

Impacting Global Software Development Through Socialization Activities in Virtual World Environments

Olly Gotel¹, Vidya Kulkarni², Des Phal³, Moniphal Say⁴, Christelle Scharff^{1*},
Thanwadee Sunetnanta⁵

¹*Pace University, New York, USA*

²*University of Delhi, Delhi, India*

³*Royal University of Phnom Penh, Phnom Penh, Cambodia*

⁴*Institute of Technology of Cambodia, Phnom Penh, Cambodia*

⁵*Mahidol University, Bangkok, Thailand*

Received November 18th, 2008

Abstract. In today's software industry, development teams are no longer co-located but distributed over locations, and problems associated with different time zones and cultures come into play. To reflect these industry scenarios, and to better prepare computer science students to capitalize upon the opportunities and address the challenges, five institutions distributed across four countries and two continents have been collaborating to investigate models of working in global software development settings. The model for the spring 2008 project emphasized friendly competition between distributed development teams and quality, via the support of coaches and the external feedback of auditors, to increase the likelihood that software suitable to deploy would be developed by the students. A virtual world environment was also used as a socialization tool with the expectation that it would provide support for the needed face-to-face interaction that lacks in distributed teams and so promote additional forms of communication. In this paper, we describe the goals behind investing in socialization and the emerging technologies that can support such activities in global software development projects. We also outline the setting and the results of our particular socialization study. We conclude the paper with reflections on the future use of virtual world environments in global projects of this nature and the resulting implications for practitioners.

Keywords: client/developer communications, global software development, software development tooling, software engineering education, virtual world environments.

1. Introduction

Business demand has influenced the way in which products are being developed in the

software industry today. Global Software Development (GSD) has become unavoidable due to its potential to increase development speed and reduce cost. However, right sourcing also presents a number of challenges. Development teams are no longer co-located but distributed over geographies, and problems

* Corresponding author. Tel.: (1) (212) 346 1016, E-mail: cscharff@pace.edu

associated with different time zones and cultures come to the forefront [15,20].

Several existing educational initiatives are looking into addressing and reflecting these industry scenarios to better prepare computer science students to capitalize upon the opportunities and learn to address the challenges (see [1,4,5,6,7,14,21,22] for a representative example). Pace University in the United States (US) and the Institute of Cambodia (ITC) have been partnering since 2005 to investigate models of working for students to develop software collaboratively. Additional institutions have joined this initiative over the four years, including the University of Delhi in India in 2006, and the Royal University of Phnom Penh (RUPP) in Cambodia and Mahidol University in Thailand in 2007. While the goal of the initiative has been constant, to develop software for Cambodian clients via globally distributed teams of students, the emphasis has evolved each year to address particular themes, including: global supply chains, tooling infrastructures, software quality assurance, integration, deployment and maintenance, entrepreneurship and socialization [8-13].

The model for the 2008 GSD project, the focus of this paper, emphasized friendly competition between distributed development teams and quality, via the support of coaches and the external feedback of auditors, to increase the likelihood that software would be developed to a standard that could be deployed in Cambodia and to give the client a choice in their selection. An additional dimension was the investment in socialization. It is commonly recognized that a poor client/developer relationship is one of the leading reasons for software failure and this is an issue that agile software development methodologies tackle directly with customer collaboration over

contract negotiation as one of their primary values [17]. With this growing awareness that social aspects of a software development project need as much attention as the technical and project management sides, the 2008 GSD project sought to explore the impact of increased socialization effort on the perception of cohesion amongst a global team and to study the nature of the client/developer relationship that this encourages. By ‘increased socialization’ we mean a concerted attempt to get a development team learning about the society and culture of the client. By ‘impact’ we mean the influence on the quality of the software produced. A socialization study was consequently designed and undertaken using a virtual world environment called Second Life (SL) (<http://secondlife.com>). The wiki of the 2008 GSD project can be found at: <http://atlantis.seidenberg.pace.edu/wiki/gsd2008>.

This paper is organized as follows. Section 2 provides context to the study with a description of the GSD setting. Section 3 describes the reasons for investing in socialization activities and the emerging technologies that can support them. Section 4 outlines the set-up of the socialization study and Section 5 presents the findings. Section 6 concludes with lessons for others and reflections on the future use of virtual world environments in global projects of this nature.

