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Delfín Ortega-Sánchez *Editor*

Controversial Issues and Social Problems for an Integrated Disciplinary Teaching

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COPACUL: An Innovative Didactic Project on Heritage Conservation for High School Students

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Manuel García-Heras, Cristina Gil, Fernando Agua, Alejandro Pinilla, Fátima Quijada, and María Ángeles Villegas

Abstract

The present contribution discloses the didactic project called COPACUL, which is an innovative didactic experience on Heritage conservation for high school students developed within the background of a more general research project focused on the systematization of methods and protocols for integral conservation of Cultural Heritage materials and their social valorization. The project is based on the current Spanish educational law as the framework from which to build a didactic proposal with transversal competences between different areas of knowledge such as Biology and Geology, Geography and History, Physics and Chemistry, as well as Plastic, Visual and Audiovisual education, using didactic tools under the perspective of Science, Technology and Society (STS). The COPACUL project comprises either didactic sequences in classrooms or

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practical workshops complemented with visits or combining workshops and visits to museums. Project implementation will be accomplished with the collaboration of three museums and three high schools.

Keywords

Cultural Heritage · Conservation · Didactics · High school · Science · Technology · Society

Introduction. Why a Didactic Project?

The research group CERVITRUM is located at the Institute of History in Madrid within the Spanish National Research Council (CSIC). One of the main goals of the group is transmitting and spreading the knowledge generated by their research to society in general and, particularly, to educational centers. Social dissemination is a key factor for the research group since it cannot be forgotten that society is eventually what sustains research and innovation and what demands solutions and strategies for Cultural Heritage conservation.

How does the group transmit and spread the knowledge generated? Through the design and development, among other initiatives, of didactic units and other educational materials to promote the approach of science to classrooms of Primary and Secondary levels of mandatory education. From this perspective the group always faces the challenge of making either academic or social diffusion plans in every proposal, project or contribution it carries out. The research group CERVITRUM looks therefore for educational proposals on the basis of the following question: what can each of us do for society feels responsible and inheritor of its Cultural Heritage?

The present contribution discloses the didactic project called COPACUL, which is an innovative didactic experience on Heritage conservation for high school students developed within the background of the more general research project HERICARE (https://hericare20.wixsite.com/hericare). This project is focused on the systematization of methods and protocols for integral conservation of Cultural Heritage materials and their social valorization, and is being financed by the Spanish Ministry of Science and Innovation through the State Research Agency (AEI as the acronym in Spanish).

The didactic proposal arises from the social and educational need to find solutions in order to society feels responsible and inheritor of its Cultural Heritage. The review of recent literature on this subject allows the elaboration and justification of such a proposal, which aims to aware students of Mandatory Secondary Education (ESO as the acronym in Spanish) of the need to know and protect surrounding Cultural Heritage, all through a transdisciplinary approach that invites reflection. The educational proposal specifically focuses on transmission of Cultural Heritage

through a Science-Technology-Society (STS) approach in order to acquire the skills, knowledge and attitudes to understand the work of scientists in this field and show the emotional component of science to encourage positive attitudes.

It is important to do not forget that complexity of today's society requires other educational factors to be taken into account, such as the need to developed higher-order skills. Since science education is an ideal framework for this, the visible thinking approach is intended to be introduced by means of the thinking routines methodology. These routines will contribute to create a classroom atmosphere in which students will be able to learn to think and learn to learn in order to their learning be meaningful and lasts over time.

Science and technology acquire a very important role in nowadays society. Accordingly, both subjects should be part of educational processes from an early age, since science is a source of discovery that allows the individual to understand natural phenomena, as well as to comprehend the relationships between society, science and technology. Learning these concepts offers the tools and the skills necessary to imagine and build a fairer and more sustainable world [1]. In addition, scientific literacy has become a fundamental element in the whole development of students to the extent that there are studies which consider necessary to take educational measures to early promote scientific literacy [2].

