VIRTUAL CAMPUS OF NTNU AS AN ARENA FOR EDUCATIONAL ACTIVITIES

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ABSTRACT
This paper discusses the use of a Virtual Campus of the Norwegian University of Science and Technology (NTNU) as an arena for educational activities. Three case studies are included. In the case studies the Virtual Campus in Second Life acts as a venue for guest lectures, as a place for collaborative 3D educational visualizations and as an arena for cross-cultural interaction. Based on the results, we discuss the advantages and challenges of using this approach and outline some lessons learned for the design of a virtual campus as a framework for educational and social activities.

KEY WORDS
Virtual campus, 3D virtual worlds for learning, 3D educational visualizations.

1. Introduction

Adopting virtual worlds for educational settings is becoming more and more widespread. As stressed in [1], 3D virtual worlds will offer new opportunities for learning in the future. In [2] it is argued that virtual worlds have promising potential for supporting learning communities. They provide students and teachers with a place where they can overcome some of the barriers of the physical world. According to [3], virtual worlds allow people to interact in a way that conveys a sense of presence lacking in other media.

3D virtual worlds can be defined as “networked desktop virtual reality in which users move and interact in simulated 3D spaces” [4]. Examples of successful 3D virtual world applications include Second Life (www.secondlife.com), Active Worlds (www.activeworlds.com) and Wonderland (https://lg3d-wonderland.dev.java.net).

There are a number of reasons for choosing 3D virtual worlds for educational activities. Firstly, visualization is a powerful tool for supporting understanding and memorizing complex concepts already widely used in educational contexts [5]. There is some evidence reported in the literature that suggests 3D graphics can be beneficial for memorization and information retrieval [6]. 3D virtual worlds can also be used to demonstrate concepts that may be difficult to represent in reality [7].

Another educational use for 3D virtual worlds is support for social constructivism [8]. This allows learners to co-construct their environments and understanding of their peers [9]. According to [10, 11], “3D virtual worlds provide a possibility for learners to construct, impact and interact with symbolic representations and data first hand which in many ways is consistent with how learners engage and learn in physical world”. The ability of this media to support informal socialization is acknowledged by existing research [2, 5]. This suggests that 3D virtual worlds can be used to create a stimulating atmosphere around a collaborative creative learning process. This is because technology builds on a pre-existing common interest by students in the international multi-user 3D computer gaming culture.

An important motivation behind the choice of this technology is its potential for supporting cross-cultural understandings and collaboration. In an increasingly globalised world, there is an ongoing need for ICT professionals to work in diverse cultural environments. When members of different cultural backgrounds come together to collaborate on a single project they are acculturated to different ways of seeing themselves in relation to others and are able to observe how others behave in the same situations. They come to appreciate different approaches to similar tasks and adjust their own behavior to accommodate these differences [12].

However, existing university study programs cursorily prepare students for such encounters and issues. Hence, the value in this work is its focus on 3D virtual worlds supporting international educational activities and cross-cultural collaborations.

To combine the goals of establishing a collaborative constructivist environment and an arena for international and cross-cultural activities, a type of 3D virtual world commonly referred to as a virtual campus was chosen as the media. A growing number of universities have introduced virtual campuses for supporting a range of
educational activities. Such projects started as online multimedia services for distance learning in the early 90s. Today, providing online educational services for time and space separated users is an important role of the virtual campus. Generally, virtual campuses provide users with different sets of possibilities, ranging from web-based systems (e.g. http://vu.org/) to immersive 3D worlds (e.g. http://www.secondlife.com).

3D virtual campuses are created based on different types of platforms and technological solutions. The most widely used platform at the moment is Second Life (SL), although it has certain disadvantages as a learning environment [13]. Linden Lab’s Second Life is defined by its developers as “a free online virtual world imagined and created by its Residents” (Linden Lab, secondlife.com). This virtual world was not designed as a purely learning platform. Nevertheless education is just one of the major application domains in Second Life and, despite some criticism, it is a good example of this type of platform.

Over 500 universities and colleges have a presence in Second Life since it opened to the public in 2003. Major universities already using SL include California State University, Harvard University, Ohio State University, University of Hertfordshire and University of Sussex, among others. The presence of institutions working in Second Life varies broadly, from full-scale, highly realistic campuses, less realistic ‘digital interpretations’ to individual classes taught in common areas [3, 14]. Other educational organizations that have a presence in Second Life include research organizations (for example, Biomedicine Research Labs), libraries (Alliance Library System), museums (International Spaceflight Museum) and so on.

