This paper describes the experiences developed using a virtual environment, accessible on the Internet, @ GD Repository (www.ufpel.tche.br/ifm/@gd). It illustrates the characteristics proposed for the environment and the phase of development and experimentation of the repository. The first part of this essay describes the context of work in which this repository is inserted, giving emphasis to the purpose of its implementation. Following the description of the context, the functional and technical characteristics, which are already implemented, are described to finally report the experiments which have outlined the methodology of production and which gave context to the didactic material through the register of the learning paths.
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THE CONTEXT OF WORK IN WHICH THIS REPOSITORY IS INSERTED

digital graphics representation for architecture learning objects

The context of the @ GD is characterized by the experimentation of technologies capable of increasing the potential of teaching/learning processes in a public institution of higher education in the south of Brazil, namely the Universidade Federal de Pelotas. Most of the experiments to produce the learning objects and to use the repository are carried out in an educational environment, which involves research, post-graduation, distance learning and extracurricular activities. The main activities come from proposals from the Modela Pelotas [1], developed by the research group GEGRAI, which involves under graduation and graduation students. It is important to point out that the researchers who take part in GEGRAI are all teachers in the Digital Graphics post-graduation course. This course has the objective of offering a specialized knowledge in Digital Graphics for professionals who need to use digital images and models to increase the potential of communication and information processes. The process of didactic material production in digital format, in the context of GEGRAI, was gradually established among the researchers of the group, in this context the collaborative construction was focused on the post-graduation course. Considering the research project Modela Pelotas, the students are motivated to choose an architectural element from the city of Pelotas, Brazil, to contribute to the project’s development and at the same time the production of the didactic material. With the aim of attending to the specific needs of the academic and scientific context in the area of Digital Graphics Representation for Architecture, the virtual learning environment is being developed with the main proposal of systemizing a collaborative process of didactic material production, supported by the concept of “Learning Objects” [2]. Experiments to structure different formats of learning objects are carried out in order to acquire the highest level of granularity possible, observing the need to reuse each of the objects. A course, a unit, a topic, a problem, a technique can determine a higher or lower potential of being associated to different educational contexts or to build up new learning objects depending on the way they are structured.

THE FUNCTIONAL AND TECHNICAL CHARACTERISTICS

collaborative work space

The @ GD Repository makes it possible to catalogue, to store and to have unlimited access to this didactic material. Furthermore, it proposes that each user can become a co-author of the used didactic material, either validating it or registering a contribution to improve it. However the collaborative process has not yet been established, it has only been experimented within the context of the mentioned course.

Five main options of interaction with the system have been implemented: for the administration of the system; for the visualization of the didactic materials; for the insertion of these materials; for the exclusion and for editing these didactic materials.

The Insertion option allows the registration and storage of the learning object through filling out 20 items referring to the metadata, which attempt to describe it. These items build up a smaller group of the metadata specified by the Dublin Core (www.dublincore.org) pattern. The selection of this smaller group seeks to consider the specific characteristics of the kinds of learning objects related to the @ GD context. It is intended that the intensive use of the environment evaluate the pertinence of the metadata used, establishing a process of continuous improvement of the sys-
tem. It is important to point out that the system and the objects are not structured for interaction with distance learning platforms, for example, as occurs with learning objects generated according to the SCORM standard (Sharable Content Object Reference Model) (http://www.cinted.ufrgs.br/files/tutoriais/scorm).

The system allows four levels of access:
- User Level 1 – System Administrator: this is the highest level in which the user has total authority to manage the registered objects and the interaction possibilities of any user, including the admission of new users.
- User Level 2 – Objects Administrator: the user can manage all registered objects but he does not have permission to manage the system tools related to the users options, or include or change user level.
- User Level 3 – Collaborator Level: at this level the user can visualize all objects, download any of them and upload new objects. Changes or the exclusion of registered objects are not allowed.
- User Level 4 – Visitor Level: at this level the user can only visualize the learning objects.

The technological resources used to the development of the @ GD system are based on free software philosophy.

The web programming is constructed mainly using the language PHP and to the database connections uses MySQL. In order to manipulate the database PhpMyAdmin was used, which allowed visualization in table format, facilitating the data organization. Two data tables were structured: one related to the registered users data and another related to the learning objects and their metadata.

