Case Study: The use of Wikis as a Teaching-Learning Tool in Science Subjects

Ascensión Hernández Encinas, Cristina Prieto Calvo, Araceli Queiruga Dios,
Concepción Rodríguez Puebla, University of Salamanca, Spain.

Abstract
In recent years the university education programs established initiatives moved away from a teaching-as-instruction system towards a student-center system. This reform is focused on what the students need to learn and led us to modify the usual teaching tools to get advantages from the technologies. Some professors at the University of Salamanca (Spain) from different science departments and diverse subjects have shared teaching experiences together to develop methodologies, and resources for improving our teaching activities. The Wiki resource has been one of the experiences developed. Here we present results about the effectively of this activity in different matters of Physics, Climate, Mathematics, and Cryptography in Bachelor's Degrees as Biotechnology, Agrifood Engineering, Industrial Engineering, Computer Engineering in Information Technologies, and Physics. Furthermore, we show details on the assessment process by using Wikis, and provide comparisons of the methodology applied to different courses.

One of the objectives regarding the Wikis is to approach research in the learning process and engage students in scientific debate of publications in journals and books. A first evaluation of the Wiki indicates that it is an effective teaching support for discussion group work, group presentations, and to encourage in science learning.

Keywords: cooperative learning, wiki, skills and competences, Moodle

Introduction

The educational potential of collaborative work has been widely recognized in recent years and included at university levels with the new Bachelor's Degrees. Many tools have been developed to achieve overall objectives. At the same time, generic skills like constructive criticism, dissemination of the results, students' autonomous workload, information-seeking, and sharing of knowledge with other students, are achieved.

One of the skills included in the degrees course specifications is the group work. In qualified jobs several tasks have increased difficulty making their individual resolution impossible. It is for this reason that companies claim, now more than ever, the transversal competence: teamwork. Among the utilities needed to work in groups, Wikis allow coordinated action by sharing knowledge and files within the group (Adell, 2007). A Wiki is a software tool for communication, cooperation, and collaboration. Using Wiki resource, web pages are created collaboratively (González Pareja, 2007). With the use of Wikis we tried to involve students in their learning processes, giving them a chance to develop ideas and disseminate them to their classmates. Wikis also keep a history of changes and record the one who made the change, which facilitates the assessment of individual tasks.

During the last years, the participants of this project have been incorporating innovation activities and collaborative work in the field of science subjects. The massive use of mobile devices that allow easily access to the Internet has encouraged us to include Wikis as tools for group work. It is proven that students find very useful the use of technology in their learning process (Cengiz & Demirtas, 2005; Ramanaua, 2009), particularly this ICT-based tool has an enormous potential for collaborative work (González Pareja, 2006). We believe that these activities will enable cooperation in larger groups, incorporating a richer dynamic views and the development of more comprehensive documents.

This paper is organized as follows: in Section 2, we will describe the Wikis as collaborative and cooperative tools. In Section 3, the methodology use during Wikis development will be detailed. Finally, in Section 4, we will show some conclusions and results.

The Wiki as a collaborative and cooperative tool

As was suggested by Thousand et al. (2002), three ways of interaction between students can be considered: the competition to see who is "best", the individual work ignoring other students, and the cooperative work as part of a group.

Teamwork is of great importance in the European Higher Education System as a methodology that facilitates the acquisition of skills through active and participative work. Some degree curricula have been designed around learning outcomes rather than content (Cole, 2009). Furthermore teamwork is currently one of the most valued skills in professional environments.

Students use to consider each subject separately, they do not usually see the relation between mathematics modules and mechanics, or between physics contents and electrical installations. In order to effectively verify the integration of different subjects, we propose some collaborative activities in which communicating tools play an important role. Wikis allow the acquisition of generic and transversal skills of organization in a collaborative work. Students need to manage large amount of data, the great majority comes from the Internet, so they should select, analyze, process, interpreting, and structure the information they will need.

Activities that combine ICT and new teaching methodologies facilitate learning and allow the development of organizational skills, decision making, teamwork and application of knowledge in practice (Ramanau and Geng, 2009). Also, they represent a considerable improvement in the student motivation.

