

# Place Metaphors in Educational Cyberworlds: a Virtual Campus Case Study

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## Abstract

*In the recent years, the usage of 3D cyberworlds for educational purposes has increased. The metaphors behind the design of virtual places are quite diverse, from replication of real universities to art museums and scientific labs. Based on the results of a case study we have performed, this paper provides an initial set of requirements for a cyberworld representing an existing university. In this connection, we analyze place metaphors and associated design features of the Virtual Campus of Nanyang Technological University in Singapore in the context of related work. Finally, we discuss the correspondence between the identified metaphors and associated educational goals, providing directions for further development of the Virtual Campus.*

## 1. Introduction

Cyber-learning has already become an important and vital part of university education. The common way of university education nowadays assumes putting on the web course materials, which can be further fortified with elements of interaction such as discussion groups and quizzes. However, the temptation to provide more and more information electronically, thus far acceding the previously used pace of teaching, may often result in disorientation and exhaust of the students whose abilities and expectations from education may significantly vary. In this connection, using and creating cyberworlds appears to be an excellent educational tool for achieving personal mentoring when teaching large classes of students. In [1] we have argued that cyberworlds have promising potential for supporting learning communities because of their capability to provide a social arena where students and teachers can meet overcoming the barriers of the physical world. Also, the virtual space provides a dynamic and flexible

environment where learners, especially distributed ones, can share information and form the environment according to their needs.

There exists a wide range of 3D educational cyberworlds, especially within the AWEDU: Active Worlds Educational Universe (<http://www.activeworlds.com>). The metaphors behind the design of virtual places are quite diverse, from replication of real universities to other planets. The worlds are also used for different purposes, from demonstrations of art and scientific concepts to meetings between physically remote students. To be able to analyze different cyberworlds, the metaphors used, and their relation to the corresponding educational goals, we have developed a characterization framework [2] shortly presented later in this paper. Especially interesting in this context are metaphors intending to create a virtual place that resembles a real one, implying that the virtual environment provides an analogy to a part of the real world. Several universities and schools introduced virtual representations of themselves, e.g. *eCollege* (<http://www.vlearn3d.org/collaboration>), *Virtual Design Studio* [3] and different worlds in AWEDU providing an analogy of the corresponding place in the real world. The rooms and the buildings of such virtual worlds give an idea about the social environment, personal office space, and available equipment and provide a “familiar” atmosphere for the user [4]. Also the case study which we have performed shows that the majority of students, when asked about the ideal virtual representation of their university, prefer a solution closely resembling reality. This motivates us to look at existing solutions providing such resemblance, e.g. *Virtual Campus of NTU*.

The paper is structured as follows. Section 2 describes the adopted characterization framework for place metaphors in educational cyberworlds. Section 3 includes some results from our study allowing us to arrive at a preliminary list of requirements of an “ideal” virtual university. Section 4 provides a short description of the Virtual Campus project and its

characterization along the adopted framework from Section 2. Section 5 includes lessons learned and the discussion. Section 6 concludes the paper and provides future directions for this work.

## 2. Characterization of place metaphors in educational cyberworlds

The following discussion is based on the preliminary exploration of all public worlds of AWEDU and some examples from the literature. All the mentioned worlds are from AWEDU unless a specific reference is specified. We will characterize cyberworlds in terms of *outlook, structure and role*, as discussed below:

**Outlook.** By the outlook of a virtual environment we understand how it “looks like”. We have earlier argued [1] that many worlds can be considered as “frontiers”: lands to conquer and horizons to expand [5]. This phenomenon needs to be reconsidered as in many cases the “frontier” is actually limited by a number of factors such as the cost of virtual land, and the overall plan for the development of the world put down by the world administrators. Therefore, we consider outlook in terms of the degree of reality or abstraction represented by the cyberworld and to what extent it looks like a frontier.

- **Real/abstract:**
  - o An existing, real place, either maximally realistic/“photographic” (*Klara*) or artistically interpreted (*Van Gogh’s Arles*)
  - o A place that looks “real” (*museums*), but without a direct “parallel” in real world (*Globe*)
  - o Fantasy/abstraction: the place or its elements have little or no resemblance to reality, defy physical laws, have abnormal proportions and “untraditional” design (*SciCentr*, Figure 1).
- **Frontiers:** most often, the expansion is in practice limited by the moderator, server capacity, cost of license, etc. Thus, we can characterize frontier worlds in terms of what indications the outlook provides:
  - o Indications for the frontier growth direction, by explicit information, landscape architecture, etc. (e.g. empty “sea” areas for building islands [6]).
  - o No indication or rules of the actual limits and possibilities of the growth (e.g. “open horizon” without any clues on where building is allowed).

