similar objects from different historical times, also the way people lived in the city of Bílbilis in the past and how life is in the present form. The same can be done with remains of columns and statues in themes associated with architecture and art.
- Students can learn about the different periods, such as "before Christ", millennium, centuries. For this, they will have to separate objects from a civilisation among those that were manufactured before and after a certain period of time or periods in millenniums or centuries. This activity is made easier because each object in VIRGO has a reference; it also indicates to which century it belongs.
- In an historical discourse, students can use their exhibition as examples to write on a theme. The proposal is to "walk through" the exhibition room of the cyber museum and use it to string a talk on a given subject.
- As a complementary activity, students can understand the Roman legacy in the Spanish peninsula. The activity would involve the creation of an exhibition based on the administrative division of the Romans with bits of pottery, typical of the area, mixed with modern pieces, by each group of students.

2) Empowering learners to design their own representations of knowledge

All teachers considered that VIRGO 1.1 empowers students' learning since they can observe results from their experimentation with the tool in a direct or virtual way. Consequently there is learning by discovery which allows them a better educational experience. The empowerment rests on the fact that it is an intuitive tool which allows them to create their learning by themselves. Thus, learning to learn how "to develop materials that can serve to continue their learning independently", as one of the teachers commented. This is due to the fact that the programme is designed so students can build and access new information in an autonomous way, experiment with what they have learned, and progress in a new content, among other possibilities. This will depend on what activities teachers plan while using VIRGO.

3) Support deep reflective thinking, important for meaningful learning

According to the teachers they cannot simply allow students to get familiar with creating exhibitions, they also have to be guided to go deeper into some targeted aspect which will allow assessing key skills. As an example of this deep reflection we have the comment of one teacher: "to create catalogues they must have imagination and understanding of the different parts that, as expected, are

groups of objects. This requires assessing theoretical information and also the one provided by VIRGO, to create new working ideas. Building exhibitions allows them to appreciate other cultures and review its archaeological and technological legacies". As a result, one teacher described VIRGO as "a creative tool where students learn in a fun way taking their learning level beyond the obvious".

4) Mindtools enable mindful, challenging learning rather than the effortless learning promised but rarely realized by other instructional innovations

In the previous point teachers brought up the fact that working with VIRGO was fun, this implies that learning through VIRGO is effortless. Some teachers considered that there is some danger that students may enjoy more the creative process rather than the development of the exhibition and forget the real purpose of the activity, the content of the subject. Thus, students have to be lead to understand all of VIRGO's potentials and be conscious that it is more important the content of the activity than the exhibition itself. This is achieved when students immerse themselves in their activity; hence, teachers have to give clear and direct instructions, and the necessary time to work.

5) Tasks or problems should be situated in realistic contexts with results that are personally meaningful for learners

Teachers defined VIRGO 1.1 as a program that simulates a reality and can be used for teaching history. Students can visualise ancient objects that are real and of an everyday use, bringing the Roman world to the present. Also creating exhibitions is very much the work of curators in museums; this includes the compilation of a given collection in different periods and styles.

6) Enable intellectual partnership in the form of distributed cognitive processing

Since the learning of the time concept is one of the most difficult ones in teaching history, teachers were asked to give examples where cognitive processes could be helped by the use of VIRGO. They proposed several simple activities such as:

- A chronological "visit": going from the oldest to most recent objects, trying to understand what a chorological structure is.
- Creating an exhibition that emphasises the changes of one artefact over time.
- Producing various exhibitions where objects of different ages are exposed so that they can show the changes of times through the clothing, implements or other things.
- Working on the exhibition, structuring the pieces while following a chronological sequence
- Dividing the pieces in time; emphasising differences between the first part of the Roman settlements in Bílbilis with the Celtiberian or imperial Bílbilis.
- Splitting the exhibition into various historical stages.
- In the same exhibition, differentiating objects in stages highlighting their differences or similarities.

However, a drawback with VIRGO is its museum based design in relation to the catalogue of objects, rather than having a pedagogical perspective which may make its use in secondary school a bit more difficult, a problem which may not arise with university students. Nevertheless, some teachers considered that the musealization criteria can be ignored and used to the best of its advantages, such as the activities described previously.

VI. Conclusions

The six principles [9] that we have used to describe VIRGO allowed us to understand Social Science Teachers' perspective, purposes and benefits of the cybermuseum, VIRGO 1.1 as a cognitive tool for teaching history. These principles guaranteed that VIRGO as a cognitive tool may not be used in classroom with a behaviourist or cognitive perspective, but rather as a constructivist tool. If VIRGO is used in the wrong context, it would cease to be useful in students' mental historical processes. Consequently, teachers must be aware that it cannot be adapted to traditional instructions, but must adapt their teaching to the building of knowledge. Since VIRGO reduces time and effort which can hinder cognitive process, it is important that teachers spend a short time assessing VIRGO 1.1 so that it can be adapted to their class plan, creating their constructive class activities, making a more efficient use of it, and also using it as support resource.