It must be taken into consideration also that the society of the information and the knowledge requires teachers to transform their vision of learning. The goal should no longer be to memorize information, but to develop higher-order skills which allow the students to adapt to the changing world and to transform it. In this sense, it must be highlighted that learning is a product of thought. To answer these needs the Zero Project was developed by Harvard University, which focuses on the visible thought, whose main goal is to integrate the development of the students' thinking with the learning of the different curricular contents at any educational stage [3]. This approach allows the introduction in the classroom of strategies to acquire skills, especially those of learning to learn (and also to think) to ensure deep and permanent learning, which make leaving behind the transmission-reception model and favour constructivist models. Scientific education must be therefore accessible to everyone due to its high value in promoting autonomy, reinforcing formation of critical and committed citizens and deepening into essential intellectual competences to the new society.

Outstanding Previous Experiences

In the last few years the research group CERVITRUM has successfully developed educational materials such as didactic units and specifically a didactic unit for Childhood education and another one for Primary/Secondary education levels, that can be seen as the precedent or the basis from which the didactic project COPACUL here exposed has been developed.

The didactic unit for Childhood education (Fig. 12.1 left) was divided into five sessions and included a complete set of work documents, a notebook for teachers and an annex of images for helping teachers at all times. The practical part of the unit was implemented in an educational center at Alcalá de Henares (Madrid, Spain): the García Lorca public school (Fig. 12.1 right). The didactic unit for Primary/Secondary education (Fig. 12.2 left) was also divided into five sessions and also included a set of work documents, along with a notebook for teachers and an annex of images. In this case the practical part of the unit was more widely implemented in three educational centers located in the autonomous community

Fig. 12.1 Cover of the childhood education didactic unit (left) and practical implementation in a public school (right)

Fig. 12.2 Cover of the primary/secondary education unit (left) and practical implementation in one of the schools (right)

region of Madrid (Spain): the García Lorca (Alcalá de Henares) and the Eugenio Muro (Cadalso de los Vidrios) public schools, and the Lagomar concerted school (Valdemoro) (Fig. 12.2 right).

Both didactic units were published with their corresponding ISBN number [4, 5] and both are free download available either at the research group website (https://cervitrum.wixsite.com/cervitrum/libros-publicados) or at the Calameó website. The Childhood didactic unit at (https://es.calameo.com/read/003341477e2017e8b0ee8) and the Primary/Secondary didactic one at (https://es.calameo.com/read/003341477e94ff2b11da8). In addition, some papers derived from both didactic experiences were also published [6, 7].

The Current Spanish Educational Law as a Framework

From the different levels in which the Spanish educational system is articulated, the present didatic project is framed at the national level in the *Real Decreto 1105/2014* of December 26 [8], which establishes the basic curriculum for mandatory Secondary Education and Bachelor. It deals with the need to frame the didactic proposal within the legislative framework as far as to foster the acquisition of scientific and technological competences, the ability to learn to learn and the critical thinking are concerned.

After reviewing other different laws it was found that they may support also the main purpose of the didactic proposal. The *Ley Orgánica 8/2013 (LOMCE)* of December 9 [9] includes in Section IV of the Preamble the need to acquire transversal skills such as critical thinking from an early age, since cognitive skills, although essential, are not enough. On the other hand, the *Real Decreto 1105/2014* [8] includes in Article 2 the need for students to acquire a set of basic skills in science and technology; digital competence; learn to learn; cultural awareness and expressions and social and civic proficiencies. In addition, the promotion of learning by competencies integrated into the curricular elements is highlighted to promote a renewal in the teaching practice and in the processes of teaching and learning.

Contents, evaluation criteria and learning standards worked throughout the didactic project are framed in the *Real Decreto 126/2014* of February 28 [10] and are directly related to the area of Biology and Geology in blocks 1 "Abilities, skills and strategies. Scientific Methodology" and 7 "Research project", as well as with block 10 of the Geography and History area "The relationship between the past, the present and the future through History and Geography". It should be noted that other areas of knowledge such as Plastic, Visual and Audiovisual Education (block 1) and Physics and Chemistry (blocks 1, 2 and 3) are also transversally addressed. The methodology should be communicative, active and participatory. This is why innovative methodologies are introduced, which are based on inquiry, experimentation and the development of thought. In short and to sum up, the didactic proposal can be framed at the current Spanish legislation. It tries to go beyond the curriculum and intends to be a reference to provide a quality response to students.

