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USING WEBQUESTS IN INITIAL TEACHER TRAINING

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***Abstract**: This study examines how student teachers change their perceptions about the goals of scientific literacy and the nature of science thought webquest based activities. Fifteen student science teachers attending a Science Education course, after receiving training in webquest development methodology, were asked to elaborate a webquest about a secondary science education topic. Then, in the context of a seminary on scientific literacy, student teachers were required to develop a rubric to evaluate the skills that a scientifically literate person was supposed to have acquired. Subsequently student teachers used this rubric to assess their webquest and propose improvements. The initial webquest, improvements proposed and the overall process were evaluated. Results show that the elaborating/re-elaborating process induced a substantial improvement in the student teachers' conceptions about the goals of scientific literacy. Particularly, the task of building a rubric led the students to a deeper understanding of skills that scientific literacy promotes. Moreover, students expressed their satisfaction with the process and considered this highly motivating.*

Keywords: ICT, Webquest, *scientific literacy*, teachers conceptions, training initial teacher, collaborative learning

I. INTRODUCTION

The implementation of the Bologna Process in European Universities heralds a major change in education methodologies and demands rethinking the objectives and contents of the university curricula. It is necessary to adapt the curricula to the skills that students should acquire in accordance with their professional profile. The acquisition of these skills, the reduced time spent in the classroom and the consequent rise of students' independent work justify the need and importance of Information Technologies and Communication (ICT) in the development of new university degrees. ICTs on their own, however, do not involve a change in the teaching, learning or evaluation methodologies. It is necessary to investigate what the contributions of ICT are to teaching and learning processes. In this context, the evaluation becomes a key factor to guide learning and to engage the students in their own learning processes (Boud y Falchikov, 2007).

In this paper we present the first results of research undertaken at the University of León (Spain) based on the methodology of Problem-Based Learning (PBL). In this research, we use WebQuests (WQ) as a collaborative activity for the design and development of didactic sequences. Specifically, we describe the experience of training-action in a group of experimental science student teachers enrolled in a master's degree in secondary school education. In training sessions, prospective teachers worked on preparing teaching sessions in WQ format. Once made, the WQs were used as an initial assessment tool to identify students' previous ideas on scientific literacy. Bearing this in mind, a seminar was carried out in order to allow the students to reflect on the aims of science education. Finally, they rebuilt their WQ according to their teaching proposals. This study concerns two lines of research, nominally: methodological strategies based on blended learning (PBL and WQ) and teachers' perceptions of scientific literacy.

II. THEORETICAL FRAMEWORK

WebQuest (WQ) was created by Dodge in 1995. It is an important PBL teaching tool that has been utilised in collaborative research exploring the possibilities of ICT. A Webquest can be defined as a research activity aimed to solve a problem task or to perform a collaborative project in small workgroups. To solve the task, it is necessary to search and analyze information obtained from predefined internet resources.

According to Erdogan (2008), WQ is a project based approach to teaching and learning that are supported by a variety of theories, such as: constructivist philosophy, critical and creative thinking, situated learning environments and cooperative learning. Research shows that WQs can promote students' attitudes, motivation and critical thinking. It is also believed to contribute to the development of students' collaborative learning skills.

The formal structure of the WQ responds to a series of defined steps: introduction, task, resource, process, evaluation and conclusions. Between them, three components are essential: tasks, resources and assessment. The tasks are organized in a detailed sequence of activities that students have to carry out. These activities can be performed in different formats making use of internet resources. They can also be used to achieve a wide variety of purposes, including: facilitating the acquisition of meaningful knowledge, encouraging students to inquiry, promoting creativity and decision making, and developing analytical skills (see Dodge, 2004 for a detailed description of these tasks).

The resources are associated with the tasks and usually provide a list of websites that the teacher has prepared in order to guide students' work. The aim is to focus attention on relevant resources.

