**MOrFEu: Towards the Design of an Environment for Flexible Virtual Spaces Organization**

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**Abstract:** We present the development of the project MOrFEu (Multi-Flexible Organizer for Virtual Spaces). The project aims at the construction of virtual environments that facilitate flexible organization and management of virtual spaces. We want to break the limitations of the available environments that limit their users to options previously established. With MOrFEu we hope that, in a simple and intuitive way, actors can participate as authors of the ongoing processes of spatial organization and planning of interactions. The central focus of MOrFEu is to support the authoring, the interaction and cooperation.

**Keywords:** Information Technology in Education Management, Modeling, Tools for learning, Web resources, Virtual Learning Environment

**1. Introduction**

The digital environments based on Web have received a great deal of attention from part of the academic community, interested in topics related to Internet and Artificial Intelligence (AI) applied to Education (Devedžic, 2006). Nowadays, the reason is the crescent evolution of research on Semantic Web, with evidence on its great potential to solve several problems found at educational environments based on Web, like, for instance, difficulties to create and reuse information, non-intelligent search, lack of interoperability between systems and contents, among others.

During the development of Virtual Learning Environments (VLE) we have sought to provide better conditions for the practice of constructivist pedagogies. The crescent popularity of those environments occurs mainly because they offer support to the addition of tools with focus on objects of learning, without the need for programming. However, the VLEs do not offer flexibility in the sense of...
creation and customization of virtual spaces, since all their features or are dependent on their programming teams or of their developers, for any creation or adaptation.

We have followed for many years, a group of students of a graduate course, training teachers in service, where these difficulties were overrun. In line with the design of the course, which emphasizes open pedagogies, we have been using multiple virtual environments, which are not integrated, among which we mention: wikis, blogs, email, discussion lists, tools for synchronous interactions, environments for handling digital collections (youtube, slide.com etc.). The introduction to those different environments has been gradual but we have noticed the great difficulty that the subjects have to understand each new environment.

In the view of such experiences, the use and production of digital environments for the implementation of cooperative activities led to many questions, mainly the following (Menezes, 2005):

1. Is the offering of tools of communication and cooperative production putting difficulties to the emergence of new forms of work in digital environments?
2. Is the offering of tools of communication and cooperative production reducing the access only to similar communities, especially those of enthusiastic use of these environments?
3. How to advance in offering of tools to support the intellectual cooperative production so that these tools evolve in line with the maturity and the needs of the communities?

In order to answer these questions, this work presents an environment called Multi Flexible Organizer of Virtual Spaces, or MOrFEu. This paper presents the design of a new technology that seeks for breaking the strict structures of current environments. From MOrFEu, it will be possible to create new elements, strictly in accordance with the wishes of its creator, releasing him/her of the forms and limits imposed by current systems.

2. Pedagogic Architectures in Virtual Spaces

The cyberspace transforms a personal computer into a kind of collective computer, offering a space of infinite possibilities for virtual navigation (Lévy, 2000). Currently, we observe a crescent evolution in the paradigms of virtual environments, where the focus is to allow the dissemination both of information and of knowledge, through the practice of crowdsourcing.

This reality is reflected through the management of knowledge, where the knowledge is built in a context of trades, through a constant tension between the "today certainties, provisional" and "doubts" that fall on those certainties (Fagundes, 1999). In this scenario, the character of pedagogic architectures (Carvalho, 2005) is to think in learning as a process of creating novelties, of
discoveries and inventions, allowing the subjects perform simulations and experiments in search of solutions to the significant issues, according to their points of view. These architectures assume apprentices as protagonists and demanding environments that support learning in network, in learning communities.

Within these architectures, flexible virtual environments seek to promote not only protagonist but also the individual and collective authorship, offering different ways of organizing the interactions and productions, having as reference flexible "spaces of authorship". Environments with these features allow pedagogical actions, if not freed, at least away from the models targeted by the "logic" of transmissive teaching. In contrast, the imposition of reproducible logic, translated into a rigid organization of space, often hinders the establishment of open and interactive pedagogic proposals. According to Menezes (2008),

Young people and adults who did not use the computer since childhood or adolescence did not build previously that (Inhelder et al., 1992) calls "scheme known" (the central unit of the processes of urbanization of knowledge) that allows assign, so more or less immediately, meaning to situations of use of digital spaces. Though many environments seek an organization and interface similar to the physical world to facilitate their ownership by students, it is known that the properties of real and virtual objects are different and this pseudo-analogy can even cause difficulties in differentiating between the "behavior" of material objects and virtual spaces.

Therefore, to facilitate that appropriation of virtual world is made more quickly and effectively, it is important to rethink the design of these spaces and, at the same time, to offer objects more suitable to this appropriation, as well as to give support to the perception of the changes and results of the interactions with these objects.

3. MOrFEu Project

In view of the plasticity and democratization of virtual environments and the new possibilities of automation of mechanical tasks, the project seeks to the design of new environments, guided by the following: plasticity, ergonomics, reduction of labor and of cognitive overload.

