Online Communities

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1 Introduction

The expansion of the Internet has resulted in an increase in the usefulness of Computer Mediated Communication (CMC) and the popularity of online communities. It is estimated that 25% of internet users have participated in chat rooms or online discussions (Madden & Rainie, 2003).

This chapter begins with an introduction to the area of CMC and Online Communities by providing their definitions as well as their advantages and disadvantages. Different types of CMC are then introduced and two special types of online communities are described in more depth. More specifically, we pay special attention to the evolution of Wiki and game based communities. These two relatively new areas of online sociability create new opportunities and challenges in the way people work, learn and play online. Wiki-based communities facilitate new modes of social collaboration, where the creation of online content is no longer an individual action but rather it is transformed into a social, collaborative activity. Massively Multi-Player Online Role Playing Games (MMORPGs) have taken the social aspects of computer game playing to a new dimension, where players interact, socialize and form networks of communities by having fun online.

Online communities are a source of valuable data that, when properly analyzed, can provide us with insights about the social experience people who are part of them have. For this reason, the analysis and evaluation of online communities requires a good understanding of all the available evaluation frameworks and methodologies that exist. We provide a description of the key methods in section 3 of this chapter. We then (in section 4) demonstrate the application of some of these methods to two characteristic case studies. Our first case study looks at how learning communities can be analyzed and how results from this analysis can be used for improving the pedagogical value of e-learning. The second case study investigates the use of activity theoretical frameworks in the analysis of computer game-based communities. We then conclude this chapter with a brief summary and suggestions for new directions in the area of online communities.

2 CMC and Online Communities

2.1 Computer Mediated Communication

It is by now no secret how vital the Internet was, is, and will continue to be in our lives. One of the most important characteristics of this medium is the opportunities it offers for human-human communication through computer networks. As Metcalfe (1992) points out, communication is the internet's most important asset. E-mail is just one of the many modes of communication that can occur through the use of computers. Jones (1995) points out that through communication services, like the Internet, Usenet and bulletin boards, online communication has for many people supplanted the postal service, telephone and even the fax machine. All these applications where the computer is used to mediate communication are called Computer-Mediated Communication (CMC).

December (1997) defines CMC as "the process by which people create, exchange, and perceive information using networked telecommunications systems (or non-networked computers) that facilitate encoding, transmitting, and decoding messages". He emphasizes that studies of CMC view this process from different interdisciplinary theoretical perspectives (social, cognitive/psychological, linguistic, cultural, technical, political) and often draw from fields such diverse as human communication, rhetoric and composition, media studies, human-computer interaction, journalism, telecommunications, computer science, technical communication and information studies.

2.2 Online Communities

Online communities emerge through the use of CMC applications. The term online community is multidisciplinary in nature, means different things to different people, and is slippery to define (Preece, 2000). For purposes of a general understanding of what online communities are, Rheingold's definition of online communities is presented:

"[online] communities are social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (Rheingold, 1993, pp.5).

Online communities are also often referred to as cyber societies, cyber communities, web groups, virtual communities, web communities, virtual social networks and e-communities among several others.

The cyberspace is the new frontier in social relationships, and people are using the internet to make friends, colleagues, lovers, as well as enemies (Suler, 2004). As Korzeny pointed out, even as early as 1978, online communities are formed around interests and not physical proximity (Korzeny, 1978). In general, what brings people together in an online community is common interests such as hobbies, ethnicity, education, beliefs. As Wallace (1999) points out, meeting in online communities eliminates prejudging based on someone's appearance, and thus people with similar attitudes and ideas are attracted to each other.

It is estimated that as of September 2002 there are over 600 million people online (Nua Internet Surveys, 2004). The emergence of the so-called "global village" was predicted years ago (McLuhan, 1964) as a result of television and satellite technologies. However, it is argued by Fortner (1993) that "global metropolis" is a more representative term (Choi & Danowski, 2002). If one takes into account that the estimated world population of 2002 was 6.2 billion (U.S Census Bureau, 2004), then the online population is nearly 10% of the world population – a significant percentage which must be taken into account when analyzing online communities. In most online communities, time, distance and availability are no longer disseminating factors. Given that the same individual may be part of several different and numerous online communities, it is obvious why online communities keep increasing in numbers, size and popularity.

Preece et al. (2002) states that an online community consists of people, a shared purpose, policies and computer systems. She identifies the following member roles:

- Moderators and mediators: who guide discussions/serve as arbiters
- Professional commentators: who give opinions/guide discussions
- Provocateurs: who provoke
- General Participants: who contribute to discussions
- Lurkers: who silently observe

CMC has its benefits as well as its limitations. For instance, CMC discussions are often potentially richer than face-to-face discussions. However, users with poor writing skills may be at a disadvantage when using text-based CMC (Scotcit, 2003). Table 1 summarizes the advantages and disadvantages of CMC (Scotcit, 2003).