**Structure.:** By the structure we understand the mutual relations between different parts of the virtual environment, for example the mutual position of rooms within cyberworlds identifying following dimensions:

- **Rigid vs. free structure**, i.e. to what extent users can alter the structure such as adding new rooms.
- **Structure generation method.** In some worlds such as *Viras* [6], the students are the ones most actively engaged in forming the structure, while in others it is predefined by teachers/developers for certain teaching purposes. Also, structure can be generated and altered automatically by agents depending on such factors as the size of an audience [7].
- **Structure-defining factors.** The structure of a virtual world may be formed according to many defining factors such as social (visualizing connections between people, e.g. *Viras* [6]), course structure (*Virtual Syllabus* [8]), educational themes (*Gene house/Fourier fountain in SciCentr*, Figure 1)
- **The components of the structure.** We can identify two major structure components which can often reflect and supplement each other:
  - o The “physical” structure components consisting of “visible” ones, such as rooms and buildings, and “invisible” ones, e.g. teleportation links.
  - o The components of the “social” structure of the place, such as the ownerships of different parts of the place and traces left of social activities.

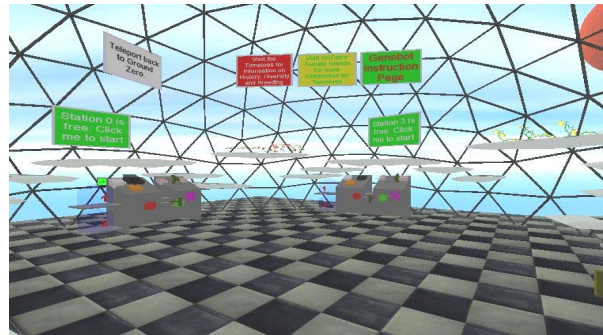


Figure 1. Gene House in the SciCentr world

**Role.** Cyberworlds and associated place metaphors can play a number of roles, one major role or several overlapping and interleaving ones. In many cases, cyberworlds intended to play a certain role (e.g. a meeting place) do not always do so due to inadequate design or various social factors. Also, a meeting place started by the end users (e.g. students) directly is often more likely to be used actively than an “official” meeting place “enforced” by the teacher. Therefore, for each role we identify the *creator, students and agents*. The creator is a teacher or an administrator who designs the world and put out course-related demonstrations or information. Students are those who shape the world according to their needs and enrich it with different products of their learning activities such

as project presentations. Finally agents modify and adapt the world according to the current educational situation such as changing the size of auditorium [7]. The role of a virtual place is also defined by the design, available facilities, and artifacts contained there, such as announcements and pictures. In the following we look at the different roles in terms of specific purposes and associated design features.

**Meeting place.** This metaphor is the most common one and can appear in various flavors:

- Purpose:
  - o The target audience of the meeting place: distant users, local users or both.
  - o The predominant meeting activity: work, discussions, socializing, etc.
- Facilities/design:
  - o Specialized meeting facilities, e.g. shared whiteboard or slide-show, generation of awareness information of other users.
  - o Design features supporting this role, e.g. outlook of a classroom or lecturing hall, table and chairs.

**Information space.** The elements of this metaphor are normally present in the most of the educational worlds, however this metaphor is rare in its pure form:

- Purpose:
  - o Presenting materials in a certain course (e.g. *Virtual Syllabus* [8]) and students projects
  - o Creating a place as a storage of common information resources (e.g. *VBI*)
  - o Presenting personal information from students for finding cooperation partners (e.g. *Viras*).
- Facilities/design:
  - o Modes of information presentation: 2D text/images; linked information resources, such as web pages; artistic/symbolic means of information expression and 3D visualization of information (e.g. chemical molecules, *Cheemet*); presenting information as in reality, e.g. documents on the table, books in a “library” or tomato beds in *Gene House*, Figure 1.
  - o Observation of information: mechanisms for information access management in different parts of the place to certain user groups and facilities for individualized views and information search.
  - o Structuring of information and navigation: “folders”-like structuring, i.e. separated units such as rooms, islands, houses designated to a certain topics; “physical” paths leading through a certain sequence of course material, e.g. *Archeology Timeline Walk in Edutopia*; virtual

“paths”, “walks” or links connecting parts of the world and associated information resources.