One of the first steps so that MOrFEu can offer their players the possibility of continuous development of the their space is the identification of usual tools of communication, such as forums, collaborative text editor, scheduling appointments, personal diary, content assistance, bulletin board, contacts, voice recorder, conference, editor of images, letters, among others.

MOrFEu is a virtual environment on the web that provides the organization of collective virtual spaces through the concept of media of communication.
MOrFEu, a vehicle of communication is an abstraction for building cooperative, synchronous, and asynchronous of hyperdocument. Its element of authoring is the Unit for Intellectual Production (UPI), used to record users’ productions, whose basic tool is an editor for UPI. Each UPI has an author, a title and a content (body). The content may use any and every piece of digital representation supported in HTML and available in the collection of media of the environment. The structure of the body depends on the nature of the productions (or artifacts). Therefore, a library of models of artifacts is provided, linked to syntax-directed editors. At any moment a user can create or edit a UPI. Each edition of a UPI results in a new version. A version of UPI may then be later used and reused in different situations of interaction. For example, a UPI that was used to send a message to a colleague can also be used for publication in a forum.

All UPI produced by the user will be recorded and versioned by the environment, independently of the vehicles. Unlike conventional environments, where the individual productions are tied to tools (a message sent by e-mail is stored by a mail server; a message posted in a forum is part of it. If the forum is deleted, the author loses the message). In MOrFEu, all these types of messages are UPIs and, first to all, they are recorded in an aggregator of UPIs, associated with each user.

Any UPI is composed (or represented) by a Communication Vehicle (CV). Each CV has its guidelines for composition. For example, a blog is a CV where productions are organized in the form of stack, the latest is on top. Similarly, a forum is a CV where productions are organized as a tree, where a UPI "responds" to another UPI or start a new branch of publication. The concept of a communication vehicle is structured in class, specialization, and instances. For each one of the three levels is provided an editor. This hierarchy can be observed through the following example: it is possible to define a class called Newspapers, by defining some properties. It is then possible to “especialize” this class to define the newspaper New York Times. For each edition of New York Times is possible to generate an instance, for example, the New York Times, November 20th 2008. The aggregator of individual UPIs is actually a specialized class for which an instance is created during the registration of new users.

4 Initial concept modeling

In the early stages of the platforms it has been proposed the identification of the classes, the associations, the attributes, and operations of components in order to ensure semantics. We developed an initial conceptual model (Figure 1) of virtual spaces, to represent the set of concepts constructed, in such a way to highlight the links between them. This mapping was based on issues of competence identified in the collective virtual spaces, taking into account features such as interactivity, usability, representation, and connectivity. In this figure we highlight the following concepts, central in Morpheus (Table 1):
Table 1 – Central concepts in MOrFEu

<table>
<thead>
<tr>
<th>Concept</th>
<th>What is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle instance</td>
<td>Collective productions built in synchronous / assynchronous form by UPIs’ composition.</td>
</tr>
<tr>
<td>Template</td>
<td>Description of the forms of presentation of a vehicle. A vehicle may be associated with different templates to suit the particularities of different users.</td>
</tr>
<tr>
<td>Type</td>
<td>It models the different types of UPIs. For example, a UPI can be a computer program, then its type is defined by the syntax of the programming language. Ie, a type is the semantic rules of a particular language.</td>
</tr>
<tr>
<td>Category</td>
<td>Collection of keywords used to put labels on vehicles and UPIs.</td>
</tr>
<tr>
<td>UPI</td>
<td>It is used to record any users’ productions.</td>
</tr>
</tbody>
</table>

Now we are working to establish a complete ontology of MOrFEu environment. A future study will intend use Foundations Ontologies such as the UFO (Guizzardi, 2005), (Guizzardi, 2008) to allow a more precise definition of Ontology.

5 MOrFEu’s Semantic Infrastructure

The Semantic Web is the name used to introduce a new generation of technologies that aims to represent the information in a way that computers are able to interpret it. Moreover, through this representation researches in Semantic Web technologies intend to offer automation, integration and reuse of information even considering different development platforms, operating systems, network protocols, and other variations in technology (Devedžić, 2006). Today this is one of the main topics of
research communities of AI and the Internet\footnote{W3C Semantic Web Activity: http://www.w3.org/2001/sw. Last access December 15, 2008.} According to Mizoguchi et al. (2007), the Ontologies are considered the basis of Semantic Web offering a formal and expressive language to generate information that can be interpreted by computers. These Ontologies can be combined, shared, modified and used to record "semantically" different types of resources such as Web pages, documents, media (digital or not), and other resources (Jovanović et al., 2008). This way, from the intensive use of metadata, ontologies offer possibility of building a network that is capable of recognizing the significance of the documents and, using a computer processing, infer new knowledge (Berners-Lee et al., 2001).