Assessment rubrics are typically used for evaluation. A Rubric is an evaluation tool that describes and grades the knowledge skills that students are expected to have reached at the end of the work or project. The rubrics usually describe different levels of performance for each evaluation criteria and are expressed in qualitative rating scales (excellent, good, needs improvement, poor) or numeric scales.

WebQuests have been widely used in non-university levels of education, initially in America and subsequently world-wide. Their use in the university context is more recent. Some authors (Wang & Hannafin 2008, Erdogan 2008) consider that they are appropriate for use in the field of teacher education in order to develop technology integration skills analogous to those used in schools. In this work we will explore the possibilities of use WQ to teach scientific literacy to student science teachers.

Scientific literacy is generally considered one of the most important goals of science education for all teachers (Celik & Bayrakçeken, 2006). Numerous studies, however, show that student science teachers hold inadequate, inconsistent or erroneous conceptions about both the nature of science (NOS) and the aims of science education (Lederman 1992; Abd-El-Khalick & Lederman 2000; Niaz, 2008; Osborne et al. 2003; Fernández et al. 2002). Therefore, researchers agree that improving the science teachers' conceptions about these topics is an essential aim for science teacher training courses. However achieving positive outcomes in this domain is very difficult because the students' ideas on these subjects are strongly entrenched in their thinking systems. They have generally developed their ideas in a subliminal way during their scientific careers and have not had opportunities to make them explicit or to contrast them with those that are generally accepted. For this reason the researchers believe that any effective teaching of these subjects should offer students the opportunity to first elucidate and then to question their ideas and conceptions. Therefore, it is suggested using active methodologies and tools that allow the students to challenge their points of view. Among the set of instruments available, we selected the WQ because we believe can be a tool that adapts to the characteristics of our scenario and objectives described above.

III. THE STUDY

3.1. Purpose

The aim of this study was to explore the possibilities offered by WebQuests in order to improve the student secondary school teacher's conceptions on scientific literacy. Specifically our interest were focused on determining what aspects of scientific literacy can be easily included on webquests and what others require additional resources that are not accessible on the web.

3.2. Participants

The study was conducted in 15 pre-service teachers enrolled in two courses "Teaching innovation and introduction to educational research" and "Introduction to the study of natural sciences" as part of a master's degree program to train secondary school teachers at the University of Leon (Spain). All students were science graduates. They all had training in science, but not in science education. They also lacked specific training in philosophy, history and sociology of science. They neither had training in innovative methodologies or the use of ICT in education.

3.3. Procedures

The work was carried out in 3 phases. Firstly students received theoretical and practical training on innovative strategies and methodological PBL teaching tools. Specifically WQ implementation was studied following the guidance provided by Dodge (2001, 2002 and 2007) and Temprano (2007a and 2007b). After receiving basic training on developing WebQuests, students were asked to select a scientific topic belonging to the Spanish curriculum of Secondary Education and developed it in the form of WebQuest. They received no indication on the approach to be given to the WQ. This ensured that the teacher students focused their WQs towards the goals that they considered primordial in accordance with their underlying ideas about why to teach science and what "ideas-about-science" should be taught. The selected topic was: volcanoes.

The second phase consisted on a seminar oriented to the introduction of the basis of scientific literacy. The key question of the seminar was: Why teach science? In a class forum, the students, on the basis of the papers selected by the teacher (AAAS, 2009; Hodson, 2008; Norris & Philips, 2003; Celik & Bayrakçeken, 2006), discussed the knowledge and skills to be expected of a scientifically literate person and constructed a rubric (table 1) to evaluate whether the WebQuest initially proposed could contribute to the promotion of each of those skills. Finally, the students modified their WebQuest in order to promote the skills that had not been considered in their initial WQ and evaluate the new proposals using the same rubric.

In the third phase, the students participated in focus groups to comment on their experience relating to WebQuest use. Finally in order to evaluate the whole process, participants were asked to complete a brief questionnaire (figure 1) consisting of a six item scale ranging from strongly disagree to strongly agree (Strongly disagree=1, strongly agree =4).

