COMPUTER SUPPORTED COOPERATIVE WORK IN THE SECOND LIFE?

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ABSTRACT

Collaborative virtual environments (CVEs), which have been a research topic in Computer Science and Human Computer Interaction for years, are becoming more and more popular for everyday use, specifically the success of Second Life being the most prominent example. These environments offer a huge potential for novel forms of human interaction and cooperation that have yet to be completely discovered and analyzed. This paper analyzes Second Life in the context of Computer Supported Cooperative Work – in what forms can Second Life contribute to facilitating joint work? Different theories from CSCW are used to classify the potential of Second Life in these regards. Our conclusions include that SL is already a good CSCW tool in many respects, particularly when it comes to awareness support and synchronous remote collaboration. Current weaknesses of SL from a CSCW perspective include asynchronous communication support and its lack of interoperability with other tools.

1 Introduction

The World Wide Web has been constantly growing and changing since its creation in the early 1970s – and it will probably continue to do so with hard- and software advances. People like to divide the development in different stages. The first stage is often titled as the "Web 1.0". In this first generation, the web was designed as a primarily static way of providing and retrieving information. Servers contained and presented this information and the users consumed it. In the late 1990s, a change slowly began. The resources in the web became more and more dynamic, as evidenced by the idea of forums and wikis which exceeded the possibilities of the first stage. The "Web 2.0" can be characterized by the fact that users can expand it and contribute. Information can be exchanged and discussions about different opinions become more and more important. The classic hierarchical information delivery is no longer the sole purpose of the web. The user has the option to participate in and design his "own web" – a fact which contributed to the name "Social Software" for Web 2.0 applications. Services like "cnn.com," for example allow the user to decide which news he wants to have on his screen and one of the options is to generate his own news feeds. Other sites like ebay or amazon.com rely on the user as an essential part of their system (in these cases, through feedback, ratings and reviews). Further, applications like del.icio.us or flickr exist for the primary purpose of allowing users to share resources – in these cases, bookmarks and photos.

The term "Web 3.0" is slowly developing. Some groups consider the Semantic Web (Fensel et al., 2002) as the main characteristic of this term. Others consider virtual realities like Second Life (SL) or "Croquet" (Smith et al., 2003) as the most important advancement of the web, justifying a new "version number". This new digital medium is not only as interactive and cooperative as the "Web 2.0", but offers integrated 3D virtual worlds with avatars (and thus representations of passive participants). This advances past the old 2D environments (Moore and Budd 2007).

The scientific community has researched virtual 3D environments for quite some time – yet, the enormous potential of these "Web 3.0" virtual worlds (which are gradually becoming more and more common as everyday tools) has not been fully explored yet. With all the media coverage, Second Life is probably the most famous example for a "Web 3.0" environment at the moment. Discussions are heated when it comes to both the idea and the implementation of Second Life, particularly in the blogosphere. Some people characterize SL as only a game (The Inquirer, September 11, 2006), while others center their view on business opportunities with in SL (Neville Hobbson, August 2, 2006). Even more radical views exist, depicting Second life as a "Money Making Pyramid Scheme" (Capitalism 2.0, January 23, 2007). In some countries, legal authorities are starting investigations about SL, e.g. because of pedophiliac content (News.com, April 12, 2006), or because the Linden Labs Money to Linden Dollar exchange policy is problematic under various gambling laws in the US (Reuters, April 4, 2007).

In addition to these discussions about purpose and legal aspects of SL, there are serious studies about the advantages of Second Life (and other CVEs) for educational purposes (Livingstone and Kemp, 2006; Brown and Bell, 2004). Results of these studies imply that collaborative virtual worlds can indeed stimulate social interactions.

In this paper, we analyze in how far today's collaborative virtual environments have the potential to be not only a means for social interaction support, but (beyond that) tools for Computer Supported Cooperative Work (CSCW). Second Life is the most popular representative of an interactive metaverse and therefore is the basis for our analyses. In the following sections, we review the most important "traditional" analysis criteria for CSCW tools, and apply them to SL.

