

This is a preprint of the paper to be published in the Sean Goggins and Isa Jahnke (Ed) CSCL at Work. The final version will be available at the Springer library <http://www.springer.com/>, due to May 31, 2012.

Collaborative Virtual Environments for Reflective Community Building at Work: the Case of TARGET

Leif Martin Hokstad * Ekaterina Prasolova-Førland * Mikhail Fominykh

Abstract In this article, we present initial results of designing a community, outlined in the TARGET framework. The main aim of the TARGET project is to research, analyze, and develop a new genre of technology enhanced learning environment – a reflective learning community integrated at the workplace that supports rapid access to competence development of individuals, namely knowledge workers within the domains of project management and sustainable manufacturing. The open question was: To what extent can 3D collaborative virtual environments facilitate *reflective dialogue* in communities to support lifelong workplace learning? One possible answer is given in this case. The empirical study is held as a part of the TARGET International Summer School, which acted as a forum for the presentation of innovative approaches, developments, and outcomes of research projects. The results of the study were analyzed to complement the TARGET community, seeding methodology as well as to provide implications for the use of 3D collaborative virtual environments for community building. In addition, TARGET illustrates how learning and working might be well integrated.

Keywords Computer support * 3D collaborative virtual environments * Communities of interest * Community seeding methodology * Second Life

Introduction

TARGET is a large university and industry project, involving seventeen European countries, focused on the creation of a serious game for competence development in the areas of project management and sustainable manufacturing (www.reachyourtarget.org).

In this article, we describe and discuss in detail the merits and results of using the TARGET International Summer School as a means to create a community in the workplace. In addition, we discuss initial results of a community seeding methodology, outlined in the TARGET community framework. We conducted a study in the virtual world of Second Life involving students, partners, and international visitors. The Summer School acted as a forum for the presentation of innovative approaches, developments, and outcomes of research projects in the areas of technology enhanced learning, serious games and collaborative technologies, facilitating the exchange of ideas between students, researchers and practitioners.

Background

The TARGET project has emerged out of a realization of the need for continuous learning, continuous adaption to changing market needs and the development of new skills and practices. Innovation and organizational development is perceived as intrinsically connected to the ability of an organization to learn. In turn, learning is seen as a collaborative endeavor that needs to transcend or extend the individual aspects of learning. The transfer aspect of learning is seen as limiting, and learning is in this perspective seen as directly connected to the workplace and the challenges and affordances in the working context.

The challenges identified in the TARGET consortium may be identified as gravitating around the following:

1. The in-demand nature of needed knowledge for innovation and development
2. The need to develop knowledge on an collaborative, organizational and not solely individual basis
3. The need to develop *in situ* knowledge, that is, knowledge that emerge from local needs and depends on the solution of the available local resources (i.e. time, human power)
4. The need to develop networks and pathways between clusters of knowledge in ever-changing organizations
5. Developing the “lived curriculum” as a basis for learning
6. Providing mechanisms and affordances for the dissemination of knowledge through reflective practices, and securing means for the flow of knowledge across the organization

The learning efforts thus are both related to the dissemination of existing knowledge, and to developing pathways for knowledge dissemination to parts of the organization where there has been little or no exchange of knowledge. In addition, learning across organizational boundaries and across disciplines is perceived as necessary for the development of new services and products.

The TARGET consortium also sees the need for developing methodologies and practices for developing knowledge that not yet exist in the organization. As such the knowledge perspective adopted here rests on what Gibbons et al. have termed Mode 2 knowledge (Gibbons et al., 1994). Gibbons et al. distinguish between Mode 1 and Mode 2 knowledge production. Whereas Mode 1 represents traditional knowledge, reflecting the classic academic hierarchies, Mode 2 knowledge is developed in an interaction between different actors from science and industry. Typically, this kind of knowledge is developed out of a defined problem or a given context, and is consequently interdisciplinary and rests on both theoretical and practical input. Mode 2 knowledge is also connected to its immediate application, and the interplay between development and application. In a very real sense, learning is not separated from the development of knowledge and its application. Although the individual and social aspects are present in all type of learning and knowledge production, to Gibbons et al. the individual drive is seen as the dominant in Mode 1 knowledge production, and the social or collective drive is seen as dominant in Mode 2 knowledge production (Gibbons, et al., 1994). The topics chosen in the TARGET game scenarios, i.e. topics from project management negotiation and sustainability all have the characteristics of being situated in the organizational context.