Table I. Evaluation rubric of scientific literacy skills

	(1) Beginning	(2) Developing	(3)Accomplished
Sl1. Understand of fundamental ideas, principles and theories	Simple recall of scientific ideas, principles and theories	Applies ideas, principles and theories only in school contexts	Applies ideas, principles and theories to understand the real world
Sl2. Knowledge about how scientific knowledge is generated and validated	Considers scientific method as a hierarchical sequence. Observation$\rightarrow$ experiment$\rightarrow$theory	Considers that scientific knowledge is tentative. Observation and theory are mutually influenced.	Understands the sociocultural circumstances surrounding the scientific knowledge.

Sl3. Use of scientific language	Ability to read and write basic texts.	Ability to read and write scientific divulgation texts.	Ability to transfer conceptual understanding and accurately interpret and evaluate scientifics texts
Sl4. Capacity to interpret scientific data	Understand basic tables, charts and graphs.	Understand tables, charts, graphs and symbolic equations.	Understand tables, charts, graphs, symbolic equations and appropriate statistics.
Sl5. Capacity to evaluate scientific argument	Ability to distinguish between opinion and facts	Ability to identify arguments on which claims are inconsistent with evidence	Ability to make explicit the key assumptions in an argument
Sl6. Appreciation of the complexity of inter-relationships among, science technology and society	Understands the differences between science and technology Appreciation the relationship as lineal	Knowledge of some paradigmatic historic cases showing complex relationship	Ability to foresee how the new scientific knowledge and technology will influence our future society
Sl7. The use of processes of science to solve problems and making decisions	Ability to solve problems only in a school context	Ability to solve problems of everyday life	Ability to solve problems and make decisions of everyday life
Sl8. Capacity to address moral-ethical issues associated with scientific research	Identifies the scientific dimensions of controversial issues	Integrates the scientific dimension in his personal value structure	Holds a personal view of controversial issues that have a science dimension

IV. RESULTS AND DISCUSSION

The WQs developed by the students before attending the seminar on scientific literacy allow us to analyze what were their underlying ideas about the goals of science education. As we can see in table II, these initial WQs, in general, were focused almost exclusively on receiving/transmitting scientific ideas, principles and theories such as the plate tectonics theory and parts of a volcanoes etc. However other important aspects of scientific literacy, such as those related with the nature of science, ethical issues, the interrelationships of science and society or using science in everyday problem solving, were not considered. To these science graduates to know science had more to do with recall concepts than with to use, value or construct it.

The seminar on scientific literacy proved to be effective. After the seminar, students were able to identify the major goals of the science education. The process of developing rubics compelled the students to form a deeper understanding of skills that scientific literacy promotes. Table II show how student and teacher valuate the initial (WBI) and final (WBII) WebQuest proposed. It is seen that the strengths and weaknesses identified by the students agree substantially with those identified by the teacher. Moreover, the proposed amendments to improve the weaknesses were relevant. Only item Sl2 was scored differently by students and teacher. This result is certainly remarkable. The teachers appreciate that the new WQs proposed did not contemplate many of the "ideas-about-science" that should be taught, according to the experts (Celik & Bayrakçeken, 2006; Osborne et al. 2003). They specifically lacked consideration of the tentative, subjective, creative, unified, and cultural and socially embedded aspects of the scientific knowledge. It would be necessary to determine whether these gaps result from student's misconceptions about the nature of science or because there are no web links appropriate to address these issues through webquest.