2 Second Life as a Cooperation Platform - a Systematic Analysis

The following subsections describe the potential. or in some cases proven value, of SL as a tool for cooperative work. Each of the subsections focuses on a different "traditional" perspective on computers as collaboration tools – as contained in literature within the fields of Human Computer Interaction, Groupware, and CSCW (Dix et al. 2004; Gutwin and Greenburg, 2002; Andriessen, 2003). We start in 2.1 – 2.3 with an analysis in how far SL fits into "classical" groupware functions and categories.

2.1 Computer mediated Communication

One central function of computers within a cooperative work process is *mediating communication*. CSCW literature often structures communication support along the time/space dimensions shown in table 1. Second Life, like most 3D virtual environments, is mainly designed for people who are not close to each other in the real world; therefore, there are no specific features for co-located communication. Yet, one can well argue that the SL generates the feeling of co-locatedness – and as such attempts to support remote collaboration through simulating the feeling of being physically co-located.

Table 1. Degree of SL support for different dimensions of Computer mediated Communication

	Synchronous	*Asynchronous*
Co-Located	no specific SL support	
Remote	+: well suited, many kinds of collaboration possible	-: lack of support for basic asynchronous communication

The more interesting dimension of table 1 (for this paper) is the distinction between synchronous and asynchronous communication. Here the far more developed aspects of SL are the different options for synchronous communication. Two avatars can communicate across SL using Instant Messaging, regardless of where they are in the virtual and physical world. Using the options of internal groups, this can be expanded to a large group of people. If two or more avatars meet in the virtual world, they can also use a direct chat which can be heard by anyone in the vicinity. This is useful for ad-hoc conversations about aspects (objects) visible in SL. The person-to-person IM and the face to face meeting have the advantage that users can see when someone is typing – a form of communication awareness (see also "awareness" subsection of this paper). With the use of social protocols it is easy to run conversations this way and manage the floor control problem. The only problem that arises is when groups use the group-IM or the number of avatars becomes so large that the typing gesture cannot be seen anymore. For this case, different solutions would have to be developed (either technically or socially). One advantage of the face to face chat is that the avatars can use emotions like gestures to enhance their conversation. These gestures and the corresponding body language are very important in real life conversations, and one can argue that the movements and body gestures of a virtual avatar are a better substitute of real-life gestures than traditional text-based expressions such as smilies. Recent additions to SL include Vivox (Vivox 2007) and Second Talk (Second Talk 2007). These are new tools which allow conversations using Voice over IP. Last year, Vivox even offered an option to call real-life phones from SL (Second Life Insider 2006). Second Talk uses the technology of Skype. In this case the user needs a regular Skype account to use it in SL. Linden Lab also announced even more advanced features of audio communication and plans to augment SL with localized audio conversations which model the "authentic" hearing model in the real world (ITWire 2007; Reuters Second Life News 2007). If different audio streams are merged intelligently in real time (to integrate "surrounding" sound and personal communications), this has the potential to become a powerful groupware tool.
The second dimension of communication is related to the asynchronous case – i.e., persons communicating with each other with a longer time delay between message sending and receiving. The most traditional and successful asynchronous communication medium is email, which is also embedded into SL: since IM can be sent per email to an offline member and are available once the person logs in again, a basic asynchronous communication function is available. The use of note cards allows writing larger messages with objects attached. Since every avatar and every object in SL has a unique identification key, the use of scripting allows note cards to be mailed to different people easily if the keys of the recipients are known. Using groups in SL also simplifies the distribution of messages and allows for group multicasts.