2. Context

The GSD project described in this paper is a partnership between sixty undergraduate and graduate students and seven faculty distributed across five institutions, four countries and two continents. Salient aspects of the project setting are summarized below.

Roles and Responsibilities. A team of ITC undergraduate students acted as clients for the project and owned the requirements of the software system to be developed, software for a library system to be deployed in the computer science department at their institution. These students were assisted in their client role by client-side coaches, graduate software engineering students located in the US. Five teams of developers from ITC in Cambodia, India, Thailand and the US (two campuses of Pace University, one based in New York City and one based in New York Pleasantville) were placed in friendly competition to develop the software with the support of development-side coaches, also graduate software engineering students located in the US. US software quality assurance (SQA) auditors (graduates and industry professionals) and Thai SQA auditor trainees were put in charge of assuring the quality of the software development process followed by the five development teams in order to influence the quality of the final products. Each extended global team was therefore composed of the clients, the client-side coaches, the developers, the development-side coaches and the auditors. Out of the five software systems developed, that of the highest quality (measured in terms of requirements satisfaction [3]) was selected and deployed in Cambodia by the ITC client and developers.

The target team for the socialization study was the US development team based in New York Pleasantville (PLV). A team of students from RUPP was responsible for introducing the PLV team to Cambodian society and culture, and for sustaining this relationship over the entire duration of the project. Figure 1 depicts the setting of the GSD project in 2008.

Process and Tooling. Each development team followed a loose waterfall-based software development process with iteration, feedback

cycles and open access to the client. The software development spanned across nineteen weeks, including two weeks for initiation overlapping with four weeks for requirements, then four weeks for design, four weeks for interleaved coding and testing, ending with the selection of one of the software systems. Subsequent deployment took five weeks.

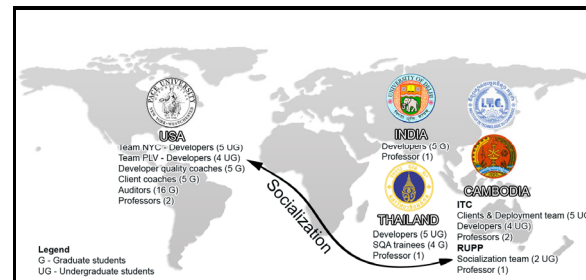


Fig 1. Overall Setting for the GSD Project in 2008.

To facilitate team coordination across distances, the software development process was supported by a tooling infrastructure that comprised a mix of engineering, communication, project management, and socialization tools [8,11]. The engineering tooling converged on the use of a professional integrated development environment, specifically Eclipse, NetBeans or Visual Studio (with unit testing and version control), and java.net for bug tracking. The communications took place via mailing lists and Internet chats to permit both synchronous and asynchronous communication. A number of wikis served as repositories for all the artifacts produced during the project, and thus facilitated team awareness and project management. Shared Google Calendars and TimeZone software were used for milestone and time awareness, but also to provide information about the semester, vacations and exam schedules of the extended global team members. Socialization activities were facilitated by Internet chats and, for the

PLV development team, by the SL virtual world environment.

3. Needs and Technologies for Socialization

Agile software development methodologies have achieved a high level of popularity in the US software industry. One important emphasis of these methodologies is on nurturing the client/developer relationship as a means to attain higher levels of client satisfaction with what is produced. Agile approaches thus demand continued access to the client and their engagement throughout the entire development process; the client is considered an integral member of the team. This relationship permits early and iterative delivery of software to gain feedback and facilitate requirements discovery. Attention is therefore paid to creating a working environment that encourages all the team members to work together effectively [17].

Our observations have suggested a need to emphasize socialization in GSD student projects, both to improve team bonding and to encourage their working toward a common goal. Establishing trust has been found crucial to improving collaboration in distributed teams [18] and trust is something that can be grown where team members believe they 'know' each other. In the past, our students have exchanged videos and country-specific gifts at the beginning of the project. They then met online via Internet chats to socialize periodically in a text-oriented manner. However, the students rarely sustained their investment in socialization once development work got underway. The consequences were noticeable; this prevented any ongoing discussions about changing requirements from taking place.