To the present context, the most important components of the TARGET project draws upon in the design of the TARGET learning environment are the following:

- Threshold concepts
- Learning communities
- Serious games and 3D collaborative virtual environments

These are discussed in more detail below.

Threshold concepts

The emerging and promising framework of ‘threshold concepts’ is applied as a means of organizing learning content within knowledge ecosystems across corporate and educational

environments (Meyer, Land, & Baillie, 2009; Meyer, Land, & Smith, 2008)¹. To be brief, threshold concepts are components of the learning content that address the difficulties and challenges from the perspective of the learner, and focuses upon the relation between the learner and the content of learning. Threshold concepts have the following characteristics:

- Transformative – it means changing the way the learner thinks about a given subject
- Irreversible – it means once learnt it cannot be “unlearned” or forgotten
- Integrative – it means previously hidden interrelations are exposed to the learner

At the same time, threshold concepts represent aspects of knowledge that are troublesome, and may initially be perceived as counterintuitive. Coming to terms with threshold concepts frequently position the learner in a state of liminality or unrest, during which the learner will oscillate between a previous understanding and an emerging, but not yet fully appreciated understanding. The period is characterized by unrest and frustration for most learners, and may be compared a troublesome or painful rite of passage. The nature of a threshold concept is frequently connected to tacit knowledge, and threshold concepts are embedded in the relations between participants and practitioners in communities. Consequently, they are hard to pinpoint for the newcomer, and the participation in a game with supportive community tools may facilitate and ease the transition into this knowledge landscape.

In cross- and interdisciplinary work, threshold concepts are likely to occur to the learners, because they are constantly exposed to and expected to transcend the limits of their own discipline. The desired outcome of the learning process is that new knowledge or new combinations of knowledge from various sources, theoretical or practical, is developed.

Examples of threshold concepts identified in the TARGET consortium, relevant for project management, are connected to negotiation, stakeholder analysis and sustainability.

Learning communities – the community landscape

Establishing and nurturing vibrant learning communities is seen as a highly complex process (Wenger, McDermott, & Snyder, 2002; Wenger, White, & Smith, 2009). Yet, at the same time, such communities are seen as highly important in developing and spreading new skills, insight and innovation (Johnson, 2010). To the TARGET project, developing a methodology for practical guidelines for the creation of a variety of possible communities is an essential part of the work. Traditionally, Communities of Practice (CoP) have been the most common form of community. Today, a gamut of community realizations may be identified and described. The opposite ends of the gamut the affiliation centers on the metaphors of ‘belonging’ and of ‘connecting’. Whereas communities of practice emphasize the static state of belonging and homogeneity, newer collaborative entities are characterized by their emphasis on connections, networks and heterogeneity. To the latter category Engeström contributes with the notion of mychorrhiza, a biological metaphor for networks that interact with its surroundings (Engeström, 2007). Perceiving the collaborative grouping as an interacting and interdependent entity, Engeström describes such structures as “both a mental landscape and a material infrastructure” for the participants (Engeström, 2007).

Drawing upon work by Hughes, Jewson and Unwin, Fuller and Engeström, one may suggest that the typology above rests on a historical and evolutionary understanding of collaboration patterns (Engeström, 2007; Fuller, 2007; Huges, Jewson, & Unwin, 2007).

¹ The authors would like to recommend Dr. Michael Thomas Flanagan’s webpage for an update on the activities and research connected to threshold concepts: <http://www.ee.ucl.ac.uk/~mflanaga/thresholds.html>

Each type or realization is situated in a specific historical context, and reflects that context. Yet, rather than representing sharply distinguished types, each type tends to stretch into the next historical period, thereby constituting a continuum of development. Hence, the notion of a Community of Interest (CoI), as introduced by Fischer et al. seems to incorporate the variety and dynamism that is a typical feature of a modern workplace (Fischer, Rohde, & Wulf, 2007).