Norwegian University of Science and Technology (NTNU) is now in the process of building a virtual campus in Second Life (Fig. 1). NTNU island is a part of the ‘Second Norway’ region and is a collaborative project involving the Program for learning with ICT, NTNU Library (UBiT) and Department of Computer and Information Science (IDI).

Fig. 1. Virtual Campus of NTNU in Second Life

The Second Life platform was chosen as it is the most common technology of choice for such educational projects. It has the potential for significant promotional value and continuing cooperation with existing Norwegian Second Life projects.

In this paper we discuss 3 different cases of Virtual Campus usage, one of them in the planning phase. This corresponds to 3 different stages of its development. In addition, the main advantages and challenges of using this approach are analyzed and some lessons learned for the design of virtual campus as a framework for educational and social activities are outlined.

2. Virtual Campus as a place for lectures, group work and cross-cultural collaboration

The development of the NTNU Virtual Campus in Second Life began in the spring of 2009 as part of a project course (IT2901 – Informatics Project II) where a group of 4 students created an interpreted model of one of the university’s buildings – Sentralbygget (Figs. 1, 2, 3) with a set of rooms, informational resources and other tools. The students were given a significant degree of freedom in developing the requirements for the campus in order to create a design that was as much as possible in the accordance with their needs as NTNU students.

The work on the Virtual Campus of NTNU is based on previous work on creative visualization of educational content and cross-cultural collaborative work in 3D virtual environments [2, 15-17]. In the following we discuss 3 different cases of using Virtual Campus for educational activities.

2.1 Case I: Virtual Campus as a venue for guest lectures

In 2009 the NTNU Virtual Campus was used as a venue for a guest lecture for students at the Flinders University, Adelaide, Australia. About 15 students (the amount varied slightly during the session) attended a lecture on educational use of 3D educational worlds. The lecture took place in a virtual auditorium by using voicefeed and an in-world slide-show (Figs. 2, 3). To avoid some technical problems and due to the fact that not all the students had access to sound, everybody except the guest lecturer used text chat for communication. In addition to attending a lecture, the Australian students evaluated and discussed the work of the Norwegian group (who also attended the session and presented their project) on the Virtual Campus. They provided feedback and discussed in general the possibilities and potentials of using the Virtual Campus for educational activities.

The session and associated discussion allowed us to highlight a number of issues related to the use of the Virtual Campus for education. Australian students remarked that the NTNU campus “was similar to our online learning system… but much more fun”. They pointed out the opportunities it presented, such as the possibility to attend lectures from Norway, noting that “it
would be great to have the opportunity to learn from Norwegians”.

The students also pointed out some drawbacks such as anonymity issues:

Flinders Markstein: People use avatars to distance themselves from responsibility for their actions
Mandis Loon: how do we know the avatar is actually who they say they are?
Flinders Markstein: How do you grade class participation?

The Australian students also pointed out that it was rather chaotic during the lecture and sometimes difficult to understand who said what (using online chat). One of the students wondered if Skype could give a better experience of lecture content. Another student responded that Skype does not support the same sense of presence as a 3D world.

The students mentioned a number of areas where they believed a Virtual Campus would be useful. These included:

Meng Kenin: Group Work and Social Activities
Kimi Chrome: Athletics competitions
Sooki Genesis: networking with students and industry people through these avatars
Odius Warwillow: Perhaps this is a good way to share guest lectures
Sooki Genesis: and learning and making contacts with people and hearing what they are doing
Kimi Chrome: People aren’t always inclined to turn up in person, this may be an alternative that works

When discussing what subjects and topics could be best covered in a virtual campus the students offered the following suggestions:

Odius Warwillow: I think discussions of things like the influence of games on children
Odius Warwillow: The history of colour
Flinders Markstein: Research ethics
Sooki Genesis: digital media
Odius Warwillow: Medieval battle codes
Kimi Chrome: we could show video tutorials in media applications
Flinders Markstein: I'm interested in the ethics of teaching using avatars

When asked for improvement suggestions, the following was mentioned:

Mandis Loon: private discussion space
Odius Warwillow: A haptic device
Mandis Loon: file sharing
Flinders Markstein: you need to be able to manipulate three-dimensionally. For example, if you are manipulating models in design

Kimi Chrome: Classes outside, in an open space around a stage area would be best

At the end of the session one of the Australian students suggested that “…we could create a campus together”.

