E-learning for improving soil use and management in Andalusia, Spain

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Abstract
E-learning offers interesting features to complement traditional training and technology transfer in the agri-food sector of Andalusia, Spain. The severe erosion risk in a large proportion of the territory makes it necessary for farmers to protect the local soil resources and to familiarize them with alternative soil management strategies. In order to achieve this, the *Instituto de Investigación y Formación Agraria y Pesquera* (IFAPA) set up a specific training program and developed the on-line course *Soil Use and Management*. The course content responds to criteria of usability, accessibility and SCORM, and relies heavily on the use of ICT, making it possible to include interactive tools that increase the user's motivation, promote more active attitudes during the learning process, and make it possible to adapt the course content to the particular needs of each user. The course was designed based on motivational resources, accompanying most of the studied processes, concepts or practical case-studies with visual impact resources and interactive tools. The inclusion of specific indicators allows the evaluation of the on-line learning process and suggests, after two editions, that 98% of the students have achieved the goals set at the beginning of the course.

Key Words
Soil use and management training, e-learning, information and communication technology, interactive tools, motivational resources.

Introduction

Thirty-five percent of the territory of Andalusia, about 3 Mha, is affected by severe erosion. Locally, as occurs in the eastern part of Andalusia, this proportion can increase up to 70%. Especially woody crops are affected, in particular, olive groves of which 59% of the dedicated area is situated on slopes between 5 and 20% and 24.5% on slopes of more than 20% (Gómez and Fereres 2004). As a result, the *Instituto de Investigación y Formación Agraria y Pesquera* (IFAPA), which has among its competences technology transfer and training in the agro-food sector in Andalusia, has started a series of activities aimed at improving agricultural soil management practices in order to achieve a more sustainable use of the soil resources in the region. Within this context and based on previous experiences, such as the design of on-line training tools on irrigation, pesticides and animal welfare, an on-line course on soil management has been developed in order to increase the awareness of farmers with respect to adequate soil management practices, by providing practical information and assessment tools to help them with the implementation of soil conservation strategies at their own farms. The aim of this paper is to provide a general overview of this new on-line course, with special attention for the technological and educational concepts and guidelines on which it is based.

E-learning: Basic concepts and technological support

As a result of multiple regional initiatives, important progress in geographical and sociocultural equality with respect to the use of Information and Communication Technologies (ICT) has been made in Andalusia, leading to unprecedented possibilities for accessing ICT in rural and remote areas, and making E-learning a valid alternative for traditional technology transfer and training models. The main features of our E-learning model are flexible learning methods, the use of motivational resources, support and follow-up of the learning process, permanent improvement by evaluating the learning process and collaborative work.

One of the most outstanding advantages of using ICT in adult training is the possibility to use interactive tools that increase the user's motivation and promote active and participative attitudes. It is well known in adult psycho-pedagogy that these kind of tools are extremely efficient in achieving significant learning. At the same time, pedagogical efficiency of visual elements is considered superior to document reading. Among the most relevant technical criteria considered in the design of the soil use and management course are those related with usability, accessibility and the Sharable Content Object Reference Model (SCORM). Usability is an attribute of quality that indicates how easy the web interfaces can be used. A usable website can be defined as one "in which the users can find what they need, can understand what they find, and can act

properly... within the time and the effort that they consider proper to do so"(Dumas and Redish, 1999). The Web Content Accessibility Guidelines (WCAG 2.0, 2008) provide not only criteria for improving web content accessibility to disabled persons, but also to other groups such as the elderly, persons with low instruction levels and with a limited command of language or internet users with slower connections or older technology. These guidelines also reduce the complexity and facilitate access to non-frequent or new internet users. On the other hand, SCORM is a collection of standards and specifications for E-learning. SCORM also defines how a content can be packaged in a transferable file to gain interoperability between platforms.

New on-line course *Soil Use and Management*

General characteristics and objectives

In the design and development of the contents for the *Soil Use and Management* course, extensive use was made of motivational resources by offering interactive access to the materials, and accompanying most of the studied processes, concepts or practical case-studies with visual resources. The use of interactive tools made it possible to adapt the contents to the particular needs of each user. Every decision taken by the student is transformed into a personalized learning scheme, so that different needs of heterogeneous student groups can be satisfied. Starting from real-life situations and case-studies, the student´s acquired practical experience enables him/her to understand the general concepts.

The course contents were deployed in Moodle, an Open Source E-learning platform, which allows the full course management. Different web programming languages such as XHTML, CSS and Javascript were used to develop the course contents, resulting in many interactive multimedia exercises, demonstrations or samples embedded into the XHTML contents. These multimedia slices have been developed using Adobe Flash CS3.The general objectives of the course are summarized in Table 1.