- o Interactive facilities to allow users to post and update information: e.g. placeholders for pictures and text, annotation facilities

**Virtual stage.** Though this metaphor is seldom presented in a “pure” form, its elements are present almost everywhere as users in virtual worlds always “play” a role, as they express identity in a different way than in reality and are “disguised” behind avatars and nicks. Such role-playing can be performed by the learners personally or by artifacts or agents created and programmed by the users.

- Purpose:
  - o “Occasional” role-playing: in “person” or through substitutes such as created artifacts and agents.
  - o Intentional role-playing, e.g. as a part of a history subject. Demands of specifically designed surroundings, e.g. *Linkworld*.
  - o Virtual stage design, e.g. *Cybergen*, *vdrama*.
- Facilities/design:
  - o Outlook of the place, creating appropriate atmosphere for the role-playing (e.g. historical sceneries).
  - o Possibilities of flexible scene modification.
  - o Templates of artifacts/agents with programmable behavior as substitutes.

**Demonstration and exhibition.** This metaphor is often used since 3D cyberworlds provide rich possibilities for demonstrations of scientific concepts and art.

- Purpose of demonstrations/exhibitions:
  - o Exhibiting real, historical and fictional places for using in history classes, excursions, role-playing, etc. (e.g. old Stockholm in *Klara*).
  - o Demonstration of art, by known artists or students themselves (*Van Gogh, Artshow*).
  - o Demonstration of scientific concepts, experiments, and equipment, with possible interactive elements/simulations (e.g. *genetics demo* in Figure 1).
  - o Overlapping purposes, e.g. Arles (real place) in Van Gogh paintings (art demonstration).
- Facilities/design: a number of features for “Information space” metaphor to apply
  - o Outlook design to create “atmosphere”, e.g. museum, exhibition hall or historical places.
  - o Clear structuring of exhibitions (e.g. *guided tour*).
  - o “Building blocks” to create new exhibitions.
  - o Agents and scripts for interactivity and simulation running (*SciCentr*, Figure 1).

**Workplace.** This metaphor is one of the most common ones, as educational worlds are usually used for different kinds of school assignments and projects, often overlapping with other metaphors, e.g. when students create exhibitions or libraries as part of their projects:

- Purpose:
  - o Synchronous vs. asynchronous cooperative work.
  - o Type of working activities: meetings and discussions or construction of environment.
- Facilities/design:
  - o The outlook of the place, creating a working atmosphere: a classroom, a lab (e.g. *Vetumini*).
  - o Facilities for performing work tasks, e.g. building elements, links to informational resources, lab equipment (*SciCentr*, Figure 1).
  - o Facilities for mediating of workplace awareness: e.g. leaving messages on the message wall, automatic event notification of users, visualized overview of others' activities, etc.

### 3. Requirements for a virtual campus

We have performed a case study among the students of the Norwegian University of Science and Technology (NTNU) taking a CSCW course. Totally 16 groups participated. The students were given an exercise where they were supposed to explore a range of 3D educational worlds to analyze different design features used, including various types of virtual campuses. At the end, the students were asked to discuss how they would have designed a 3D cyberworld representing NTNU in the most appropriate way. NTNU consists of 3 main campuses plus a number of smaller units such as libraries scattered around the city. In another exercise of the same course, students were supposed to engage in a practical cyberworld construction at world *Viras* in AWEDU.

The results were quite interesting. Three of the groups were suggested to use a variant of "Archipelago" metaphor, which is described in more detail in [6]. This metaphor was used behind the design of world *Viras*, where virtual islands are meant to represent the social units such as groups and individual students, while bridges and roads between islands represent the social connections between the corresponding entities. The variant of this metaphor, adopted by the three groups, implied different faculties and other entities in the university on islands, probably as buildings with smaller buildings/rooms representing courses. The bridges/roads, and in one case small

islands between the major ones, are meant to represent the cooperation directions and areas between different faculties and research environments. In addition, it was suggested to use the metaphor of a "cruise ship" and an "air balloon" floating above islands to denote interdisciplinary courses and cooperation areas. One of the groups also noted that the usage of this metaphor will emphasize the "self-governing" nature of the faculties.

Additionally, 2 groups suggested solutions without a particular resemblance to the physical campus but with more focus on the organization. An example is a building with floors representing different student years/classes with corresponding information or specific areas/buildings/rooms dedicated to administration, different faculties and subjects. Also, the buildings could represent courses while lecture rooms represent individual lectures.

