

# Conceptualizing Virtual Research Arena Framework: Learning Activities across Physical and Virtual Spaces

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**Abstract.** In this paper, the authors present a discussion on the Virtual Research Arena (VRA) – a framework for creating awareness of educational and research activities, promoting cross-fertilization between different environments and engaging the general public. The framework is developed to be used for educational purposes in 3D Collaborative Virtual Environments (CVEs) as well as connecting physical and virtual spaces. The goal of the paper is to consolidate the results of a number of explorative studies and form a concept of the VRA, the first realization of which was evaluated in the Virtual Campus of Norwegian University of Science and Technology in Second Life virtual world.

**Keywords:** 3D collaborative virtual environments, 3D educational content, learning communities, Second Life.

## 1 Introduction and related work

Potential and possibility of 3D Collaborative Virtual Environments (CVEs) for collaborative work with various types of content is supported by a number of studies [1, 2]. Most CVEs offer advanced content manipulation, uploading, creating and sharing 3D objects and other media, such as text, graphics, sound and video. CVEs allow creating complex interactive content and using it collaboratively for various purposes. 3D CVEs enable learning communities to leave traces of their activities that become part of the shared repertoire of the community through the process of reification [3].

In addition, the opportunity to interact in a way that conveys a sense of presence, lacking in other media [4], allows using CVEs for meetings, performances and role-playing. These opportunities result in a number of benefits for establishing and supporting learning communities and in the potential for supporting cross-cultural understanding and collaboration.

In this paper, we consolidate the results of our previous studies on the use of 3D CVEs for learning to conceptualize a Virtual Research Arena (VRA) framework. We present an overview and a context of the framework as well as a discussion on its practical use. We define the VRA as a framework for creating awareness of educational and research activities, promoting cross-fertilization between different environments and engaging the general public [5].

## 2 Virtual Research Arena: overview and context

In our previous research, we were exploring collaborative work on 3D content in a virtual campus and virtual city context. The VRA was suggested as a part of the conceptual framework 'Universcity', in which we seek to integrate different aspects of city life: culture, society, education and entertainment [6]. The 'Universcity' framework has 4 layers that correspond to the above aspects of city life and contain specific infrastructure elements or facilities. These elements of the environment are designed using the Creative Virtual Workshop (CVW) framework [6]. The CVW provides a set of principles/approaches for collaborative work on 3D content in CVEs, including its creation, sharing, reuse, presentation and exhibition.

The VRA was proposed as a social virtual environment for supplementing the Norwegian Science Fair – a festival where science projects are presented to the general public in a simple yet attractive way. As a first realization of the VRA, a virtual science fair was erected in Second Life mirroring the one in reality and presenting 8 research projects in a virtual mode (Fig. 1).



**Fig. 1.** A Virtual science fair pavilion in Second Life



**Fig. 2.** A real-life pavilion presenting the Virtual Science Fair

Furthermore, the Virtual Science Fair was presented at the fair in real life as one of the projects. The visitors in real life could come to the pavilion and immerse themselves into the virtual extension, exploring a number of projects (Fig. 2).

In addition, we were using the VRA environment for a regular practical exercise in the Cooperation Technology course. Students were asked to build visualizations representing any research project and present them at a joint session by role-playing. The data was gathered from direct observation of students' activities online, virtual artifacts, such as chat log and 3D constructions, and users' feedback provided in a form of group essays. The methodology applied proved to be effective in this particular course and promising for other areas. The students extended their understanding of cooperation and received some practical experience in cooperating with others using different technologies, their advantages and limitations.

The study demonstrated a wide range of possible topics that can be visualized and presentation methods. In addition, the results of the study helped us to develop an experimental typology of the 3D content and visualization means in 3D CVEs.

### 3 Discussion and future work

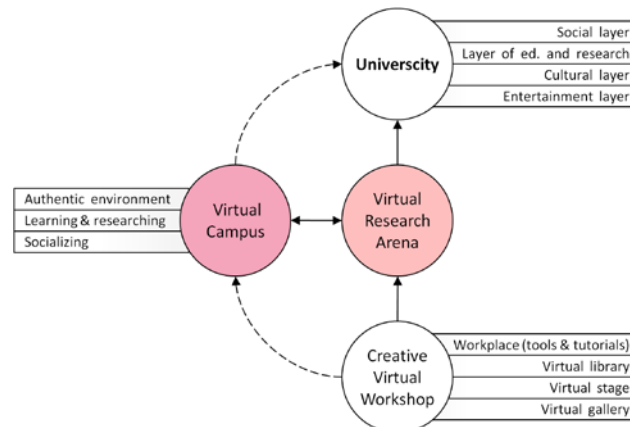
The results of the work presented contribute to 3 main areas that are connected by the VRA: first, collaborative work on 3D *content*; second, *services* contained in a virtual campus; and third, *community* represented by virtual city. In the following, we attempt to form a concept of the VRA out of our observations, results of studies conducted and feedbacks.

*Content level:* On the content level the VRA introduces basic methods for facilitating 3D construction process and elaborating on 3D content. These methods are based on the typology of the 3D content and visualization means, which provides a classification of content types in 3D CVEs (text, multimedia and 3D objects) and their appropriateness for different purposes. The typology also provides a specification of the visualization means in 3D CVEs, which includes three major aspects of the presentation form of the content (aesthetics, functionality and expressed meaning) and their roles.

*Service level:* The Virtual Campus with a number of reconstructed buildings provides an appealing atmosphere and contains community places, tools and facilities for seminars, meetings and discussions. These tools and features that provide this support within the VRA are designed based on the principal ideas of the CVW (Fig. 3) and include a *virtual workplace* equipped with tutorials and tools, providing assistance for control and navigation, communication and work with content. The workplace is linked to a library with ready-to-use 3D objects, textures, scripts and other resources. A *virtual stage* provides support for sharing and presenting content and is equipped with corresponding facilities, such as a slide-show screen and a place for presenting 3D constructions. The stage is surrounded by a *virtual gallery* where constructions are stored and exhibited.

*Community level:* In the 'Universcity' framework, the Virtual Research Arena and the Virtual Campus are infrastructure elements, which represent the layer of education and research and are connected to each other (Fig. 3). This layer is considered for supporting educational/research activities and networks. Following the 'Universcity' strategy of integrating different aspects of community life, the VRA is linked to the three other layers (cultural, social and entertainment) by attracting international visitors and tourists, connecting research environment and the general public, creating awareness of the local and international research and entertaining the visitors.

By means of the VRA, it is possible to support ties between different communities such as students and teachers, external experts and the general public. In addition, we provide initial boundary objects and introduce shared artefacts around which the interaction and collaboration are structured. Based on the CVW framework, we are developing a virtual gallery that will serve as a *community repository* [7], exhibiting 3D constructions.



**Fig. 3.** Virtual Research Arena context

Conceptualization of the VRA raised a number of challenges, such as complexity of assessing and evaluating collaborative work on 3D content, sophistication and ambiguity of 3D visualizations, difficulty of establishing communities in 3D CVEs, possibilities of connecting physical and virtual spaces and events.

The future work will contain further development and evaluation of the VRA framework. We plan to use it in a new project for creativity support in educational settings involving students from different European countries during 2011-2012.

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