Table 1. Cognoscitive, procedural and attitudinal objectives of the on-line course *Soil Use and Management.*

Cognoscitive objectives	*Procedural objectives*	*Attitudinal objectives*
• Acquire a positive attitude towards new soil management techniques • Understand the implications of soil degradation • Understand the concepts of water erosion and runoff • Understand the links between erosion and runoff, and loss of soil and water resources • Demonstrate the effect of soil management on soil quality • Learn how to use soil and crop indicators to evaluate soil quality	• Evaluate erosion risk *in situ* • Distinguish the importance of the different factors that cause erosion and runoff • Evaluate soil quality for local crops • Learn how to observe soil and crop indicators • Distinguish different degrees of soil quality as a function of the indicators	• Increase awareness with respect to soil degradation and the importance of adequate soil management to preserve soil and water resources • Consider the evaluation of soil quality as just another field operation.

Motivational resources

The most innovative and attractive contents integrated in the on-line course are the motivational resources. These elements reinforce the student's effort and participation during the learning process, carrying him/her unconsciously away, while improving his/her interest for the course contents. Graphical interfaces to execute simulations enable the users to make their own runoff and erosion calculations, compare the effect of different soil management scenarios or to evaluate soil quality for the conditions of their own fields. These tools were developed, based on published research results from SCS (1972), Renard *et al.* (1997), Gómez *et al.* (2003), Milgroom *et al.* (2005), Shepherd *et al.* (2008a,b,c), and Romero *et al.* (2007). Screen shots of the erosion and runoff simulation tools are shown in Figure 1. Other tools show how to execute simple field experiments to measure soil parameters (*e.g.* infiltration rate or aggregate stability) which are used in decision making (Figure 2), while image galleries help to achieve attitudinal objectives by increasing the awareness on the importance of soil and water conservation. Also interactive graphs (Figure 3), which enable the users to enter and represent graphically their own data, videos, and "Did you know that …?"-sections are used throughout the course. The latter stimulate the students to search for more in-depth information on certain issues, through odd observations or phenomena, causing a strong impact that generates further interest in the specific subject.

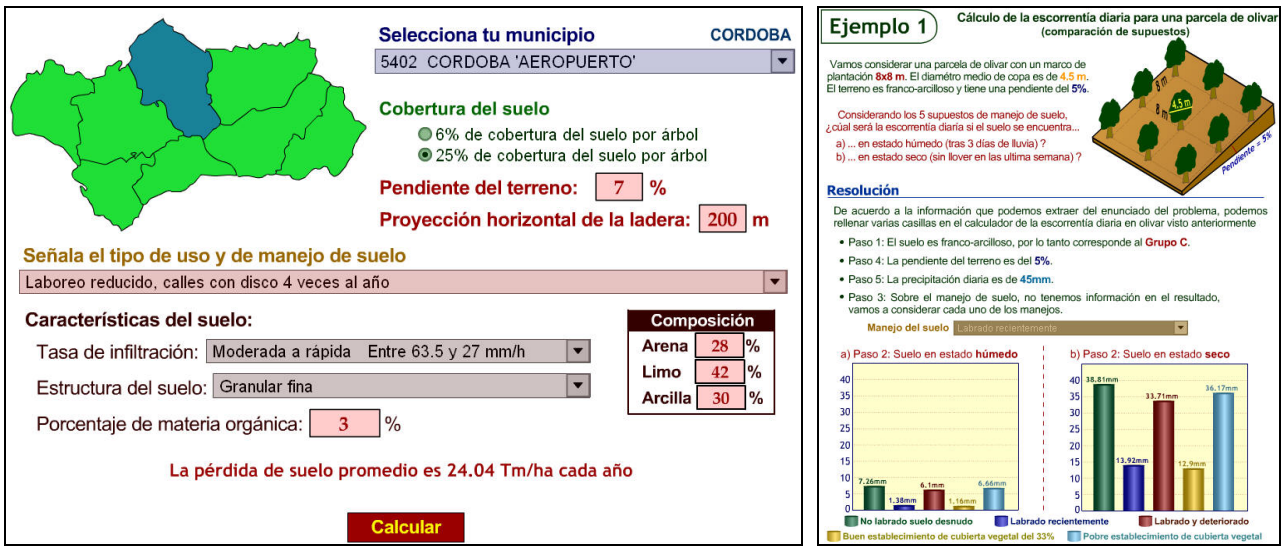

Figure 1. Screen shots of simulation tools. Data input window to calculate erosion rates (left) and results of a runoff simulation for an olive orchard comparing different soil management scenarios (right).

Figure 2. Screen shots of the required materials to execute simple field experiments. Measurement of infiltration rate (left) and aggregate stability (right).

Figure 3. Screen shots of interactive graphs for evaluating the erosion risk using field indicators (left) and for providing the soil texture class from particle-size distribution data.

Conclusion

Until now, two editions of *Soil Use and Management* course took place, with participants with training levels ranging from primary to graduate education, more or less related with agriculture. The new Internet-based training method offers an individualized follow-up of the students and takes into account the heterogeneous

education levels and professional profiles far more efficiently than a traditional classroom environment. At the same time, the design of the course materials allows the student to choose freely and interact with the content, contributing to the generation of a personalized information scheme in each case. Besides the common evaluation parameters of any training action, our evaluation takes into account some specific indicators that allow us to assess the on-line learning process. Based on evaluations, the training method is very well received with approximately 98% of students saying that they had achieved the goals set at the beginning of the course.

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