Table 1- Advantages and Disadvantages of CMC

Advantages
• Time and place independence
• No need to travel
• Time lapse between messages allows for reflection
• Participants have added time to read and compose answers
• Questions can be asked without waiting for a 'turn'
• It allows all participants to have a voice without the need to fight for 'airtime', as in a face-to-face situation
• The lack of visual cues provides participants with a more equal footing
• Many to many interaction may enhance the communication
• Answers to questions can be seen by all - and argued
• Discussion is potentially richer than in a face to face situation
• Messages are archived centrally providing a database of interactions which can be revisited

Disadvantages
• Communication mainly takes place via written messages so participants with poor writing skills may be at a disadvantage
• Paralinguistic cues (facial expression, intonation, gesture, body orientation) as to a speakers' intention are not available, except through combinations of keystrokes (emoticons) or the use of typeface emphasis (italics, bold, capital letters)
• Time gaps within exchanges may affect the pace and rhythm of communications leading to a possible loss in textual coherence
• The medium is socially opaque; participants may not know who or how many people they may be addressing

- The normal repair strategies of face-to-face communication are not available and misunderstandings may be harder to overcome

- Context and reference of messages may be unclear and misunderstandings may occur

2.3   Examples of CMC and Online Communities

Examples of CMC include asynchronous communication like email and bulletin boards; synchronous communication like chatting; and information manipulation, retrieval and storage through computers and electronic databases (Ferris, 1997). Table 2 lists the main types of CMC, their mode (synchronous or asynchronous) and the type of media they support (text, graphics, audio, video).

When it comes to website designers, choosing which CMC to employ (for instance, forum or chat-room) is not a matter of luck or randomness. Selecting the right CMC tool depends on a lot of factors. For example, in the case of e-learning, the choice of the appropriate mode of CMC will be made by asking and answering questions such as (Bates, 1995; CAP, 2004; Heeren, 1996; Resier and Gagne, 1983):

- Are the users spread across time zones? Can all participants meet at the same time?
- Do the users have access to the necessary equipment?
- What is the role of CMC in the course?
- Are the users good readers/writers?
- Are the activities time independent?
- How much control is allowed to the students?

Table 2 - CMC systems, their mode, and they types of media that they support

Type of CMC	Communication Mode	Supports			
		Text	Graphics	Audio	Video
Audio conferencing	Synchronous	Some applications	No	Yes	No

Video conferencing	Synchronous	Yes	Yes	Yes	Yes
IRC	Synchronous	Yes	as attachments	as attachments	as attachments
MUD	Synchronous	Yes	No	No	No
WWW	Sync & Async	Yes	Yes	Yes	Yes
E-mail	Asynchronous	Yes	as attachments	as attachments	as attachments
Newsgroups/BBS	Asynchronous	Yes	No	No	No
Discussion Boards	Asynchronous	Yes	as attachments	as attachments	as attachments
Voice mail	Asynchronous	Some applications	No	Yes	No
Wiki	Asynchronous	Yes	Yes	Yes	Possible
Online Virtual Game Environments	Synchronous	Yes	Yes	Yes	Yes

Audio-conferencing is a real time communication mechanism, since the communication happens synchronously. Depending on the application, text chat and graphics may also be supported. Videoconferencing, like audio-conferencing, offers a useful mode of communication, but has the added benefit of being able to also see the participants, instead of just hearing them.

IRC and chats also support synchronous communication, since they enable the users to carry out conversations through the use of text messaging. MUDs build on chats by providing avatars and graphical environments where the users can engage in interactive fantasy games (Preece, 2000).

WWW Websites are usually asynchronous providing community information and links to other sites, but sometimes also have synchronous software, like chats, embedded in them (Preece, 2000).

Email is an asynchronous mode of communication usually in the form of text. However, the ability to add attachments to email messages makes it possible for audio, video and graphics to be used also.

Voice mail is an expansion of email whereby users may record themselves speaking out a message and then send that voice file to their contact, instead of typing it. Newsgroups, like email, provide an asynchronous mode of communication, but unlike email where the messages come to the users, it is a "pull" technology meaning the users must go to the UseNet groups themselves (Preece, 2000). Finally, discussion boards, also referred to as forums or bulletin boards provide an asynchronous mode of communication where the users post messages for others to see and respond at their own time.

Preece (2000) describes in detail some of these types of CMC and their different characteristics. In this chapter, we focus on Wiki and Online Virtual Game Environments which in our view provide a set of new, novel modes of communication and online community building systems.

2.3.1   Wiki-based Communities

The "Wiki", named for the Hawaiian word "quick" is a new technology that embodies the notion of new media use where everyone is the author. It is a freely expandable collection of hypertexts which can be easily edited by any user with knowledge of a very simple mark-up language. It does not require any specific tools; all you need is a form-capable web browser client. This simplistic method gives the freedom to everyone reading the page to amend or correct what they are reading. This aims to encourage people to contribute to the expansion of the page (Halvorsen, 2005). Every user can be an author by simply clicking the edit button, changing the current text and submitting the new version, which is then converted into HTML automatically.