Once teachers adapt their way of teaching and allow students to use VIRGO in an autonomous way, they will empower them to represent their historical knowledge and promote deep reflective thinking. Although VIRGO seems intuitive and fun to use, teachers caution that students should be made aware that the content of the activity is more important than the exhibition itself, even if they are imitating a museum work of a curator in a virtual contexts. Therefore, VIRGO is also seen as presenting a good intellectual partnership with students while distributing the cognitive process, mainly if it is used ignoring its musealization criteria with secondary students. However, with university students the tool will be easier to use. Nevertheless, we recommend that studies should be undertaken using VIRGO 1.1 with secondary and university students to observe its benefit and/or drawbacks in the classroom.

Acknowledgment

We thank the Museum of Calatayud and especially its director Dr. Manuel Martín Well, in granting us permission for this project, and permanent access to the collection.

References

[1] K. Barton and L. Levstik, Teaching history for the common good, Mahwah (New Jersey): Lawrence Erlbaum associates, publishers., 2004.

[2] D. M. Silvers and D. Hendee, «Agile games for productive teams.,» in *Museum and the web 2012*, 2012, Selected papers from an international conference. http://www.museumandtheweb.com/mw2012/papers/agile_ games _for_productive_teams_0.

[3] C. Tejera, «La cibermuseografía didáctica como contexto educativo para la enseñanza y el aprendizaje del patrimonio. Estudio de páginas web educativas de museos virtuales de arte.,» Sevilla: PhD Thesis of the University of Sevilla, 2012.

[4] M. Asencio and E. Asenjo (eds), «Lazos de luz azul. Museos y tecnologías 1, 2 y 3.0.,» Barcelona: UOC., 2011.

[5] G. Zlodi and Z. Mikloševi, «Mediated heritage learning in formal and informal contexts: Antiquity CyberEd.,» in *International Convention on Computers Education,*, Rijeka: MICRO, 2014.

[6] A. Alòs-Moner, «Repositorio digitales: un concepto, múltiples visiones,» *ThinkEPI*, vol. 4, pp. 205-210, 2010.

[7] M. P. Rivero and H. Flores, «Potencialidad didáctica del generador de exposiciones virtuales VIRGO (VIrtual Generator and Organizator),» in *Comunicación presentada para el XXIV Simposio Internacional de Didáctica de las Ciencias Sociales, "Medios de comunicación y pensameinto crítico. Nuevas formas de interacción social"*, Guadalajara, 2013.

[8] D. Jonassen, Modeling with technology, Mindtools for conceptual change, New Jersey: Pearson Prentice Hall, 2006.

[9] D. Jonassen and C. Carr, «Mindtools: Affording multiple knowledge representations for learning,» in *Comuters as cognitive tools, Vol 2, No more walls*, Mahwah, NJ, Lawrence Erlbaum Associates, 2000, pp. 165-196.

[10] H. Flores-Hole, «La investigación cooperativa como modelo de selección de recursos constructivos TIC para la enseñanza del concepto tiempo en historia.,» Zaragoza: PhD Thesis of the University of Zaragoza, ISSN 2254-7606, 2013..

[11] R. Wazlawick, M. Rosatelli, E. Ramos, W. Cybis, B. Storb, V. Schuhumacher, A. Mariani, T. Kirner, C. Kirner and L. Fagundes, «Providing More Interactivity Virtual Museums: A proporsal for a VR Authoring Tool,» *Presence*, vol. 10, nº 6, pp. 647-656, 2001.

[12] T. Guerrero and H. Flores Hole, «Teorías del aprendizaje y la instrucción en el diseño de materiales didácticos informáticos,» *EDUCERE*, vol. 13, nº 45, pp. 317-329, 2009.

[13] D. Ifenthaler and N. M. Seel, «Model-based reasoning,» *Computers & education*, vol. 64, pp. 131-142, 2013.

[14] A. Engel, C. Coll and A. Bustos, «Aprender y enseñar con tecnologías de la información y la comunicación en la educación secundaria.,» in *Desarrollo, aprendizaje y enseñanza en la Educación Secundaria*, Barcelona, Graó, 2010, pp. 105-130.

[15] A. Ertmer and T. Ottenbreit-Leftwich, «Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning.,» *Computers & Education*, vol. 64, pp. 175-182, 2013.

[16] D. Staley, «Sobre lo visual en Historia,» *Revista Digital de Historia Iberoamericana*, vol. 2, nº 1, pp. 10-28, 2009.

[17] M. Chi, «Three types of conceptual change: Belief revision, mental model transformation, and categorical shift,» in *International Handbook of Research on Conceptual Change*, Nueva York, Routledge, 2008, pp. 61-82.

[18] P. Reason, «Three approaches to participative inquiry,» in *Handbook of Qualitative Research*, Thousand Oaks, Sage, 1994, pp. 324-339.

Pilar Rivero is a lecturer in the University of Zaragoza and teaches Social Sciences. She has two PhDs, one in Ancient History (Zaragoza, 2004) and one in Teaching Social Studies and Heritage (Barcelona, 2009). She is author of over fifty publications in the social sciences. She is also the co-director of the CLIO magazine (ISSN: 1139-6237) and is part of scientific committees of relevant Spanish journals. Her main research interests include digital cultural heritage. ORCID number: 0000-0002-6757-7598.

Hazel Flores-Hole is a lecturer at the University of Los Andes in Venezuela and teaches methods of enquiry in education. She has a PhD in Education (Zaragoza, 2014). Her research interests include assessment of educational resources on the web. ORCID number: 0000-0001-8728-6766.