Describing Communities of Interest, Fischer et al. state that “CoIs bring together stakeholders ... and are defined by their collective concern with the resolution of a particular problem” (Fischer, et al., 2007). CoIs can be thought of as “communities of communities” (Brown & Duguid, 1991) or a community of representatives of communities. CoIs are also defined by their shared interest in framing and resolution of a (design) problem, are more temporary than CoPs, come together in the context of a specific project and dissolve after the project has ended. According to (Fischer, 2005; Fischer, et al., 2007), CoIs have potential to be more innovative and transforming than a single CoP if they can exploit “the symmetry of ignorance” for social creativity.

Stakeholders within CoIs, as in the TARGET consortium, are considered as informed participants (Brown, Duguid, & Haviland, 1994; Fischer, et al., 2007), being neither experts nor novices, but both. They are experts in their own domains when they communicate their knowledge and understanding to others. At the same time, they are novices and apprentices when they learn from others’ areas of expertise. Therefore, the major strength of CoIs is their potential for creativity (Fischer, 2000; Rittel, 1984). CoIs have great potential to be more innovative and more transforming than a single CoP (Fischer, 2001, 2005; Fischer, et al., 2007). To the TARGET context this implies the utilization of the potential in the juxtaposition of different competences to facilitate innovation, and to develop new “across-line-of-service” products and services.

Overcoming distances in social creativity and supporting learning in CoIs requires externalizations (Bruner, 1996; Seymour Papert & I. Harel, 1991) in the form of boundary objects (Star, 1989) that have meaning across the boundaries of the individual knowledge systems, subcommunities or different CoPs that join together in a CoI for some purpose (Fischer, 2001).

Boundary objects serve these different systems or communities in situations where each of them has only partial knowledge (based on the symmetry of ignorance) and partial control over the interpretation of the boundary object (Arias & Fischer, 2000; Fischer, 2001; Star, 1989). In this way, boundary objects allow different knowledge systems and communities to interact by providing a shared reference that is meaningful within both parts. Such objects perform a brokering role involving “translation, coordination, and alignment among the perspectives of different CoPs” (Fischer, 2001). Boundary objects are typically negotiated, dynamic and have emergent characteristics. Boundary objects, because of their emergent character, are also central in the development of a culture of reflective dialogue. In the TARGET context, based on the material from the industry partners, one example of a boundary object in project management would be ‘living with uncertainty’ (Karlsen, 2011). As a concept in project management, this comes across as a counterintuitive and troublesome part of the tacit nature of knowledge in this domain, where new or less experienced learners would look for methods that give predictability, check lists for actions and the like.

Central in this perspective upon community and the learning attempted in these environments is that boundaries between disciplines and knowledge domains are constantly re-examined, broken down, negotiated and rebuilt. The boundaries between the disciplines and domains thus may be seen as *trading zones* for interdisciplinary activities (Klein, 1996). Consequently, learning depends on collaboration and co construction in a

continuous interplay amongst the participants. These zones are where innovation and development may occur, but simultaneously these zones are difficult to access and grasp.

Since the joint construction of shared knowledge occurs in knowledge domains partly unknown to the participants, a transdisciplinary approach will involve threshold concepts, since the boundary objects typically are troublesome, sometimes counterintuitive, yet they integrate a certain set of beliefs, theories, and concepts.

Collaborative virtual environments (CVEs) and serious games

Recently, there has been a growing interest in innovative forms of collaborative learning, such as serious games, that may be suited to provide memorable and transformational experiences in the workplace. Serious games are digital games that are driven by learning objectives. Such games can be deployed as test beds for Experience Management that are – so is the assumption – highly motivating and emotionally engaging, causing high and long knowledge retention.