Beyond these “basic” features however, the asynchronous communication features in SL are not well developed. Structured asynchronous communication, such as threaded discussions ordered by topic or time or the versioning of objects that are being co-developed by groups, is not supported at all.
Another important aspect for asynchronous group work is the possibility to save conversations and decisions for later reference. An example: if someone arrives late to a discussion, he might need the option of reading the past conversation to be able to understand the current state. While the histories of the conversations are available during the current session, there are no options to save them permanently in SL. Another missing feature is the option to create subgroups for discussions not including all members of a given group. Figure 1 illustrates most of the conversation options. On the top, three options are presented from left to right: The group information with its members, a note card, and a group notice. On the bottom right the IM window is placed having different folders for various private or group discussions. The bottom left holds the history of the local conversation. This demonstrates that Second Life covers most aspects of synchronous communication considered important for CSCW.

Figure 1: Conversation options in SL

2.2 Meeting and Decision Support Systems

The second important function of CSCW tools include meeting and decision support. Here typical systems include argumentation tools, meeting rooms, and shared drawing surfaces. Groups in SL have options for presenting proposals and voting. These voting decisions are also recorded for future reference. SL also allows virtual meeting rooms where avatars can meet for discussion. With the high degree of communication support and action awareness, this alone can be considered a meeting support. However, there is no general implementation of an explicit “shared workspace” with the notable exception of the shared editing of objects. A facility for noting shared results is missing. Overall, SL still has to improve in many aspects to really become a useful meeting and decision support tool.

2.3 Shared Applications and Artifacts

Besides communication and decision support, the third important function of CSCW tools is the provision of shared artifacts to work with jointly. People work on different things while in Second Life. Most of them work on creating virtual objects. For this task, Second Life supports cooperative work. Using shared permissions, users can jointly work on the same object (to a certain extend even at the same time). The only weakness with respect to jointly working on SL objects is the scripting part. In this instance, shared permissions do not work well – currently, it is not adequately supported to allow users to create a dynamic object with scripted behavior in collaboration with co-workers (see use cases in the next section for more detail). Sharing non-SL artifacts (like a text document or a spreadsheet) for joint work in SL is even more problematic. SL currently is not a suitable tool for these kinds of tasks.

2.4 Awareness

Awareness in groupware is an important factor (Gutwin and Greenburg, 2002). Knowing “what is going on in the system” is essential for groupware users. SL has a lot of tools helping awareness; for example, avatars can always see where other avatars are located, if they are working with an object or typing in local conversations. These are all aspects contributing to an awareness-rich environment.

Answering the question “who is there?” (situational awareness) is essential for successful group activities because people like to know about the status of their coworkers. As long as the coworkers are logged into SL you have a chance to see their position. For example, Figure 1 shows a list of all online members of a group. There are also possibilities of generating “awareness objects” which show when someone is online. Once you are in visual range, it is possible to see some of the avatars current actions such as the typing posture in figure 2 or the object selected in figure 3.

The question “what has happened?” (workspace awareness and situation awareness) is also central to answer in groupware tools. In SL, if a new object is created or an existing object is changed it is normally easy to see the changes. More subtle changes (script, minor size modifications) can usually go unnoticed. On the other side, email notifications are sent if another user has received or accepted objects (like note cards) sent to him.

The third important awareness question “How did it happen?” (workspace awareness) is normally not possible to answer in SL unless visible changes are closely observed. Even in this case no detailed data is available, only the observable parts might allow conclusions about the actions taken. SL is therefore covering situational awareness and parts of the workspace awareness.

Figure 2: Awareness in SL - typing movements help to structure conversations

Figure 3: Pointing at the object to edit combined with a line of white dots helps with workspace awareness