In 2008, we therefore attempted to address this issue by creating an environment in which

to emphasize social relations over the life of the project in a more visual and engaging manner. We used the Second Life (SL) virtual world environment as a socialization tool with the expectation that it would provide support for the needed face-to-face interaction and contact that lacks in distributed teams that can be the foundation for building familiarity and trust between global team members, and for ensuring its longevity.

Virtual worlds are environments that people can inhabit, and where they can work and interact with other people via characters (called avatars) in a somewhat realistic manner, with gestures, voice and text. There is some evidence that animated avatars, with their materialized visual features, can help distant collaborators to establish relationships and so facilitate non-virtual interactions [19]. Further, some of these virtual worlds have their own monetary systems and economies (e.g., Linden dollars in SL, with \$1.3 million worth of transactions occurring between individuals every day), so the profitability of creating and building customized worlds is promising.

Massively multiplayer online role-playing games (MMORPGs) such as World of Warcraft (<http://www.worldofwarcraft.com>) exploit and are the most widely used social virtual worlds. A recent report from IBM has highlighted the parallels between the skills demanded of gamers in such worlds and business leaders, both leading teams to accomplish missions through dynamic strategies and tactics [16].

Several non-gaming virtual worlds have also emerged in the last few years and are used in education and industry, Second Life from Linden Lab being the most popular. Many universities (e.g., Harvard and Stanford) now have a virtual presence in SL that they use to deliver courses and content either

synchronously in virtual classrooms and amphitheaters or asynchronously via podcasts and videos. Companies such as IBM and Toyota use SL to maintain ongoing contact with their customers and for training, continuing education, tradeshows and conferences. They are also beginning to use virtual worlds on software development projects for the virtual co-location of distributed teams, to run meetings and share artifacts in-world [2]. Sun Wonderland is another environment that has received some resonance in the software industry (<http://research.sun.com/projects/mc/mpk20.html>), notably because it does not require intellectual property items to be stored on third-party servers, and Google has recently launched Lively (<http://www.lively.com>).

4. GSD Socialization Study

In this section, we explain both how and why we applied socialization activities within SL to our GSD project context.

Second Life Set-up. The rationale behind the choice of SL as a virtual world environment for socialization was three-fold: (1) Cost -- basic SL membership and participation is free; (2) Ease -- SL only requires the installation of an SL client that will connect to existing Linden Lab SL servers and the creation of an avatar to get started; and (3) Space -- we obtained an empty island from Linden Lab for use for one semester. Figure 2 depicts the avatar of one of the students who was involved in this study and the Pace University SL Island that we created. The island was carefully populated by the instructors, with the help of the students, to reflect the involvement of the five institutions and four countries. The students were provided with a small amount of Linden dollars to buy objects in SL and bring them back to decorate

the island. Each institution had a banner with its logo and country-specific items, such as a Buddha and Indian clothes. Recreational areas were also set up to promote social relations, including a boat ride area, a swimming pool, a dance floor, a big screen for movies and music, sofas with tables and computers, tables with food, and carts with drinks and ice cream.

General Socialization Activities. It is necessary to perform some form of social activity at the onset of a project so that students who will be working together can become acquainted. The photos of all the students involved in the GSD project were therefore put on the team wikis, with their roles, contact information, preferred contact method and times, and a short biography. All the developers and clients were also required to attend organized Internet chat sessions during the first two initialization weeks of the project to establish relations. The focus was on promoting the client/developer relationship, so the auditors and coaches were not required to join the chats.