Based on several sources (Bell, 2008; de Freitas, 2008), 3D collaborative virtual environments (CVEs) can be defined as three dimensional, multiuser, synchronous, persistent environments, facilitated by networked computers. Second Life is one of the most successful CVEs at the moment (www.secondlife.com). This virtual world remains one of the most stable, developed, and populated, though there are without doubt certain limitations. CVEs have promising potential for supporting learning communities because of their capability to provide a social arena where students, teachers and other stakeholders can meet and interact overcoming distances and different time zones (Chou, 2009; Helmer, 2007). On the longer term, the CVE becomes a container of artifacts used by the users for their daily social and educational activities, and traces left by community members as a result of their participation. These traces become a part of the shared repertoire of the community through the process of reification (Wenger, 1998).

Establishing and supporting learning communities is additionally supported in CVEs by an enhanced sense of presence (Bronack et al., 2008; Park, Hwang, & Choi, 2009) and a possibility for collaborative work with various types of content (Atkins, 2009; van Nederveen, 2007).

The TARGET Platform – Learning at Work

The components of the TARGET platform consist of a 3D collaborative virtual environment focused on a serious game application where learners may interact and discuss amongst themselves through their avatars, supported by dedicated Web 2.0 tools, leading to the maturing of the associated knowledge ecosystem of the organization(s).

The center of the platform is an engaging story where each learner has their personal experience based on their unique decisions thereby affecting the situated context where their avatar is immersed. Plans of personalized learning are construed from tailored made stories that address the particular needs of the individuals, leveraging the narrative building blocks imbued with the corporate experience of industry such as Siemens and Nokia.

Games scenarios that are being developed are related to stakeholder management, negotiation scenarios, and cases involving sustainability issues. All scenarios are based on empirical material developed in the project consortium together with industry partners.

The purpose of the TARGET project as a whole is to account for and incorporate in the in-service training programs the knowledge in a company that is crucial to the operation of the business, but which at the same time is difficult to capture and to disseminate throughout generations of employees. In this project, learning at the workplace means to

activate the ‘tacit knowledge’ of different employees and stakeholders about ‘project management’ (e.g., how to organize, coordinate projects).

The data collected from industry partners Siemens and Nokia and university partner Norwegian University of Science and Technology gave the background material for what kinds of scenarios the consortium wanted to develop. In these organizations, project management courses have been offered for a long time, and evaluation material from the courses was made available to the consortium. The material was analyzed within the threshold concept framework to deduct what the most difficult concepts in the development of competence in project management. In turn, these concepts were used to design the game scenarios, and incorporating the accumulated experience in the kind of situations and challenges that the player shall experience. The main point here is that the content and game design is deeply rooted in the experience of the organizations that partake in the consortium. Furthermore, the game will be deployed in the very same organizations as a part of the ordinary in service training programs and teaching. In a very real sense, this is knowledge stemming from the workplace, developed and deployed in the workplace.

TARGET International Summer School

The TARGET International Summer School in Second Life acted as a forum for the presentation of innovative approaches, developments, and outcomes of research projects in the areas of technology-enhanced and workplace learning, serious games and collaborative technologies, facilitating the exchange of ideas between students, researchers and practitioners. The design of the Summer School activities is intended to suggest possibilities as to facilitate *reflective dialogue* in communities.

The virtual format of the Summer School demonstrated the possibilities of modern educational technologies for working and learning. Participants were able to unleash their creativity and express their ideas in a new way, demonstrating research projects to peers, experts and other visitors as well as getting feedbacks. Second Life was chosen as preliminary environment to demonstrate and try out different ideas and concepts within the TARGET framework. It was also used as a ‘proof-of-concept’ in order to test out community seeding methodology proposed by the authors in the context of organizational learning in a highly diverse consortium. The diversity of this consortium that consisted of several partners from both industry and academia provided yet another motivation for the organization of the Summer School, i.e. creating bridges between these different communities and, correspondingly, different approaches to learning.

