The Use of Learning Systems for Environmental Informatics

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This paper intends to show the relations between software applications being developed and already used in the field of environmental informatics and the recently growing number of applications using authoring and learning systems. Doing so, interesting aspects will appear which show on the one hand the usage of GIS-applications under the didactical guidance of a learning environment and which, on the other hand, increase the quality of content in learning systems by using real world data stored and prepared by the environmental software systems.

1. Why to talk about this topic ?

The first section will focus on the intersectional aspects between learning systems and software applications in the range of environmental informatics. Main attributes for environmental science applications are complexity, interdisciplinarity the broad range of users which use the application and the importance to make a know-how-transfer between them.

On the other hand the learning systems advantages can be stated as easy integration in every days schedule, adaptability to the level of knowledge the learners have, scalability of the content in respect to the individual learning target and last but not least the aspect of sustainability by reducing travelling to seminars with physical attendance.

As a conclusion we could find learning systems ideally adapted to spread knowledge from environmental informatics to the wide range of people who need this knowledge without being an expert for the special topic and without the time and the money to study the area of interest within the traditional further education system.

2. What are the main types of software tools on the market which support the learning process ?

To give an overview which software systems can be used for an application in environmental informatics the second section shortly describes and classifies the systems available for e-learning and computer based training (CBT) purposes. Beside of

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the wide range of products which offer the opportunity to transfer the courses or lectures on-line by audio-visual means to the students more interesting for a reasonable linking to environmental software will appear

- authoring systems and
- learning environments.

The potential to link these systems to environmental information systems and/or geographic information systems in general and applications using GIS in particular is pointed out.

3. How to couple them for a practicable software solution ?

After the first two more general sections the following technical oriented part of the paper describes the possible alternatives in system architecture which exist to realize a linkage and gives some criteria for choosing the most adapted architecture in dependence on the targets of the intended application. The following alternatives are discussed in detail:

1. case 0 : no coupling
   Here we have the trivial case of completely separated modules for GIS/EIS and CBT with their own databases and the appropriate client-server-architecture. The user will have to connect them “by hand” by analyzing the outputs and results within the one module and transferring them into a reasonable starting point for a continuation of work within the other module.

2. case 1: loose coupling
   This alternative should be preferred if complex, technical autarkic GIS/EIS-application are used within the CBT-lessons. Both modules, GIS/EIS and CBT, run uncoupled. However, their results are stored in a common database. From there, modules with additional functionality read them, analyze them and generate a appropriate starting state for the following session with the other module. In the contrary to case 0 additional modules undertake the task of analyzing results and preparing the run of the simulation or the CBT-module. Within these modules the amount of intelligence which was brought into account by the interactive user in case 0 has to be modeled and implemented algorithmically.

3. Case 2: strong coupling
   Two possible situations can be distinguished in this case:
   - Integration of CBT within GIS/EIS
   - Integration of GIS/EIS within CBT

The first possibility is quite seldom used but nevertheless quite interesting. The emphasis lies on the execution of a sequence of GIS/EIS commands in the form of a project work with a certain purpose.

Executing the commands the user has to bring in knowledge about the modeled system and the process of evaluating the given data. Normally he is supported by the help-system of the GIS/EIS module to accomplish this task. However, if the objective is more sophisticated the help system alone will not be able to serve with the necessary knowledge. This gap can be filled by the CBT-module. In this architecture it seems reasonable to suborder the CBT to the environmental information system because it provides help and information to execute the task within this system properly.

On the other hand there is the alternative to integrate environmental information systems within CBT. The usage of this alternative leads to a complete different objective target for the resulting IT-system. Here the GIS/EIS serves didactical reasons by giving vivid examples, illustrating complex interdependencies, or visualizing the dynamics of complex systems. The main interest lies on learning and training the knowledge given by the CBT-based lesson, the environmental information system is one medium between others (pictures, animations, …) to make the learning process interesting, ostensive and efficient.

The paper ends by the conclusion to scoop the potential which lies in the linkage of both types of software systems on the field of environmental problems for a broad range of recipients by offering the material in the internet, adapting it to the level of pre-knowledge the learner has and to concentrate on the learn target. This only will succeed if the learning process is supported by the means of didactically elaborated learning software in connection with real world data and real world problems given by a GIS-application.