Wikis are a system that explicitly supports collaboration and community building as it decentralizes the effort of creating a website from the hands of the few and distributes it to a huge community of internet users. In a Wiki environment, users are not only editing, they are also encouraged to create their own content and their own pages. A link to existing pages can be made easily, and a new page can be created by making a new link. Thus, apart from contents, the users also co-design the structure of a Wiki site.

The goal of Wiki sites is to become a shared repository of knowledge, with the knowledge base growing over time. Unlike chatrooms, Wiki content is expected to have some degree of seriousness and

permanence. In a Wiki, it is the users who create the content in collaboration and over time. Like Weblogs, Wikis have been around for some time and are popular among the technology community. However, Weblogs can be highly personal while Wikis are intensely collaborative. Whereas Weblogs tend to use a modified WYSIWYG editing environment, Wikis use a simple set of formatting commands.

Recently there is an increasing interest in using Wikis for learning (Wang et. al. 2005, Jones 2003). Although any knowledge building application that demands the absolute and immutable integrity of the content is not really suitable for a Wiki, it is useful in situations where communities of people are developing shared ideas, values or resources. A Biology teacher for example could start a Wiki site by posting some material creating a tentative structure of the subject, and uploading some media files. When the students visit, they can expand the contents by modifying or posting more material, making links to new pages, thus enriching the learning resources. Through shared construction cycles the students feel closer to the learning system as they contribute to its development instead of being passively presented with the information.

A project has already been undertaken to re-build a web-based learning site for spectroscopy using Wiki technologies with the goal to make the resource more relevant and content-rich, to attract authors from different backgrounds to provide contents in multiple languages to support the international users (Mader 2004). Perhaps the most famous educational Wiki in existence is Wikipedia (Wikipedia, 2005) a free-content encyclopedia in many languages that anyone can edit. It is the result of a vast collaboration and currently contains over a million entries in multiple languages. The Wikipedia project shows that the model might work, and that groups of people can collaboratively create shared knowledge artifacts.

However, a Wiki site could be highly unstructured as there is no editorial function that examines the contributions and guarantees quality or accuracy of its content. It is the responsibility of the users to ensure correctness and it is their collective responsibility to take care of all aspects of policy, such as appropriate behavior in the community as well as rules (Halvorsen, 2005).

Since anyone can literally contribute anything, vandalism sometimes occurs within Wikis. Therefore, version control is crucial. Each version is saved, so that it is easy to reverse to a former version if necessary (Emigh & Herring, 2005). Studies have confirmed that vandals are often stopped and the vandalized pages are reversed quickly (Viégas, Wattenberg & Dave, 2004; Aronsson, 2002).

Wiki-based collaboration could be a very practical platform for asynchronous distributed brainstorming as Wikis allow ideas to be captured quickly, they facilitate elaboration on existing ideas and document the evolution of revisions made to ideas.

With the increasing popularity of Wikis, it is not surprising that recently it has been used to assemble online communities of various interests. The central access for all users has made the Wiki appropriate for project work, document production, the joint development of project concepts, and discussion forums of all types.

The Wiki technology appears to be a suitable approach for supporting cooperative community especially for knowledge generation. One of the reasons that make it a successful tool for community building is its anyone-can-contribute policy, where producing new pages is quick and easy, as is linking them to existing pages.

Moreover, it also provides a simple means of communication through the discussion section associated with each Wiki page as well as the history entry which keeps track of the changes made by every user. In such a way, the users are constructing and discussing the page at the same time within the same space. This results in the rapid appearance of a chaotic network of Wiki pages and the knowledge grows organically. Facilitated by the Wiki technology, users can contribute and integrate knowledge into and obtaining knowledge from the existing database created by others.

The particular advantage of the Wiki approach compared to other CMC tools on knowledge generation and exchange systems is the focus on both the process as well as the result of communication (Kittowski, F.F. & Köhler, A., 2002)

Discussion boards focus largely on the process of the communication where opinions are exchanged, conflicts are resolved and agreements are achieved regarding the documents/projects which are being worked. The document/project itself is not being worked/expanded explicitly through the use of discussion boards; instead only after the consensus is reached, will the project/document be worked by extracting ideas from the postings of the discussion.

Content and document management systems are used to organize and facilitate collaborative creation of documents and other content. It is usually applications for maintaining documents, including version controls, right of access, document protections, etc. In term of collaboration, it allows the process of expansion for each document version by several people. Communication processes and discussions that lead to the end product are limited, for example, to annotations.

Wikis, in contrast, permit users to discuss and work on the document simultaneously. Moreover, cooperative production of content becomes very efficient through the realignment of the distinction between author and reader. Thus, the Wiki's features largely fulfill the requirements for a tool to support cooperative knowledge building community.

