Standardization of e-learning – stage of development and importance for agriculture

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Abstract

In order to develop sustaining systems of e-learning it is necessary to have standards which facilitate an interaction of different components for the development, presentation and management of learning contents. The paper describes the present state of standardization and its application in agriculture.

Key words: e-Learning, standards, reusable learning objects

1 Introduction

Based on the high stage of the development of hardware and software, but also because of the almost unlimited availability of wide area networks today, there are forms of learning with multimedia support which are summarized in the term of e-learning. The necessity of the multimedia support is extremely important when the learning content is highly complex and therefore animation and simulation could help to understand it much better and faster. This complexity is often to be found in the area of agriculture and that is why the development of e-learning modules is quite important there.

The development of e-learning contents is often unexpectedly time-consuming (Brugger, 2001; Nordmedia, 2005). In order to guarantee the possibility to reuse learning objects and to make it easy to update and maintain them it is unavoidable to orientate on standards. Standardization is essential for the functioning of an e-learning system. As described in section 2 of our paper, an e-learning system is a component-based software system. The interaction of the components requires a standardized data exchange.

It is our intention to show the present situation of standardization in the area of e-learning. Based on it, an evaluation and selection of software is made, especially concerning its support of standards. In this regard the consequences of the standardization in the development of the e-learning module “Information Systems in Dairy Farming” are shown.

2 Field of teaching

The motivation to convert especially this complex of informatics in agriculture into an e-learning system module is justified as regards content. Dairy farming which is characterized by a distinct organization of division of labour demands an intensive informative support of breeding, production and processing.

The present situation is marked by quite complex systems of information in the involved enterprises and by an intensive exchange of data amongst the participating partners. Another outstanding characteristic is the use of distributed data collections in highly demanding biometrical models for the decision support especially concerning the genetic evaluation.

The necessary intensive exchange of data and information is organized through permanent data relation with defined data structures (e. g. amongst enterprises and computer centres of the milk monitoring...
associations) as well as through sporadic data relation (e. g. amongst enterprises and feed laboratories) without standardized data structures.

Further typical, the complexity emphasizing characteristics of data processing in dairy farming are:

- On the separate system levels (as there are process, branch and enterprise) exists specific application systems with an intensive link to other levels.
- Apart from supporting documentary tasks there is an enormous need for decision supporting information for the enterprise’s management of husbandry, feeding and reproduction.
- Decision supporting information refers to the calculation of daily prediction for single animals concerning the system of information within an enterprise, and refers to the generation of comparable farm data and to the estimation of breeding values on a national level through a federal information system of animal production.
- The used models (mixed linear ones with partly huge dimensions) set high standards for the organization of data processing and for the evaluation of the results.
- The results of the decision supporting models are used on all system levels (agricultural enterprises, regional organizations and national organizations).

Out of these facts results a vertical classification containing the following complexes:

- equipment of hard- and software;
- data flow and data structures;
- documentation and decision supporting models.

The teaching field can be as well divided horizontally according to the organization concerning the system levels of data processing in the agriculture field (Doluschitz und Spilke, 2002 p. 26 and following):

- the level of national organizations, national organizations for the administration of the information of the animal’s pedigree;
- the level of regional organizations (e. g. breeding association);
- the level of the enterprise;
- the management level of dairy farming;
- the process controlling level including e. g. milking and feeding processes.

The structure of levels is a kind of systematization where we have to include existing intensive relations especially between neighbouring levels.

Both possibilities of classification penetrate each other and simultaneously describe the network between technical conditions and their practical use in an ideal way. Completed by an introduction and the passage describing the structure they are the classification of the teaching field and might be illustrated as a “house”. Detailed learning and teaching topics can be assigned to the points of intersections between the pillars and floors (fig. 1).

3 Components of an e-learning system

Discussing the state of standardization in the area of e-learning a clear structure of an e-learning system is really compelling. Literature does not provide us with clear helpful information concerning that structure. There are hints on functions that have to be worked out such as information procurement, presentation of learning contents, communication, production (esp. of exercises and tests), evaluation, administration, user management (Baumgartner et al., 2002; Niegemann et al., 2004), but it is impossible to draw conclusions on the structure. For this reason we suggest the following components with their determined function:
- **Learning Management System (LMS)** for the presentation of learning contents, the evaluation, the communication between teachers and learners as well as for the user management and the administration of the process of learning;

- **Authoring Tool (AT)** for transformation of learning contents into a digital form;

- **Content Management System (CMS)** for the storage of information and search for information as regards content and teaching methods.

The structure and content of our e-learning system can be seen in figure 1. The structure that we have developed makes a clear assignment of the functions possible as well as to the definition of the demands for standards to make them useful tools to support the interaction of the components. Standards have to support:

- The description of the learning objects (LO) as a presupposition for the storage and recovery in a CMS.

- The description of the LO as a presupposition for process control with the help of the LMS.

- The support of the data exchange between LOs and the LMS to facilitate a user orientated reproduction/representation of the learning process (e.g. results of tests).

We define LO as a summary of text, picture, animation, simulation etc. according to the content. The result is an independent unit which can be used with the help of corresponding documentation in different learning management systems (Baumgartner et al., 2002; Polsani, 2003).

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**Fig 1: Components of the e-learning system “Information Systems in Dairy Farming”**
4 Stage of standardization and its realization in software

4.1 Standardized interaction of the components

The present stage of standardization in the field of e-learning is a result of many years of development and it is summarized in the Sharable Content Object Reference Model (SCORM) 1.3.1 (ADL, 2004a).

The description of the LO through metadata is based on a specification of the IEEE Learning Technology Standards Committee (LTSC) (IEEE, 2002). This Learning Objects Metadata (LOM) specification fixes the way to put the description in an XML file.