2.5 Group Process Support

Andriessen (2003) identified five different group processes that groupware can support. While two of these have already been discussed in this paper (*communication* and *cooperation*), the third is *coordination*. In addition to the voting feature mentioned before, SL offers some other coordination functions. It is possible to assign certain roles inside a group. Yet, it does not seem possible to systematically coordinate workloads, which is an important aspect of coordinated work. *Knowledge sharing*, the fourth group process in the categorization of Andriessen, has different aspects in SL. First of all, SL has a large user community and a lot of people are willing to help with any problems concerning SL. This is a huge advantage when it comes to any problems concerning building or scripting objects. Second Life can also be used to share knowledge. Mason and Moutahir (2006) have demonstrated how SL can be used to successfully train students using SL as a shared workspace – this exemplifies the knowledge sharing potential of SL. The fifth type of group process is the *social interaction* of group members. In goal-oriented short-time groups, this aspect is normally less important. For longer projects, group members normally try to meet in person to better get to know each other. Typically, these personal meetings can in parts be substituted by video conferences in later phases of the project. Studies by Haythornthwaite et al. (2000) showed that initially existing social bonds can be easily expanded and recreated using digital media. It remains to be investigated if SL is immersive enough to replace real life meetings all together. The idea of SL is to create an alternative social setting: communication is possible in many forms, and the individualization of avatars helps to represent certain personal characteristics of the users. Whether or not these social interactions can create bonds similar to real meetings is a topic to be studied in the future. In summary, for the most part, the current features in SL support the five group processes. Stronger support of coordination is needed to cover all aspects.

2.6 Requirements Analysis

Having looked at different functions of groupware in the previous subsections, we conclude this section with a more global view combining different requirements for cooperation. The integrated theory upon which this view is based has been presented by Andriessen (2003), who combined different aspects from Activity Theory, Action Theory, (Adaptive) Structuration Theory, Technology Acceptance Theory, Media Match Theory and more. Andriessen describes 7 different requirements for the design (and evaluation) of collaboration technology tools – table 2 shows how SL can be characterized in terms of these requirements.

Table 2: Groupware requirements – and how SL fulfills them

Parameter	Description	Evaluation of SL	Relevant Theory
Technical efficacy	Tool evaluation includes aspects of functionality, reliability/robustness, portability, maintainability and others	The hardware requirements of SL are fulfilled by all currently sold computers. DSL and Cable are slowly becoming the standard, but there are still a lot of locations where slower connections present problems. The other problem is the lack of robustness of SL. It happened in the past that servers were shut down or crashed without warning. During peak access time, the system also becomes much less fluent. Graphical inconsistencies also happen quite frequently.	
Context match - Fitting the user	Systems have to be easy to use. Most users are not interested in spending a long time learning a complicated tool. The rewards have to be really large to invest learning time at the beginning	SL is a user-friendly environment. The tutorial teaches a lot of the necessary basic skills. Combined with the help option, web-knowledge bases, and the help of other users, most of the features can be learned and used easily.	Action Theory
Context match – Fitting the task	Users need the functionalities for the task.	This depends on the specific uses of SL. Different uses of SL and its (dis)advantages were discussed earlier. SL not only supports cooperative work, but also the work of single individuals.	Technology Acceptance Theory; Media Match Theory
Context match – Matching the social and physical setting	Group structure, composition and background need to be considered.	SL allows to outwardly represent some of the cultural differences while making them visible to all members of the group. In an international cooperation, an Asian group might design their work area and avatars differently than British workers. If a group member meets his coworkers in their environment he is confronted with a different visual setting helping to remind him of the potential cultural differences existing between him and the other person.	Social Psychology; Group Dynamic Theories
Interaction process support	The software should support intended processes without hindering others. These are basically the 5 aspects discussed above. Individual task performance is also an important aspect and should never be hindered.	SL might not support all of these functions, but also does not present any obvious obstacles. The only exception is that running SL in the background might divert computer power and bandwidth. There is also the possibility that the attention of the user gets distracted.	Activity Theory
Outcome support	The tool should contribute to the outcomes and not hinder other outcomes.	SL might not contribute a lot towards products created for the outside of SL. But with the strong social component it helps with group and possibly personal outcomes. Organizational outcomes seem to get little support by SL.	Theories for quality of work, of group dynamics and of organizational effectiveness
Introduction, adaption and group development	The tool should be adaptable by users and groups.	The system allows a lot of modifications by the users, therefore helping them to adapt it to their working style. On the other side, any changes to the core of SL have to be made by Linden Lab. There is no official plug-in architecture at the moment. Yet, Linden Lab constantly expands SL trying to fulfill the needs of the community. Therefore adaption does happen, but not in an open manner.	Adaptive Structuration Theory; Change Theories