In fact, many Wikis are collaborative communities. As mentioned previously, Wikis allow anyone to click the "edit button" and change the Website. Surprisingly, many Wikis are able to do this successfully without major issues in terms of vandalism. One of the important vandal control features is that the Wiki stores the history of each page. Thus, for each vandal, there is probably a group of people who actually needs the information that was removed through vandalism, and who will reverse the page to its former version. In addition, some Wikis are in fact not completely open as they restrict access, while some even have a democratic error/vandalism reporting system.

2.3.2   Online Virtual Game Communities

With the advent of ubiquitous broadband internet connection and the increasing graphical processing power of personal computers, a new paradigm of gaming has emerged. Massively Multi-Player Online Role Playing Games (MMORPGs) have changed the game industry dramatically. MMORPGs provide

a fictional setting where a large group of users voluntarily immerse themselves in a graphical virtual environment and interact with each other by forming a community of users.

Although the concept of multiplayer gaming is not new, the game world of most local network multiplayer games, as opposed to MMORPG, are simplistic and can accommodate only around 16 concurrent players in a limited space.

A MMORPG enables thousands of players to play in an evolving virtual world simultaneously over the Internet. The game world is usually modeled with highly detailed 3D graphics, allowing individuals to interact not only with the gaming environment, but also with other players. Usually this involves the players representing themselves through the use of avatars – the visual representation of the player's identity in the virtual world.

The MMORPG environment is a new paradigm in computer gaming in which players are part of a persistent world, a world that exists independent of the users (Yee, 2005). Unlike other games where the virtual world cease to exist when players switch off the game, in an MMORPG, the world exists before the user logs on, and continues to exist when the user logs off. More importantly, events and interactions occur in the world even when the user is not logged on as there are many other players who are constantly interacting, thus transforming the world. To accommodate the large number of users, the worlds in MMORPGs are vast and varied in term of 'geographical locations', characters, monsters, items, etc. More often than not, new 'locations' or items are added by the game developers from time to time according to the demand of the players.

On one hand, a MMORPG like a Role Playing Game (RPG); it involves killing monsters, collecting items, developing characters, etc. It however contains an extra aspect which is the internal sociability within the game. Unlike single player games which rely on other external modes of communication (such as mailing lists, discussion forums outside the game) to form the gaming culture, the culture is formed within the MMORPG environment itself.

In such a way, these MMORPG virtual worlds represent the persistent social and material world, which is structured around narrative themes (usually fantasy), where players are engaged in various activities: slay monsters, attack castles, scavenge goods, trade merchandise, etc. On one hand, the game's virtual world represent the escapist fantasy, on another, it supports social realism (Kolbert, 2001).

That means games are no longer meant to be a solitary activity played by a single individual. Instead, the player is expected to join a virtual community that is parallel with the physical world, in which societal, cultural and economical systems arise. It has been gradually becoming a world that allows players to immerse into experiences which closely match those of the real world; virtual relationship is seek, virtual marriage is held, virtual shops are set up, etc.

The MMORPG genre now boasts hundreds of thousands of users and accounts for millions of dollars in revenue each year. The number of people who play the games (and the time they invest in terms of activities within and around the game) is astounding. The MMORPG, Lineage (NCsoft, 2005), for example, had more than 2.5 million current subscribers in 2002 (Vaknin, 2002) and, within a year, Ultima Online (Electronic Art, 2005) attracted more than one hundred and sixty million person-hours (Kolbert, 2001).

Such games are ripe for cultural analysis of the social practices around them. Although fundamentally, MMORPGs are video games with virtual spaces with which the players interact, they should be regarded not just as a piece of game software; they are a community, a society and if you wish, a culture. These games are becoming the most interesting interactive computer-mediated communication and networked activity environment (Taylor, 2002). Thus, understanding the pattern of participation in these game communities is crucial, as such virtual communities function as a major mechanism of socialization of the players to the norms of the game culture that emerges as Squire and Steinkeuhler (in press) has noted:

"Playing one's character(s) and living in [these virtual worlds] becomes an important part of daily life. Since much of the excitement of the game depends on having personal relationships and being part of

[the] community's developing politics and projects, it is hard to participate just a little" (Squire, Steinkeuhler, in press)

Recently game designers have tried to stretch the boundaries further by structuring in-game activities to maximize interaction. One of the examples of sociability by design in MMORPG is Star Wars Galaxies (Sony, 2005) which is organized so that players are steered towards certain locations in the game world where social playing is expected to take place (Ducheneaut et. al. 2004)

Such communities formed around the game can be broadly divided into two categories: in-game and out-of-game communities. Most MMORPGs are created to encourage long term relationships among the players through the features that support the formation of in-game communities. One of the most evident examples is the concept of guilds. Guilds are a fundamental component of MMORPG culture for people who are natural organizers to run a virtual association which has formalized membership and rank assignments to encourage participation. Sometimes, a player might join a guild and get involved in a guild war in order to fight for the castle. Each guild usually has a leader and several guilds could team up in a war. This involves a complicated leader-subordinate and leader-leader relationship.