Table II

PROMOTION OF SCIENTIFIC LITERACY SKILLS BY THE WEBQUETS	**Students Means score**		**Teachers Means score**	
	WQI	WQ2	WQI	WQ2
Sl. 1 Understands of fundamental ideas, principles and theories	3.5	4	3.5	3.5
Sl. 2 Knowledge about how scientific knowledge is generated and validated.	1.2	1.8	1	2
Sl. 3Using the scientific language Sl .4 Capacity to read and interpreter scientific data	1.8	2.4	1.2	4
Sl .5 Capacity to evaluate scientific arguments	1.2	2.4	1.2	1.8
Sl. 6 Appreciation of the complexity of inter-relationships among science, technology, society and environment	2.4	2.4	1.2	1.8
Sl. 7 Use of processes of science to solve problems and making decisions.	1.8	1.8	1.2	1.8
Sl. 8 Capacity and willingness to address moral-ethical issues associated with scientific research.	1.2	1.8	0.6	1.8

The results of the autoevaluation questionnaire are shown in figure 1. As can be seen from the figure, participants indicate a high level of satisfaction with the training course; most of them consider themselves to have achieved a high capacity to develop WQ; and they are highly motivated to use the WQ in their future professional activity.

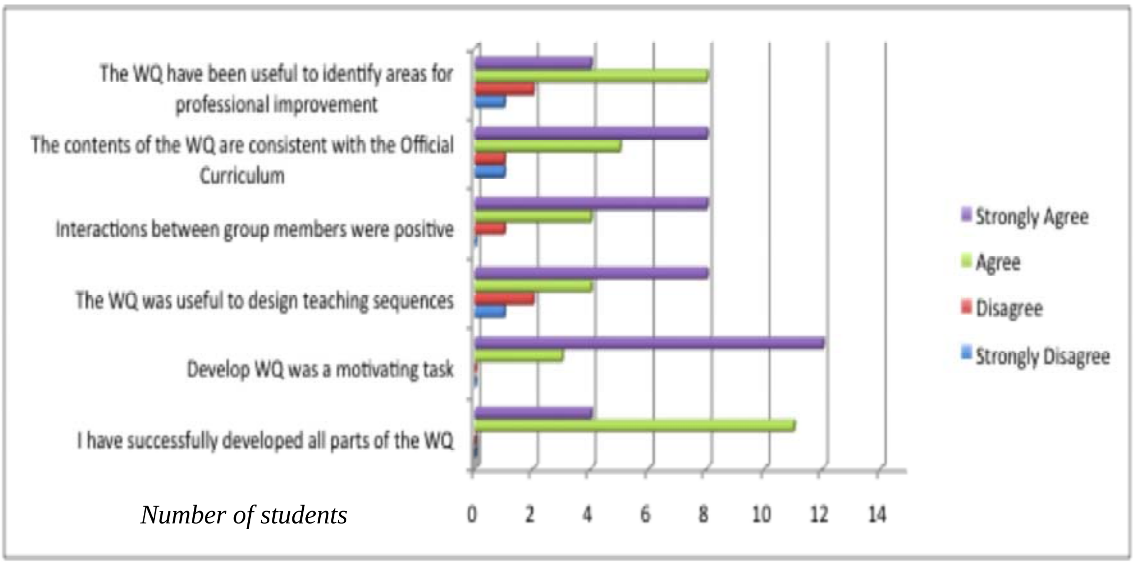

Figure 1. Autoevaluation Questionary Results

The main advantages that students commented on about the use of WQ are its potential to organize information and facilitate the work to students, clearly defining what to do and the way they have to do; and its potential as a resource for motivating students to learn. The disadvantages noted were of a technical level, for example problems trying to connect to the network, links which do not work properly and inadequate computer equipment. The greatest problem experienced, however, was the difficulty of finding appropriate Spanish-language web resources for their teaching objectives. Students teachers felt that the WQs were useful to detect their training needs. When redoing their WQ, they became aware of the difficulties in sequencing the contents and the lack of coherence between objectives, contents, tasks and assessment tools.

V. CONCLUSION

This innovative educational experience showed that the preparation and review of WQ served not only to incorporate ICT into the field of science teacher training, but also had positive effects on students' motivation, attitudes, and achievements. The process of creating rubrics showed to be especially effective because it demanded students to deepen their understanding about the skills that should be promoted by the science education.

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