During the Summer School, we conducted a number of events and activities, both in a virtual environment and in real life. Virtual Campus of Norwegian University of Science and Technology (NTNU) in Second Life provided a venue for the virtual world part of the Summer School and a number of tools to support all the associated events.

A central part of Summer School has been a student project competition that focused on creating visualizations of research projects and presenting them to the audience through role plays. The goal of these activities has been to explore innovative aspects of the CVE technology, focusing on community building and collaborative construction, and sharing of knowledge. This method is based on ‘constructionism’ (Seymour Papert & Idit Harel, 1991) – an educational philosophy that implies that learning can happen most effectively through the design and building of personally meaningful artifacts (Papert, 1986; Seymour Papert & Idit Harel, 1991).

These projects were performed in cooperation with a cooperation technology course at NTNU. The participants of the student project competition included 25 students in seven groups, 2-4 students in each, both regular NTNU students (master and PhD level) and

international students, participating in the NTNU International Master program. The total building period was five weeks. During the final session, the students presented their projects in the form of role plays (Fig. 1). They also evaluated each other's constructions and received evaluations and feedbacks from the international visitors. In addition, two seminars were conducted: "Using Virtual Worlds to Improve Business Presentation Skills" by Judith Molka Danielsen and "TARGET EEU (Extended EU) – A step toward new e-learning technologies" by Albena Antonova and Ekaterina Prasolova-Førland.



Figure 1. Role-playing presentation of a student project

After the competition, the students delivered a group essay where they reflected on their experience. The students discussed potential use of their constructions, different aspects of collaborative work, role play, 3D visualization, and learning in CVEs.

The Summer School was conducted in conjunction with the Norwegian Science Fair, which is a part of an annual festival Norwegian Science Week. The goal of this event is to present science projects to the public. In Trondheim, which is recognized as a 'student city' and a 'technological capital', the festival is organized in pavilions on the central city square. In the Virtual Campus of NTNU, a Virtual Science Fair was erected in Second Life to mirror and enhance the one in reality. One of the major city landmarks – King Olav Tower, was reconstructed in the virtual science fair on the virtual 'central square', in same place where the fair was organized in reality (Fig. 2).

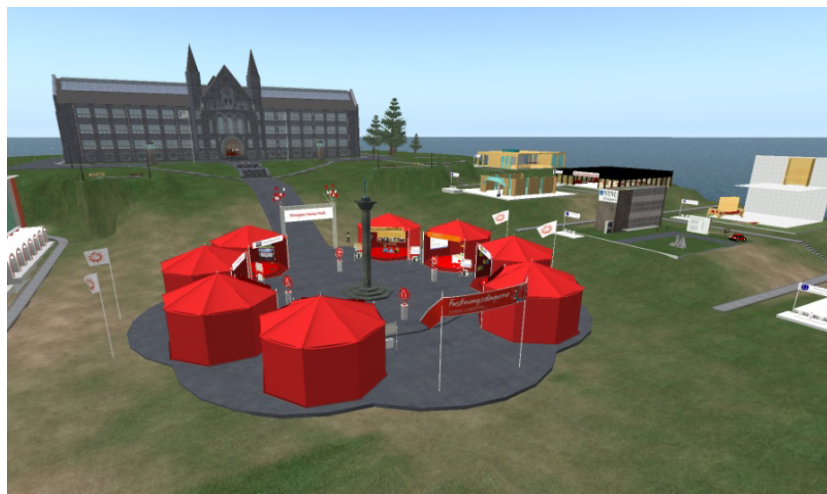


Figure 2. Virtual Science Fair in the Virtual Campus of NTNU



Figure 3. TARGET pavilion at the Virtual Science Fair

Virtual Science Fair was designed based on the principals of the Virtual Research Arena (VRA) – a framework for creating awareness about educational and research activities, promoting cross-fertilization between different environments and engaging general public (Fominykh & Prasolova-Førland, 2011). The Fair consisted of eight pavilions and, together with the Summer School constructions, formed a common environment in the Virtual Campus (Fig. 2). Each pavilion presents a research project from different NTNU departments and other research environments (Fig. 3). Examples of the projects presented (in addition to presentation of the TARGET project itself) included:

1. “Virtual Eidsvoll” – a historical reconstruction project in Second Life for studying Norwegian history;
2. “Multi-lingual text annotator Typecraft” – a free online tool for language experts and anthropologists;
3. “Digital style” – a project advertising social networking and mobile technologies;
4. “vAcademia” – an educational virtual world.