Based on this framework a flexible didactic tool is proposed, which may be adapted by the teacher to either his/her educational context or the corresponding stage of his/her students. In addition, some outside the classroom agents such as scientific researchers and visits to thematic museums will be used as didactic resources. Thus, the didactic project comprises five sessions divided into a didactic sequence in the classroom of two days, practical and experimental activities in workshops and museums of another two days and a final fifth day devoted to reflection and evaluation activities. Each group of sessions will be shown in the following sections.

Didactic Sequence in the Classroom

This sequence lasts two days. The first day is divided into three phases. A previous short questionnaire of test type is made to students in the first phase to find what they know about Heritage conservation. In the phase two the teacher will present basic concepts of Cultural Heritage with the support of images. During this second phase students will be asked to provide some examples of Cultural Heritage in general and of cultural goods in particular. The teacher will show, in the final third phase, materials classification of cultural goods (e.g., organic, inorganic, and multicomponent materials) also with the support of images. In the same way, students will be asked to provide some examples.

The second day is in turn divided into two phases. In the first one the teacher will present basic concepts of preventive conservation of Cultural Heritage with the support of images and students will be likewise asked to provide some examples of preventive conservation. Finally, in the second one, the teacher will present those parameters affecting conservation, such as relative humidity, temperature, light, pollutants, and so on, also with the support of images. In this final case, students will be asked to find and photograph some examples of these parameters to show in the final activity session.

Practical and Experimental Activities in Workshops and Museums

They will be carried out in two days. An experimental workshop inside the classroom will be undertaken in the first day. It will be supervised by a teacher and/or a scientist of the research group CERVITRUM and will be based on the *Aronson puzzle* or *specialist tables* methodology [11, 12]. The classroom will be consequently divided into groups of 5–6 students. Suggested topics for workshops would be those engaged to main research lines of the group, such as conservation of ceramics, glass and stained glass windows and environmental pH optical sensors.

After the workshop, the teacher will verbally review basic concepts in the classroom.

A museum will be visited in the second day. The visit will be accomplished not only from a cultural or historical perspective but also, and especially, from a conservation perspective thanks to collaboration in the project of three very different museums, either from the nature of collections housed or location in different climatic environments, namely the Naval Museum in Madrid, the National Museum of Natural Sciences also in Madrid, and the Glass and Crystal Museum in Málaga. During the visit and individually or in groups the students will make contributions following the "I see, I thing, I wonder" routines such as those of the columns of Fig. 12.3. After the visit, the teacher will undertake a compilation of basic concepts in the way back to classroom by making an oral quiz of quick questions that students will be able to answer by freehand.

Another possibility in the making of practical and experimental activities is to join the two days into one, that is, carrying out experimental workshops inside the own museums, under a joint educational and conservation perspective. An activity of this type is highly recommended.

Through practical and experimental activities by means of workshops either inside the classroom or in the museums themselves, it is intended to promote the following ideas with the aim to highlight the importance of Cultural Heritage and how the students can get involved in its conservation:

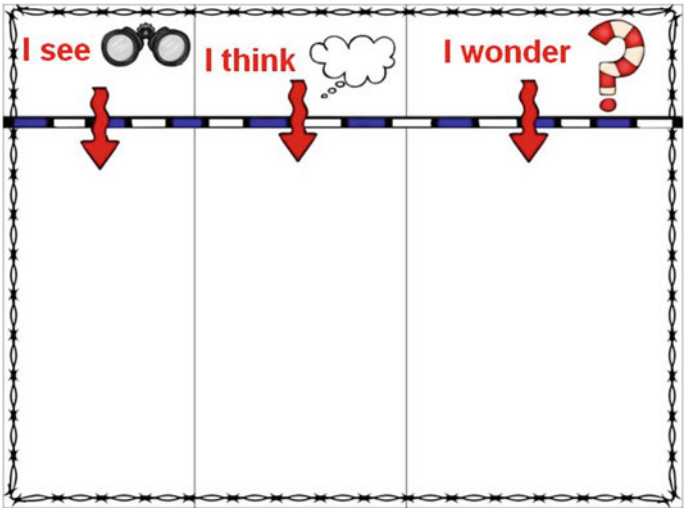

Fig. 12.3 "I see, I thing, I wonder" routines

- To value the importance of Cultural Heritage and its conservation.
- To promote respect for the use and enjoyment of Cultural Heritage.
- To know the different types of cultural goods, their constitution, their threats, and their problems of conservation.
- To make connections between the different material objects and their conservation environments.
- To develop thinking, reflection, and responsibility between students [13].

Final Activity of Reflection, Evaluation and Conclusions

After the didactic sequence in the classroom (2 days) and the practical and experimental actions (2 days more), a final fifth day will be devoted to reflection and evaluation activities. The teacher will first verbally review basic concepts and then he/she will undertake a short written test to students to assess their degree of assimilation. Reflection and evaluation will be always accomplished following routines of "Before I thought, now I think" as shown in Fig. 12.4.

Next, the students will be asked to carry out a small investigation about a cultural good located in their immediate surroundings. In the making of this investigation they should take some photographs of the cultural good chosen, look for some information on Internet and social media and ask other people for their opinion about this cultural good. They should evaluate visually also its state of conservation. Finally, the students will have to publish their results with the help of graphic materials in a physical or digital panel enabled by the education center.

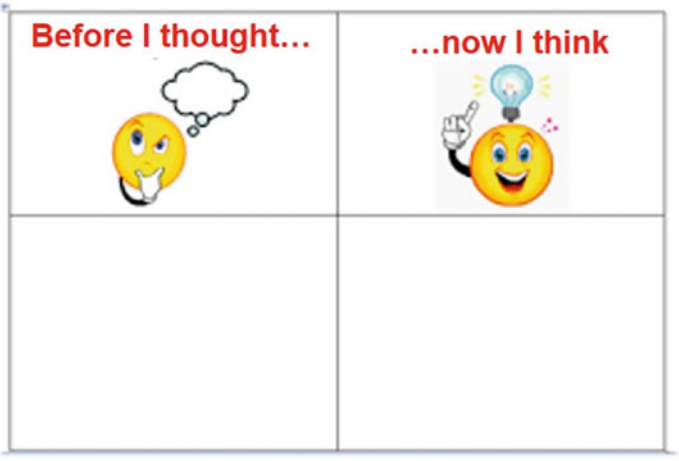

Fig. 12.4 "Before I thought, now I think" routines

The students will be evaluated through a metacognition staircase by means of the following five metacognition questions:

1. What have you done or what have you learned?
2. How have you done it or how have you learned it?
3. What difficulties have you had?
4. What has it served for you?
5. On what other occasions could you use what you have learned this way of learning?

Materials

The didactic project COPACUL will provide with the following materials for the development of all the activities mentioned:

- Previous questionaire of test type for students.
- Definitions and example images for teachers.
- Scripts for experimental workshops for the collaborating teacher/researcher.
- Scripts for museum visits for the collaborating teacher/researcher.
- Short written test to assess the degree of students assimilation.
- Quick questions for the oral quiz.
- Indicative scheme to undertake the small investigation about a cultural good.

This didactic project will be implemented in three high schools: the IES Las Lagunas (Rivas Vaciamadrid, Madrid), the Lagomar school (Valdemoro, Madrid), and the IES Vicente Espinel (Málaga). The workshops to be accomplished will take place according to these couples of institutions: (1) The IES Las Lagunas with the Naval Museum (Madrid); (2) The Lagomar school with the National Museum of Natural Sciences (Madrid); and the IES Vicente Espinel with the Glass and Crystal Museum (Málaga).

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