In addition, to encourage social interaction, MMORPGs are specially designed in such a way that some game goals are almost impossible to be achieved without forming communities. For example, one player alone could spend a long period of time collecting all of the items needed to assemble a device. But a guild could ask its members to fan out in small groups and collect all of the necessary components in one day. Complex devices beyond the reach of any individual player could be quickly constructed by the guild. The guild could also accept donations from members and then distribute those contributions to others according to their needs, benefiting everyone as a result of this collaboration (Kelly, 2004).

Apart from relatively long-term relationship such as a guild communities, MMORPGs also provide many opportunities for short-term relationship experiences. For example, a player could team up with

another player to kill monsters in order to develop the abilities of their avatars (level up) or some more expert players could help newer players to get through the game.

When trying to win the game, players often need to get information from other resources: guidebooks, discussion forums, other players, etc. Therefore game playing is generally more concerned with player-player interaction than with player-game interaction. What is at first confined to the game alone soon spills over into the virtual world beyond it (e.g., websites, chatrooms, email) and even life off-screen (e.g., telephone calls, face-to-face meetings).

Apart from these external communities around the game which are mediated through e-mails or online forums (which also exist in many other games), there is an interesting phenomenon that fuses the internal and external game communities. The participation in an external community starts to break the magic circle of the game – that game space is no longer separate from real life – as the out-of-game community trades in-game items for real money.

For example, Norrath, the world of EverQuest, was estimated to have the seventy-seventh largest economy in the real world based on buying and selling in online auction houses.

"About 12,000 people call it their permanent home, although some 60,000 are present there at any given time. The nominal hourly wage is about USD3.42 per hour, and the labors of the people produce a GNP per capita somewhere between that of Russia and Bulgaria. A unit of Norrath's currency is traded on exchange markets at USD0.0107, higher than the Yen and the Lira." (Castronova 2001)

Having illustrated the social phenomenon around such playful virtual community, it is believed that it is fruitful to research such communities as we might be able to derive some useful implications on how successful Computer Supported Collaborative Work (CSCW) and Computer Supported Collaborative Learning (CSCL) environments can be designed. For this reason, in the next section we will describe some of the methodologies that can be used in such studies, and in section 4 we will present the application of some of these methods to two case studies.

3 Analyzing Online Communities: Frameworks and Methodologies

There are various aspects and attributes of CMC that can be studied to help us better understand online communities. For instance, the analysis of the frequency of exchanged messages and the formation of social networks, or, the analysis of the content of the exchanged messages and the formation of virtual communities. To achieve such an analysis a number of theoretical frameworks have been developed and proposed. For example Henri (1992) provides an analytical model for cognitive skills that can be used to analyze the process of learning within messages exchanged between students of various online e-learning communities. Mason's work (1991) provides descriptive methodologies using both quantitative and qualitative analysis. Furthermore, five phases of interaction analysis are identified in Gunawardena et al.'s model (1997):

I.   Sharing/Comparing of Information

II.   The Discovery and Exploration of Dissonance or Inconsistency among Ideas, Concepts or Statements

III. Negotiation of Meaning/Co-Construction of Knowledge

IV.   Testing and Modification of Proposed Synthesis or Co-Construction

V.   Agreement Statement(s)/Applications of Newly Constructed Meaning

In this section we provide a description of some of the most commonly used online community evaluation techniques as well as their weaknesses and strengths.

3.1 Query Based Techniques and User Profiles: Interviews, Questionnaires and Personas

3.1.1 Interviews

An interview can be defined as a type of conversation that is initiated by the interviewer in order to obtain research relevant information. The interview reports have to be carefully targeted and analyzed to make an impact (Usability Net, 2003). Interviews are usually carried out on a one-to-one basis where the interviewer collects information from the interviewee. Interviews can take place by telephone and face to face (Burge & Roberts, 1993). They can also take place via non-real time methods like fax and

e-mail, although in these cases they function like questionnaires. Interviews are useful for obtaining information that is difficult to elicit through approaches such as background knowledge and general principles. There are three types of interviews: (a) Structured interviews: consist of pre-determined questions asked in fixed order like a questionnaire; (b) Semi-structured interviews: questions are determined in advance but may be reordered, reworded, omitted, and elaborated; (c) Unstructured interviews: it is not based on pre-determined questions but instead the interview has a general area of interest and the conversation may develop freely.

Interviews can be used to gain insights about general characteristics of the participants of an online community and their motivation for participating in the community under investigation. The data collected comes straight from the participants of the online communities, whereby they are able to provide feedback based on their own personal experiences, activities, thoughts and suggestions.

Advantages of Interviews (Usability Net, 2003) include: what is talked about can address directly the informant's individual concerns; mistakes and misunderstandings can be quickly identified and cleared up; more flexible than a questionnaire; can cover low probability events.

Disadvantages of Interviews include: danger of analyst bias towards own knowledge and beliefs; accuracy and honesty of responses; often must be used with other data collection techniques to improve quality of data collected.