The Virtual Research Arena in this case served as a metaphor and realization of TARGET’s ideas of technology transfer between diverse communities and establishing connections between different disciplines and practices, involving representatives from universities, research institutions, businesses, and the general public. It can also be thought as a virtual workplace where learning can take place in many forms as elaborated in the next section.

The potential and usefulness of the Virtual Research Arena were evaluated by the students participating in the Summer School in their essays. There has been some criticism since there was no actual support for doing research, but just for presenting results. Positive feedbacks were related to conceptual opportunities of the VRA.

The Virtual Science Fair was presented at the fair in real life as one of the projects. The visitors in the real life could come to the physical pavilion and immerse themselves into the virtual extension of the fair, exploring a number of projects (Fig. 4).



Figure 4. Virtual Science Fair is demonstrated to the visitors of the ‘real-life’ Science Fair

Lessons learnt for CSCL@Work

In the following, we will discuss how we followed some recommendations based on literature review aligned with input from the consortium, and how this was implemented in the TARGET summer school. In addition, we will suggest implications for the learning processes that may be deduced from the cases. We will also suggest possible future work.

In the TARGET learning environment, collaborative learning has been designed as a reflective learning community at the workplace. TARGET will be a reflective community platform for learners who need to have rapid access to develop competencies in the domain of project management using a serious games approach. The game simulates the activities associated with ‘planning and executing a project’. Through play, participants develop competencies and expertise in project management.

The first TARGET International Summer School in Second Life proved useful insight in terms of testing out community seeding methodology introduced earlier (Prasolova-Førland & Hokstad, 2009), including the new focus on Communities of Interest, social creativity and community evolution approach, see e.g. (Fischer, 2001; Fischer & Ostwald, 2002).

In the following, we will discuss how Summer School functioned as an example of community seeding in a serious game within the TARGET context. Using the community framework and a set of recommendations for community seeding and sustaining we have introduced earlier (Prasolova-Førland & Hokstad, 2009), the process is elaborated and illustrated along the dimensions of domain, community/network and practice.

Domain

Recommendation: It is necessary to define the domain and engaging issues: issues important to the organization, aspects that are important and motivating for people and can bring in new members. This also includes identifying the ideas, insights and practices that are to be shared in the community at the early phase (Kaulback & Bergholdt, 2008; Wenger, et al., 2002).

Realization in the Summer School: In the Summer School, the focus was on the topics central for the project domain: exploration of the potentials of role plays and simulations in a business/scientific context, alternative means of project presentations. Project visualizations at the Virtual Research Arena have been extensively used for educational purposes in accordance with the constructionist approach (Seymour Papert & Idit Harel,

1991). At the same time, they have been used as a means of knowledge sharing across different communities of interest, in this way supporting social creativity (Fischer, 2005). For example, according to one of the student essays, *“The Virtual Research Arena could be quite useful for presenting things like: ...enable idea gathering in a more interactive intuitive setting ... make visualization extensions for information sources like Wikipedia, where visitors can see things in an interactive 3D setting”*.