In the educational context, the Semantic Web and ontologies have been used to solve several problems encountered in current educational environments based on Web Some problems such as the sharing and reuse of didactic material, search for content (e.g. learning objects) and management of repositories of learning objects, can be solved using and adapting the concepts of the Semantic Web. In fact, several results presented by the community of AI applied to Education show that the learning environments based on Semantic Web can provide positive results when compared to the educational environment based on current Web (De Bra et al., 2004; Devedžic, 2006; Isotani, 2008). Many of these results are available on the portal O4E - Ontologies for Education\footnote{http://o4e.iiscs.wssu.edu/xwiki. Last access November 04, 2008.}.

### 5.1 MOrFEu’s Semantic Server

Given this reality, we can think of an infrastructure based on ontological resources and components of the platforms used in the structuring of virtual spaces for the MOrFEu. Thus, a possible architecture, using Devedžic (2006), could contain the following main objectives:

- Allow the definition of the concepts involved in creating vehicles of communication (VCs);
- Facilitate the reuse of resources;
- Allow inferences on results of consultations;
- Offer the possibility of expansion of VCs for other platforms including e-Learning or Groupwares.
- Provide an efficient management of organizational memory with educational content sensitive to the context of the users.

The architecture of the semantics of MOrFEu is composed of five sub-systems, which represent the visible part of the UPI. These modules interact with the repository of ontologies and repositories of Resources and Components. The following is a detailed overview of sub-systems: This way, a Learning Project is
designed as a Virtual Space of cooperative construction, composed of the vehicles: Development Project, logbooks, Guidance Forum, and Guestbook.

a) Authoring space: In this module, each feature is seen as an aggregation of several components of content that can be classified according to their types and levels of granularity. Thus, a new feature resembles an assembly line where the author can use new content and / or reuse the existing resources and components.
b) Services. The goal is to build services using components of collaboration, learning, reference or review.
c) Versioning. In this module is handled all procedures performed during changes in UPIs.
d) Semantic search. The component "search" works with the mapping of ontologies and / or the use of rules of inference to the RDF indices provided by the Ontology Repository. The indices created in the form of an RDF file can be viewed by SPARQL, which is recommended by W3C (W3C 2008).
e) Distribution. Module that describes the rationale for the distribution of UPIs, considering the needs and profiles of users.

6. Building a Vehicle of Communication

Figure 2 is an example of modeling a communication vehicle capable of organizing a cooperative authoring site of a working group developing Learning Project, a pedagogic methodology based in constructivism (Fagundes, 1999).
each one can refer others of the same group and can receive comments through new UPIs.

7. Final Considerations

The project MOrFEu aims to establish a new paradigm for construction of virtual spaces, providing new experiences of seeking and socialization of knowledge. From the philosophical point of view we are proposing a new way of thinking the organization of virtual spaces, with center of the concerns support the organization of individual and collective production, interactions and publications. This is a strategic choice; it is here that we want to go in the coming years. While the point of view this becomes implement in bits, in transfer of bits, is important to take as the basic unit of record, process and composition which we are calling UPI, chosen to model of the atom productions. Like all choices in a poll, this is provisional and is intended to support our theoretical discussions focusing the attention of those environments in which individuals produce intellectually instead of thinking of the data handled by this or that tool.

We have empirical evidence to support this choice. Our work with many environments, in different situations, showed that the modeling tools and data were not ideal to think more flexibly about these environments. From this point of view, what is different is the choice of a way to organize contents from UPI, which may be published and republished in various vehicles.

In this context, the media of communication, independent of time (synchronous or asynchronous) result in documents, open, continuously built up to the flavor and the needs of a particular community. To view them, we think on the concept of templates that can be molded to the needs and tastes of their readers. The forms of interaction that will lead to such hyper-document also will require further deepening.

Similarly we have sought in previous research, developing a conceptual structure that supports the construction of smart environments to support activities of virtual communities, where real and synthetic agents can coexist and cooperate. In this sense we also present the design of a model for knowledge representation and processing sophisticated enough to give the birth to the desired flexibility and intelligence. MOrFEu is, therefore, the natural result of our previous experience (AmCoRA⁴, “Moonline, FAmCoRA, Timoneiro⁵).

Among the contributions, MOrFEu will provide for various interdisciplinary areas, for example, media, education and technology. It appears that the profile of the project focuses on innovative methodological fields of the most recent researches, directed at issues such as the Semantic Web, through proposals for technologies that give the "power" to computers through the creation of standards, protocols and languages that facilitate intelligent production of information.

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Although structural changes will surely occur in the project during future development, this paper describes a proposal that encourages new studies, such as:
i) development of intelligent agents to monitor actions and information retrieval, 
ii) modeling of Ontologies for supporting MOrFEu, 
iii) realization of other experiments in real situations of learning, exploring the implementation of collective actions, to identify domain specific activities that require the use of features unavailable in conventional environments, 
iv) identification of needs and design of virtual spaces to organize and manage the collective knowledge produced in cooperative activities, 
(v) identification of needs, modeling and design of vehicles to facilitate the development of environments toward articulation among users to potentiate the social networks.

References