3.1.2   Questionnaires

A questionnaire is a self-reporting query based technique. Questionnaires are typically produced on printed paper, but due to recent technologies and in particular the Internet, many researchers engage in the use of online questionnaires, thus saving time, money and eliminating the problem of a participant's geographical distance. There are three types of questions that can be used with questionnaires: open questions, where the participants are free to respond however they like; closed questions, which provide the participants with several choices for the answer, and scales where the respondents must answer on a pre determined scale.

For online communities, questionnaire can be used to elicit facts about the participants, their behavior and their beliefs/attitudes. Like interviews, questionnaires are an important technique for collecting user-opinions and experiences they have had through the use of CMC and their overall existence in online communities.

The main advantages of questionnaires are: they are faster to carry out than observational techniques; can cover low probability events, while disadvantages include: Information is idealized version of what should rather than what does happen; responses may lack accuracy or honesty; danger of researcher bias towards subset of knowledge he/she possesses; must be used in conjunction with other techniques for validity.

3.1.3   Personas

Findings from interviews and questionnaires can be further used as a basis for developing user profiles using personas. A persona is a precise description of the user of a system, and of what he/she wishes to accomplish. (Cooper, 1999). The specific purpose of a persona is to serve as a tool for software and product design. Although personas are not real people, they represent them throughout the design stage (Blomkvist, 2002) and are best based on real data collected through query based techniques.

Personas are rich in details, include name, social history and goals, and are synthesized from findings through the use of query based techniques with real people (Cooper, 1999). The technique takes user characteristics into account and creates a concrete profile of the typical user (Cooper, 1999).

For online communities, personas can be used to better understand the participants of the community and their background. Personas can also be used as a supplement to Social network Analysis (described later in this chapter) to get a greater overview of the characteristics of key participants of a community. Using personas, web developers gain a more complete picture of their prospective and/or current users

and are able to design the interfaces and functionality of their systems, to be more personalized and suited for the communication of the members of their online communities.

Advantages of personas include: can be used to create user scenarios; can be anonymous protecting use privacy; represent the user stereotypes and characteristics.

Disadvantages of personas include: if not enough personas are used, users are forced to fall into a certain persona type which might now accurately represent them; time-consuming.

3.2   Log analysis

A log, also referred to as web-log, server log or log-file is in the form of a text file and is used to track the users' interactions with the computer system they are using. The types of interaction recorded include key presses, device movements and other information about the user activities. The data is collected and analyzed using specialized software tools and the range of data collected depends on the log settings. Logs are also time stamped and can be used to calculate how long a user spends on a particular task or how long a user is lingered in a certain part of the website (Preece, Rogers & Sharp, 2002). In addition, an analysis of the server logs can help us find out: when people visited the site, the areas they navigated, the length of their visit, the frequency of their visits, their navigation patterns, from where they are connected and details about the computer they are using.

Log analysis is a useful and easy to use tool when analyzing online communities. For example, someone can use log analysis to answer more accurately questions like student attendance of an online learning community. Furthermore, logs can identify the webpages users spend more time viewing, and also the paths that they used. This helps identify the navigation problems of the website, but also gives a visualization of the users' activities in the virtual communities. For instance, in the case of e-learning communities, the log files will show which students are active in the CMC postings even if they are not active participants (few postings themselves), but just observing the conversations. Preece (2003) notes that data logging does not interrupt the community, while at the same time can be used to examine mass interaction.

Advantages of Logs (Preece et al., 2002): helps evaluators analyze users behavior; helps evaluators understand how users worked on specific tasks; it is unobtrusive; large volumes of data can be logged automatically.

Disadvantages of Logs (Preece et al., 2002): powerful tools are needed to explore and analyze the data quantitatively and qualitatively; user privacy issues.

3.3   Content and Textual analysis

Content analysis is an approach to understanding the processes that participants engage in as they exchange messages (McLoughlin, 1996). There have been several frameworks created for studying the content of messages exchanged in online communities. Examples include work from Archer, Garrison, Anderson & Rourke (2001), Gunawardena, Lowe, and Anderson's (1997) model for examining the social construction of knowledge in computer conferencing, Henri's (1992) content analysis model and Fahy et al's (2001) Transcript Analysis Tool (TAT) which is described in more detail below.

The TAT focuses on the content and interaction patterns at the component level of the transcript (Fahy et al., 2001). After a lengthy experience with other transcript tools and reviews of previous studies Fahy et al. (2001), chose to adapt Zhu's (1996) analytical model for the TAT. Zhu's model (1996) examines the forms of electronic interaction and discourse, the forms of participation and the direction of participant interaction in computer conferences. The TAT also contains echoes of Vygotskian theory, primarily those dealing with collaborative sense making, social negotiation and proximal development (Cook & Ralston, 2003). The TAT developers have come up with the following strategic decisions (Fahy, 2003): The sentence is the unit of analysis; the TAT is the method of analysis; interaction is the criterion for judging conference success and topical progression (types and patterns).