The suggestions from all other groups implied resemblance to the physical NTNU main campus, either the whole or some parts of it. One of these groups suggested making different solutions to local and distant students, i.e. maximally "realistic" for the former to increase familiarity, and more abstract, organization-focused for the latter to maximize the learning effect. The following suggestions have been given:

- In the majority of essays, the resemblance of the real campus was considered more as a major "theme" or "shell" to include additional features, labs and private rooms. It was also mentioned that while the overall structure of the campus should be more rigid and regulated by administrators, students and employees should have an opportunity to extend and develop the campus within the overall guidelines, especially in terms of private/leisure areas, e.g. developing a virtual representation of the local student club.
- Using highly realistic elements, such as canteens, lawns used for socializing, auditoriums for lecturing, teacher's offices where the teachers can be met for consultations, and bus stops as teleportation points between the campuses.
- "Shortcuts" in navigation, for example maps with information about destinations, teleportation links between buildings and faculties, as well as some modifications to the internal structure of the campus. This includes "collocation" of the distributed sub-campus and additional areas for meetings and exchange between different research environments.
- Faculty-driven "libraries" with important links and resources, together with rooms for specific topics and advanced demonstration areas and labs.

- Models of existing lecture halls dedicated to keep resources in specific courses or used for “live” lecturing, with such “advanced” features as visualization of the students needing assistance.
- An important point stressed in several essays is the necessity to have private groups and student rooms, something not feasible in the real university, with associated facilities, such as document manipulation, whiteboard, and features “ensuring” privacy. A related suggestion is in differentiated modes of communication: broadcasting versus buddy-lists.
- Combining different types of structuring: e.g., using the well-known corridor on the campus, so-called “Stripa” (landing lane) and the doors to real auditoriums there as a metaphor, with the doors containing teleportation links to different educational resources/topics.

Based on the discussion above, we can arrive at the following preliminary requirements for a 3D virtual campus representing a real university:

- R1.** The virtual campus shall clearly represent the administrative, scientific and pedagogical-related features and structure of the university.
- R2.** There should be, as feasible, a possibility to provide different views of the campus for different groups of students and educational/social situations, depending on their needs, e.g. a simplified 2D view of the organizational structure of the university, and a 3D realistic representation, with multiple links and interconnections between the two systems. Different views also encompass customizing the presented information and different modes of communication.
- R3.** The outlook of the virtual campus and the major structure should, at least partially, resemble the real university. The degree of resemblance and the part of campus recreated depend on the concrete situation and user needs, from one-to-one correspondence to the overall recognizable “theme”, to create a safe and familiar atmosphere, and to support the “identity”. Outlook of different parts should be differentiated according to the types of activities performed there (work/socializing). The “lower” elements of the hierarchy (e.g. lecture halls and workrooms) might not benefit from the reality resemblance, or on the contrary, exhibit unrealistic features/designs if necessary for enhanced and more effective educational experience.
- R4.** The major structure should be rather rigid and controlled by administrators, while structures lower in the “hierarchy” can be developed by the students or teachers to ensure flexible and

dynamic development of the campus according to the current needs. There should be corresponding tools available, as well as mechanisms for keeping such development in accordance with the adopted rules and design themes.

- R5.** The navigation in the virtual campus should be significantly simplified compared to the real one, with shortcuts/teleportation links, menus and maps with logical and understandable structure, shorter distances, simplified walking paths and additional navigational modes such as “flying”. Customized information (e.g. about locations or where-about of friends) should be provided to assist user navigation.
- R6.** The virtual campus should contain resources and tools to support a broad variety of activities normally present on a university campus, including information resources (virtual “libraries”), groupware tools, interactive simulation facilities, etc.

#### 4. A realistic virtual university: Virtual Campus of NTU in Singapore.

In this section we will consider one of the most “realistic” 3D virtual universities: Virtual Campus of NTU (<http://www.ntu.edu.sg/home/assourin/vircampus.html>). It is a shared virtual world of the real campus of Nanyang Technological University in Singapore built with VRML and Blaxxun Contact communication platform. The Virtual Campus (VC) includes VRML models of the land, buildings, interiors, avatars, and texture images. It can be accessed from any Internet-connected personal computer (Figure 2).



**Figure 2. Real and Virtual Campuses of NTU**

VC is primarily a learning tool for computer graphics students illustrating to them theoretical concepts of virtual reality and shape modeling. It is

used during lectures, as well as after classes for consultations. Many visitors to VC are computer graphics students. VC is also populated by a number of “bots” performing different functions such as guiding around the campus and answering questions on computer graphics. In the following, we analyze the chosen metaphors and design features along the framework presented in Section 2.