Second Life Socialization Activities. The four US students who were to be part of the socialization study (PLV) were concurrently exposed to Cambodian society and culture with the help of two RUPP students. The RUPP students were introduced to their roles and to SL by the US professors during a visit to Cambodia prior to the project. The RUPP students were to lead weekly sessions in SL to discuss predefined topics, covering: the geography of Cambodia, an introduction to the Khmer alphabet, the importance of the Chinese New Year in Cambodia, movies shot in and around Cambodia, and the Khmer Rouge period in Cambodia's history. The PLV students also received Cambodia-specific gifts, such as postcards, tee shirts, books and CDs as part of the socialization experience. This interaction between RUPP and PLV students was sustained

within SL for the entire duration of the project. Note that this was purely visual and textual. Voice was not used to communicate within SL because there were lots of difficulties in synchronizing and testing the voice parameters. Additionally, and from our past experience, we have found that students prefer to communicate via emails and Internet chats, despite our encouragements to try voice.

Second Life Party. At the end of the GSD project, all the students were invited to the Pace University SL Island for a project closure party with virtual food, drinks, and country-specific music and activities to celebrate their achievements. The party was well attended by the US developers, the Thai, Indian and RUPP students, and all the instructors, and lasted two hours, making us think that these types of socialization activities should have been organized from the beginning of the project. Figure 3 shows some of the students and professors socializing during the SL party. The ITC students (both the developers and clients) did not attend the party due to difficulties with high speed Internet access and the limitations of their computers' video cards. Technology issues effectively excluded the students from ITC in experiencing SL.



Fig 2. Student Avatar on the Pace University Island.

Experimental Design. To study the impact of socialization via the use of a virtual world environment in GSD projects, and to do this in

a controlled manner, only one team of developers in the US was exposed to the Cambodian culture of the client through SL socialization activities. The impact of these efforts on the development team's cohesion (sense of team membership) and interaction with the Cambodian client was evaluated and compared with the other four development teams as control groups, and with the second US-based development team in particular. Specific attention was placed on investigating whether the PLV/RUPP social relationship would transfer to curiosity and knowledge about the client and so lead to a similar relationship with the actual Cambodian client, in turn encouraging any necessary requirements discussions.



Fig 3. Socializing at the Project Closure Party.

Measures and Data Collection. A quality relationship between the developer and client would be indicated by simple things, such as the developers knowing the members of the entire global team and hence recognizing the client-side -- their names, their faces, some elements about their culture and country, and also having knowledge about time zones, vacations and holidays. From the software development perspective, a quality relationship would lead the team to work more effectively toward a common goal, and foster the trust necessary to discuss options and provide feedback more openly.

To measure the country and team awareness of the students we designed two exercises. Firstly, a map exercise that required the students to put the four countries and cities of the GSD project on a map of the world, as well as to match flags, regional dishes (e.g., Amok and Samosa) and famous international landmarks (e.g., Angkor Wat and the Taj Mahal) with their associated countries. Secondly, a faces exercise that required the students to select the photos of their extended global team members out of the sixty participating students, and to put names to these faces. The map exercise was administered three weeks after the beginning of the project and the faces exercise was administered in the middle of the project. Note that only the results related to the socialization study are elaborated upon in this paper. The results of the control groups are compared and contrasted with the experimental group. Additionally, data were gathered via post-project questionnaires that evaluated the students' perception of SL and its use in socialization activities, along with the overall experience of students on the GSD project.

5. Findings

Prior to this study, the PLV students had heard about SL but had never used it. Some of the students from the control group in the US had experienced SL, but the other groups in Cambodia, Thailand and India had never heard about it before. The socialization study and the project closure party was the first encounter for many of the students with the SL environment.

Team Cohesion. In the post-project questionnaire, the developers were asked to report their understanding of who they considered to be part of 'their team'. All five of the development teams naturally said the

developers themselves, followed by their development-side coaches and the instructors. Surprisingly, the clients and client-side coaches were not considered as main members of the team, even for the experimental PLV group. The developers considered the implementation of the software as the core teamwork more so than the uncovering requirements. The auditors, due to their role as external eyes, were also not considered part of the team. Socialization made no difference to team membership perceptions.

Knowing Cambodia and Colleagues. The results from the two socialization exercises are summarized in Figures 4 and 5. The map exercise showed that the PLV students acquired some knowledge of Cambodia and Cambodian life. While they could place Cambodia and Phnom Penh on a map of the world, and could recognize Cambodian dishes and landmarks, they could not say what the time difference was between New York and Phnom Penh. However, they did do better than all the other development teams in this exercise, except for Thailand. Not surprisingly, Thai students have a lot of knowledge about Cambodia given it is a neighboring country and in the same time zone.