In this way, the Virtual Research Arena and its pavilions served as ‘boundary objects’ between different research communities (Arias & Fischer, 2000; Fischer, 2001) and at the same time contributed to promoting research projects to a broader audience of students, researchers and general public. During the course of the Summer School, a number of boundary objects have been collaboratively created in order to facilitate the exchange of ideas between communities of students, researchers, and practitioners. These boundary objects contributed to establishing a common ground and shared understanding and vocabulary among community members by to a significant degree taking advantage of visual symbols, interactive elements, and aesthetics means. Participants took advantage of the mutual “symmetry of ignorance” (Fischer, 2000; Rittel, 1984), allowing social creativity to be unleashed at the boundaries of different domains, demonstrating research projects to peers, experts and other visitors as well as getting feedbacks. The result of these activities might be what the students called “boundary projects”, as appears in one of the essays: *“Virtual Research Arena can be a great opportunity to foster both research activities and collaborative learning. First, it can be used as means for making every researcher aware of other research projects. We believe this is an extraordinary way to promote collaborations among different projects. Using this approach new cross boundary projects may come out”*. In this way, our experience shows the potentials of 3D visualizations for supporting learning and exchange of ideas in a virtual workplace as well as enhancing creativity across boundaries of different communities of interest.

Implications for TARGET learning process: Boundary objects seem important in the learning environment. On the one hand, they represent to the individual learners, an exposure to multiple perspectives. On the other hand, they represent common points of reference to the community of learners. Boundary objects may be seen as parts of the trading zone between the various disciplines and the participants of a community that represent these disciplines.

Community/network

Recommendation: The process of seeding a community should to a substantial degree be based on existing social networks in order to be successful. At the same time, establishing connections across communities is important (Fischer, et al., 2007). Establishing mutual trust and “investing in social capital” is crucial (Bos-Ciussi, Augier, & Rosner, 2008).

Realization in Summer School: During the Summer School, we studied how the students collaborated around their creative visualizations, building upon constructions from previous student generations. The Summer School has also demonstrated the ideas of community seeding, evolution and re-seeding model (Fischer & Ostwald, 2002) where the ‘seeds’ represented by students’ projects grew on the ‘soil’ generated by the evolution of earlier student generations at the Virtual Campus, and were later integrated in the Virtual Research Arena, reseeded the new community of TARGET researchers and early adopters.

A number of events, such as seminars, gatherings and a role-playing session, during the course of the school allowed extending social networks across countries and institutions. The potential of the VRA was mostly seen in promoting presented research environments by creating a socializing and gathering place around project presentations. Increased awareness among researchers, students, university departments, research groups,

institutions, and the general public was emphasized as a way for promoting collaboration and an important opportunity for establishing new contacts. In this way, our experience with the Summer School highlighted the importance of informal communication spaces for working, community building and collaborative creative activities.

Implications for TARGET learning process: Establishing productive and creative communities rests on a delicate and complex balance between the “symmetry of ignorance” and the symmetry of interests amongst the participants. Both formal and informal means of interaction are needed as well as openness towards other communities and networks. Learning under these affordances requires a highly flexible infrastructure.

Practice

Recommendations: a) The first step in terms of establishing a community practice is creating a preliminary design for the community, based on the “Seven principles” (Wenger, et al., 2002), such as launching the community with dedicated community spaces, both private and public and corresponding initial community events (Wenger, et al., 2002).

b) It is recommended to provide initial boundary objects and introducing shared artifacts as catalysts of collaboration (Thompson, 2005; Wenger, 1998) such as “monuments” (symbols strengthening identity within the community, e.g. logos); “instruments” (an infrastructure supporting interactive communication) and “points of focus” around which the interaction and collaboration will be structured.

c) It is necessary to identify early what knowledge to share and how, laying an initial plan for a community repository, identifying ways to capture and store ‘soft’ knowledge to be embedded into community practice and stored into relationships (Wenger, et al., 2002).

Realization in Summer School: In order to create a preliminary ‘design’ for the community/communities in question, there have been introduced dedicated community spaces (e.g. lecture halls, campus buildings, reconstruction of Trondheim central square with exhibition tents) and associated community events: Summer School seminars and the Virtual Science Fair in conjunction with the real one. According to student feedbacks, these arrangements were suitable for connecting communities of students and researchers: *“We think the Virtual Research Arena (VRA) is highly suitable for research activities. Researchers at university level are often geographically distributed across countries. This is due to the fact that research projects often need top specific knowledge in small domains that is hardly available inside its own country boundary. With limited resources (money) available in the project, and bearing in mind the CO2 emissions from flight travels, researchers may like to have a platform to meet that mimics real life meetings.”*

As a part of establishing shared practice, we have introduced a number of shared artifacts as catalysts of collaboration such as TARGET stand as a “monument” (Fig. 3), building tools and meeting facilities as “instruments” and “points of focus”, such as campus buildings, constructions on the Virtual Science Fair and both previous and recent student constructions (Fig. 2). These focal points were demonstrated to the public facilitating collaboration within and between communities of students, researchers, TARGET partners and the general public (Fig. 4).