This XML file includes for instance:
- general data (e.g. title, language, description);
- information about the cycle of life and the evolution (e.g. version, status);
- technical aspects (e.g. format, size, location, requirement for use);
- didactic and educational details (e.g. interactivity type, learning resource type, target group (according to age), duration of learning interactivity);
- statements about the relations to other learning objects.

Figure 2 shows a fragment of an appropriate XML file for the LO “Data Transfer”. The metadata contain general information as the title and the description of the LO as well as educational information about the type of the LO (narrative text) and the state of difficulty (medium).

The LO and the metadata are stored in a database for administration so that the LO can be accessed easily.

```xml
<general>
  <title>
    <langstring>Data Transfer</langstring>
  </title>
  <description>
    <langstring>This text describes the process of data transfer</langstring>
  </description>
</general>

<educational>
  <learningresourcetype>
    <source>
      <langstring xml:lang="x-none">LOMv1.0</langstring>
    </source>
    <value>
      <langstring xml:lang="x-none">Narrative Text</langstring>
    </value>
  </learningresourcetype>
  <difficulty>
    <source>
      <langstring xml:lang="x-none">LOMv1.0</langstring>
    </source>
    <value>
      <langstring xml:lang="x-none">medium</langstring>
    </value>
  </difficulty>
</educational>
```

Figure 2: Fragment of LO metadata
The Aviation Industry Computer Based Training Committee (AICC) has developed a CMI (Computer Managed Instruction) interface which makes it possible to check and control the process of learning. It contains a data and function model to exchange data between LO and LMS. The specification is integrated in SCORM as well (AICC, 2004; ADL, 2004b).

For a standardized exchange of learning content which normally consists of many complexes, “Content Packaging” was specified. The result of the process of packaging is a compressed file, the “Package Interchange File” (PIF). This file contains a complete e-learning module which can be transferred to an LMS. All files that belong to that module are integrated here.

Summarizing this passage we can draw the conclusion that the several efforts to make standardization possible have reached a certain stage that facilitates its practical use.

4.2 The selection of software

SCORM should be well supported by appropriate software to use it properly. There are already many SCORM conformant products of the 1.2 version, whereas the current version 2004 (1.3) is only supported by 4 LMS (http://www.adlnet.org/index.cfm?fuseaction=scormprod, on 04-04-2005). That is why we work with SCORM 1.2.

One very important innovation in the version of 2004 is the definition of navigation and sequencing. The sequence of the presentation of LOs is generated from metadata which contain the structure of the corresponding e-learning module. An e-learning module can be organized in a hierarchical or network structure. The SCORM 1.2 supports only the hierarchical structure whereas the SCORM 2004 additionally offers more flexibility with its support of network structures.

While working with SCORM 1.2 we have to implement the sequencing ourselves instead of defining it in metadata. Therefore we had to find a useful tool where conformity with SCORM was a pressing condition. Macromedia Authorware (www.macromedia.com) was the only available tool which provided a SCORM 1.2 version support in November 2003 when we had to decide on the project.

Further advantages of this product that we took into consideration are:

- provision of an editor to describe the LOs with the help of metadata as a condition for storage and accessibility,
- provision of a graphic tool to structure the content,
- support for the production and evaluation of exercises and tests,
- interaction of an LMS with the produced content in Authorware.

Authorware provides a compiled file which contains LOs and corresponding control. The disadvantages of this procedure have to be seen in the necessity of the browser plug-in and the necessity to use Authorware. At the moment this kind of the plug-in is only available for the operation systems Windows and Mac OS. Considering that those modules are used in education and further education we think that there is not any important restriction because our target group mainly uses the operation systems mentioned above.

We use an own database application as a CMS to manage the LOs which are described in XML according to SCORM. ILIAS 3 (http://www.ilias.uni-koeln.de) is used as an LMS which is available as an open source.

5 Conclusions for the elaboration of the e-learning system

Because limited resources urgently demand to pay attention to the possibilities of reusability of the LOs from the very beginning it has to be emphasized that the reasons for standardization of e-learning (mentioned above) for the area of agriculture are of special importance. Concerning this e-learning standards make an important contribution to the continual suitability of the results of our work. To investigate the stage of standardization and its implementation in software was an important preparation.
for the actual development of our e-learning system “Information systems in dairy farming”.

Out of the structure of the teaching field described, according to its content (see section 2) the needed LOs were developed so that the realization of each topic is a complex LO which co-operates with the LMS ILIAS through a CMI interface (see section 4.1). For each of those LOs a SCORM conformant dataset is generated. It is used as described in section 4.1 for the content management. Figure 1 illustrates the structure of the system with its components and the structure of the content. The topics are represented by the house in the centre of figure 1. Authorware 7 is used as an authoring tool for the production of LOs and their description with the help of metadata. Furthermore animation and simulation are used for the realization of the topics to visualize the complexity. One of the additionally used tools is Macromedia Flash. Reusability is quite important because of the high expenditure for those multimedia elements. The LOs and their metadata are transferred to the CMS which is responsible for the storage of, enquiry for and access to the LO at the time of development.

The communication between the content and LMS is organized with the help of the CMI interface which is provided by ILIAS. The CMI interface supplies information about the student and his learning progress which are stored in the LMS. In our system we record these data through tests which are evaluated in the system itself. The results are transferred to the LMS and stored in a learner’s profile. So the student can get information about his learning progress.

A striking advantage of the e-learning system is the generally applicable structure which is reusable for different contents in some other fields of informatics in agriculture. The consequent work with SCORM covers usability of the content in several LMS as well as the possibility to investigate and use LOs once again.

6 Acknowledgement

The Ministry of Education of the federal state of Saxony-Anhalt is gratefully acknowledged for funding the first and fourth author.

7 References