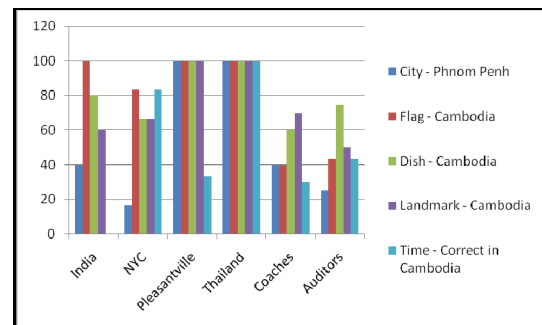


Fig 4. Map Exercise – Knowing Cambodia.

The faces exercise showed that the PLV students did not recognize all the photos of their extended and global team members, especially the clients and client-side coaches, and they did not know their names. While they knew the

names and faces of the RUPP students they interacted with in SL (not shown on the figure), this did not transfer to their project responsibilities; they did not learn more about the actual Cambodians they were working with.

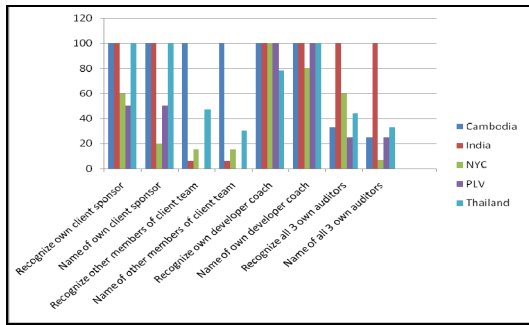


Fig 5. Faces Exercise – Knowing Colleagues.

Client/Developer Relationship and Resulting Software Quality. One of the PLV students reported having numerous chats using Instant Messenger with one of the members of the Cambodian client team. The same student also provided the following statement in the post-project questionnaire: “SL helped me a lot to know the client’ background and culture... I could relate and predict her way of thinking”. However, the overall relationship between the client-side and development-side was seen to be no better and no worse following socialization activities. Further, there was no correlation between the socialization activities and the improved quality of the end result. If anything, the quality of the work of the PLV team suffered from their multiple responsibilities in the overall project, delivering a lower number of requirements satisfactorily than three of the other teams.

Overall Perception of Second Life. A RUPP student stated that “I started being familiar with [SL] and found out that it was really interesting because I just sat in front of my computer and I could see many places in the virtual world without spending a huge amount of money in

the real world”. For example, cities are replicated in SL providing students with the prospect to discover and interact with people in locales around the world they could rarely afford to visit, using the essence of a place to trigger encounters. Table 1 summarizes and compares the perception of SL as reported by the students. Note that ITC is missing from this table because SL’s technology requirements meant that use was prohibitive for them (SL demands bandwidth and a suitable computer video card).

Table 1. Perception of SL as a Socialization Tool.

Question	Cambodia - RUPP	US - PLV	US - NYC	India	Thailand
Previously heard about SL	No	Yes	Yes	No	No
Prior game experience (platforms)	Desktop, online and mobile phone games	Desktop, online and Nintendo Wii games	Desktop, online, Nintendo Wii and DS and Sony PSP games	Desktop and online games	Desktop, online and mobile phone games
Serious or fun tool	Fun	Serious	Fun	½ Serious ½ Fun	Serious
Use earlier in project	N/A	N/A	Yes	Yes	Yes
Good social tool	Yes	Yes	Yes	Yes	Yes
Future use	Yes	No	Yes	Yes	Yes

The results show that SL was a discovery for almost all of the students. The PLV and Thai students considered SL as a serious tool whereas the other students considered it as a vehicle for fun. The PLV students considered the weekly SL meetings a burden and additional work for them to do on top of everything else, fuelling their perception and resulting in them being the only team not keen to see future use of SL (as contrasted with their RUPP SL collaborators). All the other students considered that SL had the potential as a socialization tool and would like to have seen it used more widely from the beginning of the project for them. Students considered that SL was a possible benefit because it was visual and body language could be simulated, but they also suggested it less convenient than instant messaging. One of

the PLV students stated that: “I rather use yahoo IM to talk because it is more natural”.