Wikis can be used in learning as an information resource, a collaboration tool (Parker and Chao, 2007), or a tool for building e-learning contents (see some characteristics included in Figure 1).
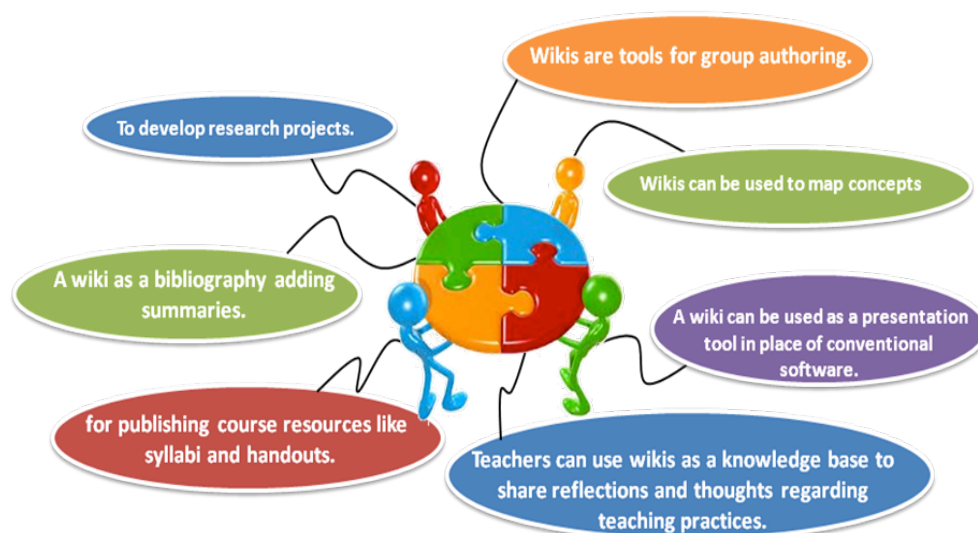

Figure 1: Some different uses of Wikis

Methodology

Although there are many programs that allow the development of Wikis, in this work we have used the activity with the same name (Wiki) that appears in the Studium online platform (Moodle-based virtual learning environment used at the University of Salamanca). The same configuration is similar to other activities of the virtual platform, providing assistance on its operation in the system and also tutorials that could be found online (http://docs.moodle.org/).

One of the most important decisions when setting a Wiki is the possibility of collaboration between all students in the class. Another option would be to have different Wikis for different groups. The option chosen depends on the size of the course and the objectives pursued with the Wiki. We have used the first option in the Physics course in Biotechnology Degree. In the case of Climate Physics and

Climatology subjects both options were combined. In the course of Cryptography in Computer Engineering in Information Technologies Degree, the whole group option was used. The goal to achieve is the development of an online document where the whole group collaborates, and in which all members have the same opportunity to make changes. The first page of the Wiki provides the starting point for successive contributions. It highlights certain concepts or links for which an extension is suggested. When users pass with the mouse over some words, these change the icon indicating the possibility that this term could become the title of a new page that will enrich the Wiki. It is possible to update the Wiki doing changes in various pages, and also to maintain an historical copy with all versions.

Since the beginning of the course, students know the weight of their contributions to the Wiki in their final mark (Ng, 2013). It was not easy to establish the quality of a contribution. We thought about the advantages of developing rubrics for assessing this type of activity. Interesting rubric for a Wiki could be the one proposed by Wever et al. (2011), which assesses four aspects: (1) the contribution (contributions are relevant with information and oriented toward the goal to achieve); (2) discussion (if students formulate opinions with arguments and they are justified); (3) sources (the student creates relevant material to the Wiki); and (4) social behavior (student work, interact, discuss, comment, and help others).

In the case of Physics course in Biotechnology Degree, Wikis are used for discussion and as an extension of scientific articles related to the curriculum (Prieto et al., 2013). Emerging issues are chosen to attract the students: Particle physics in life sciences, laser in biology or determination of the c value using a microwave. The teacher developed the first page, in which the main article with the topic under study appeared as an annex, and it established basic concepts, methods and instruments in a few lines. There is also the possibility that the student did a summary article in colloquial but proper terms. Students are instructed in the sense that every scientific paper must refer to quality sources (bibliography). As most of Moodle activities, the time that the Wiki is accessible can be established. In this case, the Wiki remains open to the student's feedback from the first time the item is considered to the end of the semester.