The TAT was designed to permit transcript content to be coded reliably and efficiently (Fahy et al., 2001), while the advantages of TAT are (Fahy, 2003; Cook & Ralston, 2003; Fahy et al, 2001): It reveals interaction patterns that are useful in assessing different communication styles and online behavioral preferences among participants; It recognizes the complexity of e-conferences and measures the intensity of interaction; It enables the processes occurring within the conferences to be noted and

recorded; It probes beyond superficial systems data, which mask the actual patterns of discussion; It relates usefully to other work in the area; It discriminates among the types of sentences within the transcript; It reflects the importance of both social and task-related content and outcomes in transcript analysis research.

The unit of analysis of the TAT is the sentence. In the case of highly elaborated sentences, the units of analysis can be independent clauses which, punctuated differently, could be sentences (Fahy, 2003). Fahy et al (2001), have concluded that the selection of message-level units of analysis might partially explain problematic results that numerous researchers have had with previous transcript analysis work. They also believe that the finer granularity of sentence-level analysis results in several advantages (Fahy, 2003; Ridley & Avery, 1979): Reliability; Ability to detect and describe the nature of the widely varying social interaction, and differences in networking pattern, in the interactive behavior of an online community, including measures of social network density and intensity; Confirmation of gender associations in epistolary/expository interaction patterns, and in the use of linguistic qualifiers and intensifiers. Table 3 shows the TAT categories (Fahy et al., 2001; Fahy, 2003).

Table 3 - TAT Categories

Category
1: Questioning
The questioning category is further broken down into two types of questions:
1A Vertical Questions
These are questions which assume a "correct" answer exists, and that they can be answered if the right authority to supply it can be found. Example: "Does anybody know what time the library opens on Saturdays?"
1B Horizontal Questions
For these questions, there may not be only one right answer. These questions invite negotiation. Example: "Do you really think mp3 files are should become illegal, or you don't see any harm by them?"
2: Statements
This category consists of two sub-categories:
2A Non-referential Statements
These statements contain little self-revelation and usually do not invite response or dialogue and their main intent is to impart facts or information. Example: "We found that keeping content up-to-date, distribution and PC compatibility issues were

causing a huge draw on Ed. Centre time."

2B Referential Statements

Referential statements are direct answers to questions. They can include comments referring to specific preceding statements.

Example: "That's right, it's the 1997 issue that you want."

3: Reflections

Reflections are significant personal revelations, where the speaker expresses personal or private thoughts, judgments, opinions or information. Example: "My personal opinion is that it shouldn't have been a penalty kick."

4: Scaffolding and Engaging

Scaffolding and engaging initiate, continue or acknowledge interpersonal interaction. They personalize the discussion and can agree with, thank or otherwise recognize someone for their the helpfulness and comments. Example, "Thanks Dave, I've been trying to figure that out for ages ☺"

5: References/Authorities

Category 5 is compromised of two types:

5A: Quotations, references to, paraphrases of other sources.

Example, "You said, 'I'll be out of the city that day'."

5B: Citations, attributions of quotations and paraphrases.

Example: "Mathew, P. (2001). A beginners guide to mountain climbing."

3.4 Social Network Analysis (SNA)

"Social Network Analysis (SNA) is the mapping and measuring of relationships and flows between people, groups, organizations, computers or other information/knowledge processing entities. The nodes in the network are the people and groups while the links show relationships or flows between the nodes. SNA provides both a visual and a mathematical analysis of human relationships" (Krebs, 2004, pp.1). Preece (2000) adds that it provides a philosophy and a set of techniques for understanding how people and groups relate to each other, and has been used extensively by sociologists (Wellman, 1982; Wellman 1992), communication researchers (Rice, 1994; Rice et al., 1990) and others. Analysts use SNA to determine if a network is tightly bounded, diversified or constricted; to find its density and clustering; and to study how the behavior of network members is affected by their positions and connections (Garton, Haythornhwaite & Wellman, 1997; Wellman, 1997; Henneman, 1998; Scott, 2000; Knoke & Kuklinski, 1982). Network researchers have developed a set of theoretical perspectives of network analysis. Some of these are (Bargotti, 2002):

- Focus on relationships between actors than the attributes of actors
- Sense of interdependence: a molecular rather atomistic view

- Structure affects substantive outcomes

- Emergent effects

"The aim of social network analysis is to describe why people communicate individually or in groups" (Preece, 2000, pp. 183), while the goals of SNA are (Dekker, 2002):

- To visualize relationships/communication between people and/or groups using diagrams

- To study the factors which influence relationships and the correlations between them

- To draw out implications of the relational data, including bottlenecks

- To make recommendations to improve communication and workflow in an organization

Preece (2002) and Beidernikl & Paier (2003) list the following as the limitations of SNA:

- More theory that speaks directly to developers of online communities is needed

- The data collected may be personal or private

- The analysis of the data is quantitative and specific to the particular network, while common survey data are qualitative and generalize answers on the parent population

It is also worth pointing out that network analysis is concerned about dyadic attributes between pairs of actors (like kinship, roles, and actions), while social science is concerned with monadic attributes of the actor (like age, sex, and income).