THE EXPERIMENTS

The @ GD environment was structured and is being evaluated in an educational context, which integrates teaching/learning activities, research activities and online extra-curricular courses directed to Architecture. The contents are delimited from the identification and systemization of knowledge structures capable to explore the computer graphics tools to support different phases of the architectural design. In this context the didactic materials are generated, in a digital format to support face to face and e-learning situations, based on autonomous learning the content is accessible to be re-used in multiple educational contexts. The research activities are concentrated on delimitation of knowledge structures and investigation related to the adequate methodologies to produce and store the learning objects. The focus of this work is directed towards the definition of an adequate methodology, describing the strategies of the @ GD Project. The strategies have to establish a framework of the didactic material stored in the repository. Using the @ GD Repository, in this experimental phase, enabled the research group to detect problems associated to the proposal of structuring the existing didactic material under the concept of learning objects, and their characteristics of granularity and usability. Considering the large amount of time used in the production of the learning objects associated to the human and technological resources necessary, the study is pointing to the attribution of high granularity for the learning objects, increasing the possibility of using these materials in many educational contexts. Thus, for each material, the possibility of breaking it up into smaller and self-sufficient contents is identified. The proposal is to optimize the storage system to avoid the use of information in a duplicated manner.
The experimentation developed before this proposal registered the occurrence of didactic materials with similar parts connected in different ways, resulting in distinct learning objects. However, the division into small and specific objects can establish a complex registration effort, especially to define a specific type of metadata: the description of relationships with other learning objects.

THE METHODOLOGY TO REGISTER THE LEARNING PATHS

In the current context, some specific learning paths are being outlined in Courses, Units of study and Activities, which associate learning objects in a particular manner in order to accomplish the defined objectives. Initially all this generated information was registered as learning objects that culminated in repeated data in the storage system. In order to avoid this problem the learning paths are being registered as another kind of metadata instead of as learning objects. This kind of metadata is structured as a “concept map”, graphically representing the relationship among groups of learning objects, which compose the mentioned learning paths. NOVAK and CANAS [3] point out that “concept maps” have the capability to explicit a cognitive structure in such a way to make evident the relations among groups of concepts from representations and links of them. These maps are associated with each one of these learning objects, allowing the addition of numerous paths, which are registered as these objects are used again. The “Cmap Tools” (IHMC - University of West Florida) are used in order to facilitate the map production. This tool allows the construction of maps by individuals or in a collaborative way. The maps are published on the Internet either for visualisation or to promote a collaborative process. Based on this open structure the maps can be freely enlarged without any rules previously established. Thus these maps are also used as an interface to the learning paths. The previously mentioned courses of Digital Graphics for Architecture are organised in a Virtual Learning Environment, based on learning paths. The learning path on figure 1 characterizes the Geometric Modelling class, offered regularly at the Digital Graphics Post-Graduation Course. The focus of the class is the methodology to produce 3D models, which defines the trajectories. These trajectories connect learning objects or even other specific trajectories, relative to each unit or topic. The trajectories are established by configured metadata pertaining to each individual object.

In the trajectory in figure 1 the learning object “cyclic symmetry”, of higher granularity, is in the context of the topic “symmetry”, which is connected to the unit “analysis methodology of geometric form and composition”. If a user of the repository accesses the object of higher granularity, through this kind of metadata, they can understand the context in which this learning object can be applied and can still experiment the use of this object in different ways, creating new learning paths.

The concept map showed in figure 2 demonstrates the learning path for studies of Symmetry used during the Geometric Modelling course for the chosen historical building located in the city centre of Pelotas.

This trajectory in figure 2 becomes metadata associated to each one of the objects that the student used to carry out the study of symmetry.
The concept map showed in figure 2 demonstrates a specific learning path used during an extracurricular activity for the Geometric Modelling of the chosen historical building. The focus of the course is the methodology to produce and publish 3D historical models on the Internet using Google Earth and SketchUp. Several objects that build up this trajectory are common to the trajectory of the post-graduation course. With the characterization of the conceptual maps as metadata there is no need to configure a learning object for each course, avoiding the repetition of data in the repository.

Fig. 3: The GPS_3D Course, an extracurricular activity.

THE RESULTS

One problem faced was related to the generation of learning objects with high granularity, which consequently increases the usability, allowing to build other objects based on combinations, to be used in different situations and in various educational contexts.

In order to generate a metadata system able to indicate the relationships among objects, demonstrating the possibilities to compound learning objects with lower granularity responding to specific learning problems, the research group introduced the use of concept maps.

It is important to point out that the use of concept maps facilitated the process to identify possibilities to break the didactic material into small contents, being established as a methodology to organize the learning objects. Moreover, the students were motivated to use concept maps to describe their own learning processes, the results have been contributing to the repository to keep a record of the learning paths. The experimentation based on the use of concept maps as an interface to visualize and access the learning objects during the courses suggested the aggregation of these maps as metadata in the @GD Repository. The use of concept maps as another type of metadata has been experimented, attempting to register the mentioned relationships, considering that these maps allow the visibility of associations among learning objects and at the same time keep a record of learning paths used on courses of Digital Graphics Representation for Architecture. Currently the proposal is to evaluate the results and to share the experience with the scientific community specific to the field of digital graphics, with the intention of expanding the users of the system.

NOTES