Fig. 2. Students from Flinders University, Australia, exploring the inside of the “Sentralbygget” in the Virtual Campus of NTNU

Fig. 3. Australian students attending a virtual lecture from Norway

2.2 Case II: Virtual Campus as a place for collaborative 3D educational visualizations and cross-cultural interaction

The Virtual Campus of NTNU was used for one of the practical exercises in a course TDT4245 – Cooperation Technology. It counted as 35% of the total workload. The exercise was carried out in 6 groups, 3-4 students in each. In this exercise, the students were asked to build a visualization/construction representing one of the research areas or a course taught at NTNU. The students were asked to consider how their constructions could be used in educational activities on the Virtual Campus and for promotion of NTNU. On October 23, they had a joint session with students from Flinders University, Australia (7 students + 1 teacher), Mari State Technical University, Russia (5 students + 1 teacher) and 1 teacher from Molde University College where the
visitors were guided through the building sites and asked to give their comments and feedback to the Norwegian students’ work-in-progress. The exercise deadline was 14 days later. Assessment was based on the participation in the construction effort and on a group essay, where the students were asked to discuss different aspects of collaborative work and learning in the context of a virtual campus, collaborative work on 3D educational content as well as future trends and possibilities. The students were also asked to discuss potential use of their constructions and possible directions for development and improvements for the Virtual Campus as a whole. Students evaluated each other’s constructions and received evaluations from the visitors. The total building period was approximately 6-7 weeks though the majority of building activity took place before the demonstration day of October 23rd. Before the start, students had a tutorial on Second Life (in classroom). Shortly after that, a meeting online in Second Life was organized where the students presented their project proposals, were assigned a building area and received additional training in Second Life building. One of the UBIT team members was online in Second Life most of the working hours for consultation and assistance. Students were given a number of pre-made objects and scripts, plus they were encouraged to visit other places in Second Life to be inspired and obtain additional objects that were freely available in designated repositories or ‘shops’. The meeting in Second Life took place at 08:00 Norway time, 10:00 Russian (Moscow) time and 16:30 Adelaide time. The meeting was delayed as the Australians had some technical problems with updating Second Life to a new version since the last time they had visited SL; they also had some bandwidth problems during the session.

The students used different elements in their presentations, pre-made and specially designed buildings, text ‘notecards’ with information, 2D pictures and 3D models, videos, sounds, interactive elements and so on. The following provides an overview of the session, structured around the presentation of student constructions.

**Group 1, History of NTNU:** The group decided to present the history of NTNU since the university turned 100 in 2010. Group 1 showed a timeline of the history, including information in the form of text, images and video (Fig. 4).

**Group 2, DNV Fuel Fighter:** The group decided to design and develop a presentation of the student project “DNV Fuel Fighter” that received first place in an annual competition for European high schools and universities. The goal of the competition was making the most fuel efficient vehicle, using the energy equivalent to one litre of petrol. Group 2 had an exhibition with posters, pictures, video and a 3D model of the car, allowing visitors to drive it themselves (Fig. 5).

**Group 3, NTNU Medical center:** This group created a virtual "Health Care Division", responsible for training and creating awareness related to medical field. The project was at a very early stage (Fig 6).

**Fig. 4. Museum of history of NTNU**

**Fig. 5. DNV Fuel Fighter**

**Fig. 6. NTNU Medical center**
Group 6, NTNU Museum of Modern Art: Group 6 created a virtual museum of Arts and Music. Students had the idea of allowing talented people, especially NTNU students, share their fine arts learning with each other, as well as displaying their work and attracting potential sponsors (Fig. 9).

Fig. 7. Virtual Studentersamfundet

Fig. 8. Dancing floor inside Virtual Studentersamfundet

Fig. 9. NTNU Museum of Modern Art

Sentralbygget tour: After the project presentation, the visitors and NTNU students took a tour of the central building of the university – Sentralbygget (Fig. 1), discussing its design:

Amaritis Miranda: how does it feel for you here?
Tazzzz Stormcrow: it feels empty without the usual amount of student in first life :)
Sol Algoma: I think it’s quite realistic
Sol Algoma: It also show what you can expect to find in the building, as a new student
Mowse Olivieri: its pretty fun running around

One of the NTNU students was critical to the fact that Virtual Campus of NTNU is not commonly known to its students and employees and suggested advertizing on the university’s website to make the Campus fully available for teaching, student projects and social activities.

Towards the end of the session we had some suggestions for improvements, mostly from the visiting teacher, such as providing facilities for easy storing and retrieving of student projects, information in virtual rooms about their real counterparts and more interactivity. All the visitors were also asked to take a short survey, where they provided a general feedback on the Virtual Campus and voted for the best students’ project.

An analysis of this case based on student essays, chat logs and student constructions was conducted.