In addition, we have explored innovative ways of capturing, storing, and mediating knowledge through 3D creative visualizations and role-plays. The 3D constructions capturing the knowledge and experiences acquired by different generations of students and researchers will be stored in a ‘project gallery’ constituting the community repository, where they can be retrieved and updated/annotated by community members at any time. The work on such a gallery provides one of the directions for future research, i.e. exploring alternative and innovative ways of visualizing, storing, and managing community knowledge.

Implications for TARGET learning process: A game scenario that encompasses experiences and challenges that interacts on the balance between the symmetry of ignorance and symmetry of interest, seem fit to be the event or monument that attract participants into these kinds of learning environment.

Conclusions and Future Work

In this chapter, we describe a sociotechnical platform that fosters workplace learning in the field of project management. We have presented and discussed initial testing results of a community seeding methodology, outlined in the TARGET community framework, and explored different aspects of community building in the context of serious games and 3D CVEs. The purpose was to explore learning environments by inviting participants into practices where knowledge and insight is emergent from the diversity of the contributions.

We asked to what extent a 3D collaborative virtual environment facilitates *reflective dialogue* in communities to support lifelong workplace learning. Our experience demonstrated that 3D collaborative virtual environments *can* support reflective dialog in learning communities in following ways:

- By providing boundary objects to enable dialog between learners from different backgrounds and disciplines
- By providing a flexible infrastructure and both formal and informal meeting and workplaces for members of different “Communities of Interest”
- By providing a set of shared artifacts as catalysts of collaboration and a shared repository for storing and 3D visualization of community knowledge
- By enriching reflective dialog with innovative expression forms, such as role plays and 3D visualization

It is important to understand that attempts to control such communities directly are in most cases destined to fail, according to the principles and understanding suggested by Wenger (Wenger, et al., 2002). In this tradition, the design principles for vibrant and alive communities are not meant to be ‘recipes’ and are not the same as most organizational designs. They could rather be seen as triggers and catalysts for a community’s natural evolution, often based on pre-existing social structures.

Also, communities cannot be measured in conventional ways as traditional methods are not likely “to appreciate the creativity, sharing and self-initiative that are the core how a community creates value” (Wenger, et al., 2002). Following this understanding, we outline a number of implications for TARGET learning process and organizational learning in a serious game context in general:

- The importance of 3D visualizations for supporting learning and exchange of ideas in a virtual workplace as well as enhancing creativity across boundaries of different communities of interest
- The importance of informal social spaces for community building and collaborative creative activities
- The need to explore alternative and innovative ways of visualizing, storing, and managing community knowledge

For the future work, we plan to continue seeding and nurturing reflective and creative TARGET communities according to the principles and guidelines outlined above, contributing to development of associated community social tools and support systems. In addition, a new TARGET Summer School (in collaboration with EU CoCreat project (<http://www.cocreat.eu/>) was held autumn 2011, with a focus on collaborative virtual

workplaces for creativity support. During this process, future work will encompass a number of research issues:

- Further exploration and development of the community methodology in the context of serious games and 3D virtual workplaces
- Providing support for creative communities and communities of interest in 3D virtual worlds in a cross-disciplinary and multi-cultural context
- Exploring the potentials of role playing and serious games for supporting learning at the workplace
- Further experiments of integrating serious games in workplace development programs;
- Further exploration into threshold concepts as content identifiers in complex learning environments
- Further development of methods for community repository building and maintenance

Acknowledgements

The research presented in this paper is funded by EU FP7 TARGET project, grant agreement nr. 231717.

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