**Outlook.** VC is a very typical example of a “photographic” resemblance of a real place. Local students easily navigate the familiar 3D environment, visit replica of existing faculty and department buildings, lecture theatres, libraries, or meet with friends in their hostel rooms. Also, some additional elements not having counterparts in reality, such as the Virtual Collaborative Shape Modeling Laboratory, are added to VC for enhanced functionality. The “frontier element” is clearly less prominent here as the possible expansion and modifications, though not limited in terms of technology, is bound by the physical layout of the university it represents. However, this metaphor does not limit modifications in the elements “low” in the hierarchy, such as individual student rooms.

**Structure.** The structure of VC is rather rigid. It is mostly created by the teacher and to a very little extent can be altered by the students. The major structural components include the buildings of the campus. They are connected in two ways: through the “physical” doors, walks and roads, as well as with a set of teleportation links.

**Role.** As mentioned before, most educational cyberworlds can play many roles at once, some major and other peripheral ones. Here we will look at the degree how the different roles are represented at VC as described in the framework, also in relation to the associated educational goals. It is worth noting that the teacher and a number of project students play the major role in shaping the design and developing the metaphors. This might affect the balance between the intentions behind the different design choices and the actual usage of the place.

**Demonstration and exhibition.** The most prominent role of VC is the “demonstration”, both of the campus itself as well as possibilities and concepts of computer graphics and virtual reality. The major facilities supporting this role include bots for guided tours, and most importantly, the tools for creating virtual models in the Collaborative Shape Modeling Laboratory (Figure 3).

**Meeting place.** This role is rather prominent in VC. The meeting place is mostly “officially” designed by the teacher for educational events though private “hostel rooms” are designed by students themselves and can be used for “informal” meetings. Though the

primarily aim of the meetings is educational activities, VC, as a replica of the real campus, includes places which could be used for socializing such as “parks”, “mingling” areas and dormitories.

**Workplace.** This role is also quite prominent as VC is a workplace for students working with computer graphics projects and courses, including the development and design of the campus itself, following the lectures and having discussions with peers or real or virtual tutors. The teacher links virtual lecture theatres and other places with streaming video of current and pre-recorded lectures and events. Also, 3D talking cyber-instructors can provide work-related assistance and quickly answer questions on computer graphics and virtual reality. The major facility for supporting the role of the workplace is however the Collaborative Shape Modeling Laboratory.



**Figure 3. Collaborative Shape Modeling Laboratory**

**Information space.** The role of information space is rather peripheral. VC can be seen as the place displaying general information about the campus organization, probably for new students, and containing otherwise some community resources such as links to lectures and materials in the computer graphics course, including the student projects (e.g. students’ dormitories models). The major modes of information presentation are the 3D visualization (3D shape modeling), as well as linking to educational resources such as video files of lectures. The mechanisms for information finding and retrieval are analogous to the reality such as the positioning and design of offices and other units where students can find different resources while walking around like in a “real” campus, within designated units (faculty

buildings). Also interactive acquisition of information is possible such as by asking questions to bots.

**Virtual stage.** The “virtual stage” role is present only to the extent how it “normally” exists in most virtual worlds, as mentioned in Section 2, since users can freely choose or design their appearance, thus expressing identity in a different way than in reality. Also, the bots populating VC are playing different roles and are programmed to behave like other visitors (Figure 4). The virtual stage role is therefore supported by providing a library of avatars and the bots that play roles of virtual humans, simulating conversations in synthesized voices and providing a “crowd” effect.

The application of the Virtual Campus and associated tools for shape modeling during a one-semester course of computer graphics at NTU clearly demonstrated that understanding of shape modeling concepts by the students has significantly improved.



**Figure 4. Avatars and bots**

## 5. Lessons learned and discussion

The preliminary results show that the experiences with VC have been rather positive. The existing e-learning platform used in NTU gives rather a "two-dimensional look" of the teaching process. In contrast and in addition to it, on Virtual Campus of NTU professors are able to meet with their students in virtual 3D classrooms, "see" and communicate with each other, and so add more immersion and fun to education. Besides that, distant overseas students get a feeling of really being on the campus.