3. Discussion

The cases described above provide an insight into the pedagogical experience. And, they add important insights to our earlier research on 3D virtual worlds in education. The exercise also motivated a critical analysis of teaching methods in 3D virtual environments, and associated challenges and perspectives. The major lessons learned that were derived from this experience are summarized below.

3.1 Second Life as a technological environment for learning

The responses from students during the sessions and expressed in their essays are in many ways consistent with previous findings on using 3D worlds in education. For example, NTNU students pointed out the advantages of 3D worlds in terms of establishing initial contact with people from other countries (“collaborating with international students would be easier in the virtual campus than with other media”) as well as making it easier to contact the teacher for help and questions: “it is simple in the virtual campus to have private chats with lecturers and professors […] There is no one else to embarrass yourself in front of”. Still, as discussed during virtual lecture in Case I, there are certain issues with anonymity such as the possibility for misuse and irresponsible behavior.
Though the students noted that working in Second Life requires more effort from the users than, for example, chat rooms, the advantage was the sense of “being somewhere”: “the ‘physical’ presence of other people in a virtual environment [...] is an advantage over simply a name on a screen”, giving the students “more room for expressing who you are”.

It was also noted that “…the barriers against talking to people you do not know, either they are international or local, are far smaller than in real life”. It was easier to “discover new people to socialize with” as “one can get in touch with new people more easily by simply walking over to a person nearby”. This complies with existing research attributing growing popularity of Second Life to the key characteristic of social software or Web 2.0. It exhibits [18, 19]: social networking, the ability to create and share media content, a feeling of presence and a connection to the community.

In this respect the more negative survey responses from the visitors in terms of advantages of 3D virtual worlds and Second Life in particular for cross-cultural collaboration were a bit surprising and differed from our earlier findings when using a different technology (Active Worlds, [17]). The reason might be the shortness of encounter and associated technical problems. Still, it was acknowledged that there were advantages in using this technology in terms of allowing meetings across vast distances and time zones.

For demonstration and visualizing ideas this 3D virtual environment supported previous findings [16]. For example, one of the NTNU groups reported that “it was easier to do brainstorming in the virtual world than use sketches as this would not have depicted the ideas clearly.” Also, the students acknowledged the importance of being able to rework and modify 3D content created by others.

Both during the sessions and in the essays, the students mentioned the existing technological limitations such as the high-bandwidth requirement and some performance issues. As one of groups put it in their essay, the usage of the Virtual Campus might be “overkill” for certain activities. Also, in some cases, it was easier to coordinate activities and meetings by email than in Second Life, as it was “harder to create a common set of rules” and “hard to separate the game side from the serious side”. This is a known Second Life weakness and is often stressed in the literature [13, 20]: not designed for educational purposes, SL creates a number of learning difficulties.

Nonetheless, responses from both NTNU students and visitors indicated that Virtual Campus is relevant for a wide specter of educational activities, especially those involving work on 3D models (such as architecture) and distance education. According to the essays, students “believe in more virtual lectures” and suggest that “SL would be a greater way to promote NTNU in a more interesting way than what is done on the web pages” alone.

3.2 Lessons learned for designing Virtual Campus as a framework for learning and socializing

This subsection summarizes the major lessons learned for further design and development of the NTNU Virtual Campus based on feedback from NTNU students, visitors and previous research.

**Appearance.** The campus of NTNU should be realistic and convey the spirit of NTNU but at the same time be engaging and user-friendly. The degree of resemblance with the physical campus depends on the situation and users’ needs. It may range from an exact correspondence to an abstract but recognizable ‘theme’. It helps to create a safe and familiar atmosphere and to support the ‘identity’. The appearance of different parts should be differentiated according to the types of activities performed there (work/socializing). Some elements might not benefit from the reality resemblance, or deliberately exhibit unrealistic features/designs if it is necessary for enhanced and more efficient educational experience.

Practically all NTNU students expressed the wish for the NTNU Virtual Campus to exhibit a significant amount of realism. At least 2 groups suggested building the main building of the University – Hovedbygget as symbol of NTNU (currently under construction) and an area more closely resembling the major information place – Stripa (a long corridor inside Sentralbygget) – where presentations from students, faculties and companies could be held. At the same time, realistic elements were criticized as being not very user friendly such as small rooms (difficult to enter) and the necessity to open doors (as cumbersome). It is interesting to note that the visitors suggested more abstract constructions, such as rooms without walls, ‘floating buildings’ and other ‘sci-fi’ elements. An explanation could be that the visitors did not feel the same attachment to the physical campus as NTNU students did.