3 Use Cases

In the last section, Second Life was analyzed based on different CSCW theories from a rather theoretical point of view. In this section, we now focus on four different "use cases" and discuss the possibilities and limitations of SL as a CSCW tool for these applications. The choice of our use cases is guided by the following questions: 1) whether SL is used as an *exclusive* tool or not, and 2) whether the aim is to generate exclusively SL content or not. SL-only here means virtual objects and scripting for objects. This results in 4 different combinations, which will be presented in the next subsections.

3.1 SL as an Exclusive Tool to Generate SL Content

This "completely SL-embedded" scenario is characterized by groups of avatars cooperating to generate digital content (i.e., virtual objects) that is to be used within SL. Here the permissions and communication options discussed earlier in this paper show their full potential. Combined with the help of the SL community (which is frequently available for building topics), a group of actors can indeed construct a lot of things. The motivation for people to cooperate can have different reasons: social bonds to other people, joint interests (e.g., for creating large areas of SL for gaming purposes, or for designing virtual worlds that resemble physical worlds), standing in the community, or business interests (e.g. specialists helping in the creation of better objects for fees; objects which can be sold for Linden dollars). While this first use case is well supported by SL, large problems remain. The most pressing one is probably the lack of collaborative programming support: scripts cannot be edited jointly in a simple manner, which hinders effective teamwork on complex objects with dynamic behavior.

3.2 SL in Combination with External Tools to Generate SL Content.

If the aim of a collaborative work activity is to create SL content, but SL is just one of the tools to be used, that could theoretically change the situation – a greater variety of tools usually means better tools are available for a given task. However, in practice there is not much difference when compared to the first use case: the SL-internal tools are well suited for creating SL content (or, put differently, there are no alternative better tools!), and the primary weakness of SL (collaborative script editing) cannot easily be overcome through the use of external tools. While it would of course be possible to edit scripts collaboratively in a group editor, transferring this data into SL would essentially mean manual copy&paste operations done by the only person who is entitled to do so, which is a very weak form of "collaborative script editing". In terms of communication support however, a weakness of SL (poor asynchronous communication) can be overcome by means of using websites, wikis and forums on the "old Web 2.0", which help with asynchronous and structured communication facilities.

3.3 SL as an Exclusive Tool to Generate External Content

For a lot of companies it is interesting to use the cooperation functions of collaborative virtual worlds such as SL for the development of products which are outside of SL. Again, two different use cases can be divided: using SL only and using SL as one of many tools. Since SL has a simple, integrated 3D-CAD generator, a very attractive and intuitive use case for the first category (SL as exclusive tool) is computer aided collaborative design. Potential problems with espionage can be overcome using private properties of objects, and construction areas that are not observable by others. If the digital ownership rights agreement between Linden and the user holds-up before court, ownership will probably not be an issue either. Currently however, successful implementations of collaborative design applications are hindered by several other problems. First, a set of problems is associated with data security and availability. SL does not guarantee access at all times, and some hacks of the system have already been reported (The Inquirer, September 11, 2006). Linden also does not guarantee that personal creations are protected in case of server crashes. Second, the poor data exchange options between objects created inside and outside of SL create a problem. Such a transfer would be necessary to use existing designs within SL, and to re-use SL creations in external tools. Third, a problem for more advanced engineering and design tasks is that the design tools within SL are very limited. Here, one major restriction is the limit of 255 elements in one object. The atomic elements (primes) can also have only limited shapes. With creative manipulations, this is more than enough to create the illusion of complex objects to the viewer (especially if complex textures are used). Yet, it is not enough for complex designs to be transferred to the real world. For these reasons, SL is currently not a good choice as an exclusive tool for these tasks since a professional 3D tool in combination with NetMeeting or similar desktop sharing software could constitute a more powerful working environment – albeit one that lacks advanced communication features.