As we can see, VC meets the majority of requirements in Section 3, though with a number of limitations. It provides a realistic consequent outlook, with areas for both work and socializing, reflecting the real one (R3) with a rigid outer structure controlled by the teacher (R4). It partially allows for extension and development of units lower in hierarchy such as designing student dormitories and project presentations (R4). It represents the main administrative structure by

providing own virtual places/buildings for different units and departments of the university (R1). To a certain degree, the 3D Virtual Campus is backed up by the alternative view of the university, represented by the university web pages and its web-based e-learning platform (R2). The provided navigation modes are simplified compared to the real ones as one can both “walk” and follow the teleportation links (R5). Also, VC includes a number of tools for different purposes such as Shape Modeling Laboratory and agent-consultants (R6).

However, in this case and in a given organizational context and deployment methods, it is difficult to meet all the requirements fully. Due to the restricted audience of users (mostly computer graphics students), the range of supported student activities and courses is rather limited, which is also reflected in the range of available tools and informational resources. Also, the flexibility of development and extension of the campus is lower than in similar systems mostly due to the limitations of the Blaxxun platform. In addition, VC is still a work in progress, and not all the planned features are implemented yet.

Currently, the main educational goals of VC are illustrating the concepts of VR, being a part of the computer graphics assignments, as well as conducting virtual consultations through the talking agents. Another goal is to attract prospective students. More applications are planned in future. The comparison of the listed goals and the analysis of VC in the previous section allow us to make a number of conclusions concerning the appropriateness of design and future deployment and development of VC:

- VC’s chosen metaphors and design features provide a good correspondence to its major educational goal: demonstration of concepts and possibilities of virtual reality as well as teaching of computer graphics
- Though the adopted design facilitates extensive meeting and information sharing activities, these functionalities are currently not exploited fully due to the limited student “attendance” and involvement of the different research and educational environments of the university. To address this issue, VC will become a compulsory part of the curriculum for computer graphics students. This will motivate them to contribute more actively to this community and in this way participate in shaping the design in the way it is most appropriate for their concrete needs.
- In addition, to attract more students, it is suggested to place more resources of various kinds (e.g. educational, informational and entertainment-related) into VC. In the nearest future, it is planned

to add more “fun” to education by setting up properly the clubs, shopping mall, staff offices with talking avatars, etc. The Shape Modeling Lab will also be redesigned to accommodate more visitors and have a more appealing outlook.

- The flexibility and simplicity of the development is still limited, which can be an inhibiting factor for broader student masses to use VC. Possible solutions could be to add an extensive library of objects (*Fleamarket*, which is already under construction) and other tools for expanding VC by the visitors, e.g. more templates of private places.

There are some limitations about the chosen approach as the requirements based on the feedbacks from the students of one particular university and department are applied to another. There exist a number of differences between the two universities in question, NTNU and NTU such as the predominant cultural context, administrative and social structure and the physical layout and architecture. Still, the preliminary set of requirements seeks to be as general and possible and does not include references or connections to certain departments, scientific environments or locations. Furthermore, we believe this approach is justified as our goal is to provide an initial, starting requirements set, which will be revised and updated iteratively after considering several other systems. Applying the requirements to a variety of different universities will help reaching “the common denominator” and obtain the requirements valid for most relevant contexts.

The preceding discussion provides some starting point for updating the initial requirements. The adherence to the requirements in Section 3 does not automatically lead to active attendance and usage. On the other hand, this example shows that a realistic virtual campus does not necessarily serve the main purpose of being a place for taking courses, communicating with tutors and peers and accessing educational resources. Therefore, the requirements should be adjusted and differentiated by taking into account the different *roles* that virtual campuses might play in every specific situation. This observation supports the adopted division between *outlook and roles* in the characterization framework for place metaphors.

## 6. Conclusions

In this paper, we have discussed the design of cyberworlds representing a real university, and proposed a preliminary set of requirements for such a virtual world. We have also analyzed the design of the

existing cyberworld, representing the campus of NTU, in terms of metaphors used and corresponding educational goals. From the preceding discussion it appears that, though Virtual Campus satisfy most of the presented requirements, it still has limited flexibility in terms of extension and modification by a big and diverse group of users rather than by only computer graphics students. Also, it exhibits many known problems of 3D cyberworlds such as “critical mass” issue. Generally, the usage of “realistic” virtual environments for educational purposes should be considered individually in every specific case. Future work in this context will include further development of the design and the deployment modes of Virtual Campus. Also, based on the future experiences with the Virtual Campus and analysis of other similar systems, the requirements will be revised and extended.

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