When discussing the appearance of their own constructions, the students put less emphasis on realism (except for the groups that made Studentersamfundet, which they considered a “major landmark”), focusing more on creating a ‘relaxing’ and engaging atmosphere where students can socialize and study engaging visual presentations of NTNU projects such as the DNV Fuel Fighter. The overall appearance of the NTNU island should be more consistent and aesthetically pleasing, with natural landscape elements, such as “hills and trees”.

**Structure.** The overall structure of NTNU Virtual Campus should be consistent and organized and resemble the structure of the real campus. At the same time there should be possibilities for flexible development of the campus by the students or teachers according to needs, such as labs, auditoriums for lectures and other events, and personal group rooms with special privacy options. There should also be additional ‘shortcuts’ for easy navigation such as teleportation links, ‘escalators’ and maps providing a comprehensive overview of the campus for the newcomers.
A recurrent demand in student essays was the necessity to map the virtual and real structures and events in the NTNU campus, such as feeds of announcements, videos of lectures and other events (e.g. concerts and political debates taking place in Studentersamfundet) to the corresponding places in the Virtual Campus and in the opposite direction (information about events in the Virtual Campus on NTNU’ webpages). It was also suggested to provide a way to integrate the Virtual Campus with It’s learning (NTNU’s LMS system). Similar initiatives have already been realized with the integration of Second Life and Moodle (see Sloodle, http://www.sloodle.org/moodle/).

**Tools and facilities.** The Virtual Campus should contain resources and tools to support a broad variety of activities normally present on a university campus, including information resources, groupware tools, interactive simulation facilities, etc. Besides these, social activities should be supported as well.

A common suggestion in chat and student essays was the need to introduce tools for free exchange of resources across the borders of reality and ‘virtuality’, such as video, audio and other informational resources. There should be possibilities for easy creation, demonstration and retrieval of student projects. There should also be facilities to enhance virtual lecturing, such as possibilities for recording and allowing the students to follow virtual lectures while also being outside virtual auditoriums (e.g. while touring an exhibition area).

### 3.3 Case III: Virtual Campus as a venue for International Summer School

Based on the results of feedback from students and visitors of the Virtual Campus, we are now working on further development and extension of this project. In addition to using the Virtual Campus for exercises and lectures for students at NTNU and cooperating universities such as Flinders University, Australia, we plan to use the Campus, as a venue for part of an international Summer School. This Summer School will be conducted as a part of TARGET project. The TARGET (Transformative, Adaptive, Responsive and enGaging EnvironmentT) project was started on January 1st, 2009, as a large-scale integrated project under the Digital Libraries and Technology-Enhanced Learning EU FP7 framework. The main aim of the project is to develop a new genre of technology-enhanced learning environment that supports rapid competence development, and the two domains of innovation and project management have been selected as pilot areas.

It is planned to organize a significant part of TARGET Summer School activities at the NTNU Virtual Campus. We suggest this solution for a number of reasons:

- Using a ‘virtual venue’ for the TARGET Summer School will contribute to a significant cost reduction, potentially attracting more visitors, both during the sessions and after to access educational resources available at the venue.
- Using a virtual environment for a Summer School will allow us to create an infrastructure and a set of educational tools tailored to the particular courses and educational designs.
- The supporting infrastructure and tools will be developed within the framework of the Virtual Campus by NTNU with support from other TARGET partners. Examples of the design facilities and tools needed include, but are not limited to:
  - Customizable auditoriums/meeting spaces
  - Communication tools
  - Social/community tools
  - Tools for content creation
  - Tools for managing associated informational resources and knowledge repositories.

Part of the content created during the Summer Schools will be presented at the ‘virtual venue’ for later reference with the possibility for reuse. In addition to ‘pure’ virtual events, an ‘augmented’ variant will be available where some of the participants will be physically co-located while others will be in the ‘virtual venue’. The two groups will then be connected by big screens, audio equipment and so on. We believe that such an augmented system will ensure maximum flexibility and at the same time provide a cost-effective solution. The virtual and physical venues will in addition be augmented with more ‘traditional’ networking and community tools, such as forums, blogs and other social software tools.

### 4. Conclusions and future work

In this paper we have focused on the concept of the virtual campus as a framework for educational and social activities. We have argued that virtual campuses need to provide an efficient, user-friendly and systematic tooslset for support of a wide range of collaborative learning activities. Based on the results of 3 case studies presented here we propose a set of requirements for a virtual campus and design the overall system based on these. Future work will include further development of our Virtual Campus with a subsequent evaluation among the students of our university and other participating universities.

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