In the same way, the subject of Cryptography for Computer Engineering in Information Technologies used Wikis: Issues related to the history and evolution of the cryptography, of the most famous cryptosystems and its application, also some machines built to keep security in transmissions.

The objective of the different Wikis that have been developed in Climatology subject is to introduce students in climate research tasks. The work consists on analyzing climatic data. Thus, it is intended that the students check the physical processes that relate the different climatic variables. In this case, the course is divided into four groups. Each group discusses a problem and incorporates all the information in the Wiki, so it could be analyzed, compared and discussed by all students. An example of one of the Climatology topics is the study of thermal indices and global warming in relation to agricultural production and phenomenological phases. The design of the Wiki is very important to maintain uniformity in the final document. It is also important to provide adequate guidance, and a scheme to approach to participation is the most interesting aspects of the syllabus. Figure 2 shows a presentation from one of these groups from Climatology course.

Figure 2: Presentation of the group work during class time.

Conclusions and results

When evaluating the results of the proposed activity, we found aspects that highlight the potential of Wikis as a tool that facilitates the collaboration. We also found areas where improvements were needed.

The participation of students in the subjects of Climatology & Cryptography was majority; however, it was around 50% in Biotechnology. One explanation for these differences is the different methodologies used by different teachers, and the purpose behind the Wiki (its goal inside the whole subject).

We believe that some Moodle technical aspects of the Wiki activity need to be improve to facilitate collaboration and presentation of work. For example, in many cases difficulties were related to the tool itself, since the system did not allow the addition of new pages and they should be included as annexes. It seems that the problem is related to the browser. Anyway, it was a limitation. There were also problems to include images, which generated non-attractive documents. We hope that these technical problems will be solved with new versions of Moodle.

The collaboration of students often limited to make contributions that expand the information on the main page. Therefore, the new page is not linked to the old pages. At this point a proactive activity by the teacher was fundamental.

Regarding the most commonly used source of documentation that students used, it was Wikipedia. Unfortunately, students do not dare to correct contributions made by their peers. This Wiki's potential for constructive criticism was missed. The reason is probably the lack of critical spirit or the lack of a common idea about the final result.
The results of the use of Wikis in the subjects of Climatology are quite preliminary because the experience takes place in the semester in progress, but we hope the effectiveness of the methodology because students are motivated to develop tasks to build Wikis.

The results of the Wikis experience could be compared with the results on the use of discussion forums. Certainly, these are more dynamic in terms of specific contributions, but the general result is not a unique document, but rather brainstorms on various topics. Perhaps they could be seen as complementary activities:

establishing a forum discussion on the characteristics of the document that the group wants to develop and finally Wiki document that reflects the results.

Our preliminary results on the use of Wikis have demonstrated the potential of the tool for the development of a joint document that involves more students and includes diverse viewpoints. This activity develops transversal competences, like innovation and collaboration among students. We have noticed that to ensure the achievement of the final goals it is necessary that teachers follow-up the progress of the Wiki, also having a dynamic role in the activity. It would be desirable to combine the Wiki with a forum for discussion of the objectives pursued. We also believe that we should develop assessment items as rubrics to assess the results of this activity.

So, to summarize the conclusions:
- A Wiki helps to develop the creativity, the engagement, the interpersonal and communication skills. Moreover, a Wiki also improves writing, and builds connections between old and new knowledge.
- Wikis are a gateway for students to acquire and build knowledge.
- It allows students to take ownership and builds trust between all members involved in the Wiki (Schweder & Wissick, 2009). It is an exceptional collaboration tool.
- Wikis also create an environment where students are responsible for their own learning.
- Wikis prepare students for real life applications. Today's students must be prepared to work with others. A Wiki is a great way to incorporate these skills in the classroom.
- One of the advantages of Wikis is that students develop transversal skills and also specific skills.
- Students learn to work in groups and answer questions to peers. They appreciate the efforts of the other members of the group.
- Being critical of other groups. Improved capacity for reflection and analysis, and improve their learning ability.

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