6. Lessons and Discussion

During this student GSD project, we attempted to give one set of developers a socialization experience to help them understand and appreciate the society and culture of the client. We anticipated that this would have a positive impact on the client/developer relationship and so improve the quality of the software system produced through a better understanding of requirements. This is a relationship that is delicate in most software development projects and compounded in a global setting, so we hypothesized that visually based socialization would nurture it. While these efforts did increase the general knowledge about Cambodia amongst the PLV developers, it did not result in them considering the clients as part of their team and it did not positively impact the quality of the software system they produced.

This outcome was not a failing of this mode of socialization per se. The reality was that the mechanism, whilst we assumed it would appeal to students, actually was considered as an additional work. Rather than enjoy the experience, they resented the extra work as it impinged on their ‘development time’, and as a result they never quite caught up with some of the other competing teams.

Socialization activities are essential to plan and undertake on GSD projects, as suggested in Table 2, but any technology used for socialization needs to have a low start-up cost. As virtual world environments become used more increasingly for both playful and serious gaming, a population of users that is well versed in this technology will be growing. It is

certainly a competence to capitalize upon for software development practice in complex settings and we recommend that the software industry look more critically as to its potential.

Table 2. Introducing Socialization.

Activity	Objective
Create shared calendars and use time zone software.	To know the time at each location and to be aware of when other students will and will not be available to work. Promote sensitivity for meeting scheduling and deadline management.
Exchange photos, bios and videos.	To put a name to a face – make the experience personal and the commitments real.
Exchange of gifts.	To foster a stronger bond between parties based on giving and receiving. Exchanging something seeds a dialogue.
Web site or wiki with shared resources.	Promote learning about each other, not just the project-specific materials.
Chatting / instant messaging.	To support unscheduled, quick and informal discussions. Encourage them and perhaps schedule them to ensure they happen.
Group announcements / Emails.	To promote shared awareness and create a sense of community. For instance, send holiday wishes to those team members having a national holiday and remind other extended team members.
Socialization exercises.	To enable students to recognize what they should but don't know about those they are working with. Our map exercise was designed to see if students knew anything about the countries while the faces exercise was designed to check whether they recognized team members.
Use of virtual world environments.	To forge a visual and more physical connection with team members and places. Simulate face-to-face encounters.

Acknowledgements

This work is supported by a National Collegiate Inventors and Innovators Alliance grant (#3465-06), “Incubating the Next Generation of GSD Entrepreneurs” and a Campus Second Life scholarship. We thank all 60 students who have been involved in this work.

References

[1] Aspray, W., Mayadas, F. and Vardi, M.Y. *Globalization and Offshoring of Software*, Report of the ACM Job Migration Task Force, 2006.

[2] Bartholomew, R. Evaluating a Networked Virtual Environment for Avionics Software Development. *Proc. Int. Conf. on Global Software Engineering (ICGSE'08)*, pp.227-231, Bangalore, India, August 17-20, 2008.

[3] Crosby, P.B. *Quality Is Free: The Art of Making Quality Certain*, McGraw Hill, 1979.