3.4 SL in Combination with External Tools to Generate External Content

Finally, if SL is used in combination with other groupware tools for the purpose of developing "Non-SL" content, the collaborative virtual world shows its full potential and offers numerous possibilities. As discussed

earlier, SL is sufficient to fulfill most needs in the synchronous communication sector. Through the improved presence and personality of actors (as compared to "Web 2.0" applications), SL has the potential to augment remote synchronous collaboration almost to the level of co-locatedness (though studies will be needed to support this hypothesis). One simple example application is to replace traditional video conferences with virtual meeting rooms inside SL, thereby reducing the required network bandwidth and the required physical resources (i.e., costly videoconferencing or meeting rooms). The degree of social authenticity will probably be smaller in virtual meetings than in videoconferences, but the additional communication functions in SL (private messages, shared written notes, etc) can possibly make up this drawback.

4 Conclusions

This article discussed weaknesses and strengths of SL as a tool for computer supported cooperative work. The potential and current possibilities of the system were analyzed based on different HCI and CSCW theories. In many respects, SL is already a good CSCW tool that might develop beyond the gaming and education fields towards other professional fields. The authors are aware that SL is constantly changing as Linden Lab is developing new features – e.g., the inclusion of an audio surrounding will improve communication. We do believe, however, that this paper has shown some *structural* advantages and disadvantages of SL as a cooperation tool that are not likely to change with new system revisions and bug fixes.

The advantages include the high potential of SL as a platform for supporting remote synchronous collaboration (by providing an almost "co-located" experience) and the numerous kinds of awareness and social identity expression that SL – different from most "Web 2.0" tools – supports.

Apart from these, the article has also identified current important challenges for the further development of SL as a collaborative work tool. One major aspect that is noticeably missing in SL is an integrated *asynchronous* communication system such as a structured message board. This would probably help cooperation. The fact that Linden Lab has forums on their websites shows that the need for such a medium has been recognized. The inclusion of an internal browser into SL would allow the "Web 3.0" to seamlessly access the "older Webs". For cooperative work, this would also allow utilizing the advantages of the more textually oriented traditional web resources in combination with SL, thereby making SL a more powerful tool for digital conversation purposes.

One further problem with SL is the commercial aspect. For groups to effectively use it, money needs to be invested. Many activities such as the creation of groups and the uploading of files all cost money, and virtual land is needed for developments. This has to be bought and is constantly taxed. We do not to posit that all good software should be free. Users are of course willing to pay for quality products, and maybe they are willing to pay for cooperation services (though this is questionable, given the available free tools). Unlike most commercial software, cooperation in SL does not have cost fixed value for each license and maybe for support or updates, but is based on a "pay per use" which is additionally complicated based on the fluctuating value of the virtual currency Linden Dollar. These changing values make book keeping much more difficult. This might still be cheaper than buying other commercial software, but paired with the low security and data availability guarantees of Linden Lab, this greatly reduces the appeal for commercial use.

In summary, we believe there is a need for in-depth studies to determine the actual effectiveness of SL as a CSCW tool in the practical field. In particular, it would make sense to conduct long-term studies and look at the communication and conversation behavior of collaborators, the media choice, and media role or social interactions. Networked digital media are not only capable of recreating and expanding on existing social bonds, but can also help in creating completely new bonds between people who do not know each other personally. But how does a virtual reality as rich as SL affect these bonds? Can bonds between avatars be as strong as bonds in real life? In the past years some people actually started to place stronger importance on online appointments of their avatar than on real life friends ("I cannot come to the party tonight. We have a guild meeting in World of Warcraft" is a quite common saying by students). Without judging this trend, the question of its implication remains interesting. If these bonds are so strong, can groups of people working together in a virtual environment be as effective as a group meeting in real life? How do these bonds influence their work efficiency and their subjective feeling of workload? Based on the analysis in this paper, we believe that collaborative virtual environments like SL can be an interesting research topic that promises interesting results in the field of CSCW.

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