- [4] Damian, D., Hadwin, A. and Al-Ani, B. Instructional Design and Assessment Strategies for Teaching Global Software Development: A Framework. *Proc. 28th Intl. Conf. on Software Engineering (ICSE'06)*, Shanghai, China, May 20-28, 2006.
- [5] Damian, D. and Zowghi, D. Requirements Engineering Challenges in Multi-site Software Development Organizations. *Requirements Engineering Journal*, 8(1):149-160, 2003.
- [6] Favela, J. and Pena-Mora, F. An Experience in Collaborative Software Engineering Education. *IEEE Software*, 18(2):47-53, March/April, 2001.
- [7] Ferguson, E., Henderson, P., Huen, W. and Kussmaul, C. IT Offshore Outsourcing: Impact on CS/IS Curriculum. *Proc. 36th SIGCSE Tech. Symp. on Computer Science Education*, pp.258-259, St. Louis, Missouri, USA, February 23-27, 2005.
- [8] Gotel, O., Kulkarni, V., Phal, D., Say, M., Scharff, C. and Sunetnanta, T. Evolving an Infrastructure for Engineering, Communication, Project Management and Socialization to Facilitate Student Global Software Development Projects. *Proc. Work. On Infrastructure for Research in Collaborative Software Engineering (IRCoSE'08)*, Atlanta, USA, November 9, 2008.
- [9] Gotel, O., Kulkarni, V., Neak, L. and Scharff, C. Integration Starts on Day One in Global Software Development Projects. *Proc. Intl. Conf. on Global Software Engineering (ICGSE'08)*, pp.244-248, Bangalore, India, August 17-20, 2008.
- [10] Gotel, O., Kulkarni, V., Scharff, C. and Neak, L. Students as Partners and Students as Mentors: An Educational Model for Quality Assurance in Global Software Development. *Proc. 2nd Intl. Conf. on Software Engineering Approaches For Offshore and Outsourced Development (SEAFOOD'08)*, Zurich, Switzerland, July 3-4, 2008.
- [11] Gotel, O., Kulkarni, V., Neak, L. and Scharff, C. Working Across Borders: Overcoming Culturally-Based Technology Challenges in Student Global Software Development. *Proc. 21st Conf. on Software Engineering Education and Training (CSEE&T'08)*, Charleston, South Carolina, USA, April 14-17, 2008.
- [12] Gotel, O., Kulkarni, V., Neak, L., Scharff, C. and Seng, S. Introducing Global Supply Chains into Software Engineering Education. *Proc. 1st Intl. Conf. on Software Engineering Approaches For Offshore and Outsourced Development (SEAFOOD'07)*, Zurich, Switzerland, February 5-6, 2007.
- [13] Gotel, O., Scharff, C. and Seng, S. Preparing computer science students for global software development. *Proc. Conf. on Frontiers in Education (FIE'06)*, San Diego, USA, October 28-31, 2006.
- [14] Hawthorne, M.J. and Perry, D.E. Software Engineering Education in the Era of Outsourcing, Distributed Development Distributed Development, and Open Source Software: Challenges and Opportunities. *Proc. 27th Intl. Conf. on Software Engineering (ICSE'05)*, St. Louis, Missouri, USA, May 15-21, 2005.
- [15] Herbsleb, J.D. Global Software Engineering: The Future of Socio-technical Coordination. *Proc. 29th Intl. Conf. on Software Engineering - The Future of Software Engineering (ICSE-FASE'07)*, Minneapolis, USA, 20-26 May, 2007.
- [16] IBM and Seriosity. Virtual Worlds, Real Leaders: Online games put the future of business leadership on display. *A Global Innovation Outlook (GIO) 2.0 Report*, 2007.
- [17] Manifesto for Agile Software Development <http://agilemanifesto.org/> (accessed September 2008).
- [18] Moe, N.B. and Smite D. Understanding Lacking Trust in Global Software Teams: A Multi-case Study. *Proc. Conf. on Product Focused Software Process Improvement (PROFES'07)*, Riga, Latvia, 2007.
- [19] Moore, R.J., Cabell Hankinson Gathman, E., Ducheneaut, N. and Nickell E. Coordinating Joint Activity in Avatar-mediated Interaction. *Proc. CHI'07*, pp.21-30, San Jose, USA, April 28-May 3, 2007.
- [20] Olson, J.S. and Olson, G.M. Culture Surprises in Remote Software Development Teams. *ACM Queue*, 1(9), December/January, 2003-2004.
- [21] Petkovic, D., Thompson, G.D. and Todtenhoefer, R. Assessment and Comparison of Local and Global Software Engineering Practices in a Classroom Setting. *Proc. 13th Annual Conf. on Innovation and Technology in Computer Science Education*, Madrid, Spain, June 30 - July 02, 2008.
- [22] Purvis, M., Purvis, M. and Cranefield, S. Educational Experiences from a Global Software Engineering (GSE) Project. *Proc. 6th Conf. on Australasian Computing Education (ACE'04)*, pp.269-275, Dunedin, New Zealand, 2004.