There are two approaches to SNA:

Ego-centered analysis – Focuses on the individual as opposed to the whole network, and only a random sample of network population is normally involved (Zaphiris, Zacharia, & Rajasekaran, 2003). The data collected can be analyzed using standard computer packages for statistical analysis like SAS and SPSS (Garton, Haythornthwaite, & Wellman, 1997).

Whole network analysis – The whole population of the network is surveyed and this facilitates conceptualization of the complete network (Zaphiris et al., 2003). The data collected can be analyzed using microcomputer programs like UCINET and Krackplot (Garton et al., 1997).

The following are important units of analysis and concepts of SNA (Garton et al., 1997; Wellman, 1982; Hanneman, 2001; Zaphiris et al, 2003; Wellman, 1992):

- Nodes: The actors or subjects of study.

- Relations: The strands between actors. They are characterized by content, direction and strength.

- Ties: Connect a pair of actors by one or more relations.

- Multiplexity: The more relations in a tie, the more multiplex the tie is.

- Composition: This is derived from the social attributes of both participants.

- Range: The size and heterogeneity of the social networks.

- Centrality: Measures who is central (powerful) or isolated in networks.

- Roles: Network roles are suggested by similarities in network members' behavior.

- Density: The number of actual ties in a network compare to the total amount of ties that the network can theoretically support.

- Reachability: In order to be reachable, connections that can be traced from the source to the required actor must exit.

- Distance: The number of actors that information has to pass through to connect the one actor with another in the network.

- Cliques: Sub-sets of actors in a network, who are more closely tied to each other than to the other actor who are not part of the subset.

Social Network Analysis is a very valuable technique when it comes to analyzing online communities as it can provide a visual presentation of the community and more importantly it can provide us with qualitative and quantitative measures of the dynamics of the community. The application of SNA to the analysis of online communities is further demonstrated with a case study in section 4 of this chapter.

4   Case Studies

In this section we present two case studies that demonstrate the use of theoretical and analytical techniques for studying online communities. In the first case study, we demonstrate how the results from an attitude towards thinking and learning questionnaire can be combined with social network analysis to describe the dynamics of a computer aided language learning (CALL) online community. In the second case study, we present a theoretical activity theory model that can be used for describing interactions in online game communities.

4.1   Computer Aided Language Learning Communities

In the first case study we demonstrate a synthetic use of quantitative (SNA) and qualitative (questionnaires) methods for analyzing the interactions that take place in a Computer Aided Language Learning (CALL) course. Data was collected directly from the discussion board of the "Learn Greek Online" (LGO) course (Kypros-Net Inc., 2005).

LGO is a student centered e-Learning course for learning Modern Greek and was built through the use of a participatory design and distributed constructionism methodology (Zaphiris & Zacharia, 2001). In an ego-centered SNA approach, we have carried out an analysis of the discussion postings of the first 50 actors (in this case the students of the course) of LGO.

To carry out the social network analysis we used an SNA tool called "NetMiner" (Cyram, 2004) which enabled us to obtain centrality measures for our actors. The "in and out degree centrality" was measured by counting the number of interaction partners per each individual in the form of discussion threads (for example if an individual posts a message to 3 other actors then his/her out-degree centrality is 3, whereas if an individual receives posts from 5 other actors then his/her in-degree is 5).

Due to the complexity of the interactions in the LGO discussion we had to make several assumptions in our analysis:

- Posts that received 0 replies were excluded from the analysis. This was necessary in order to obtain meaningful visualizations of interaction.
- Open posts were assumed to be directed to everyone who replied.

- Replies were directed to all the existing actors of the specific discussion thread unless the reply or post was specifically directed to a particular actor.

In addition to the analysis of the discussion board interactions we also collected subjective data through the form of a survey. More specifically, the students were asked to complete an Attitudes Towards Thinking and Learning Survey (ATTLS). The ATTLS measures, through the use of twenty Likert scale questions, the extent to which a person is a 'connected knower' (CK) or a 'separate knower' (SK). People with higher CK scores tend to find learning more enjoyable, and are often more cooperative, congenial and more willing to build on the ideas of others, while those with higher SK scores tend to take a more critical and argumentative stance to learning (Galotti, Clinchy, Ainsworth, Lavin, & Mansfield, 1999).

The out-degree results of the social network analysis are depicted in Figure 1 in the form of a sociogram, and the in-degree results are depicted in Figure 2. Each node represents one student (to protect the privacy and anonymity of our students their names have been replaced by a student number). The position of a node in the sociogram is representative of the centrality of that actor (the more central the actor the more active). As can be seen from Figure 1, students S12, S7, S4, S30 (with out-degree scores ranging from 0.571 to 0.265) are at the centre of the sociogram and possess the highest out-degree. The same students also posses the highest in-degree scores (Figure 2). This is an indication that these students are the most active members of this online learning community, posting and receiving the largest number of postings. In contrast participants in the outer circle (e.g. S8, S9, S14 etc.) are the least active with the smallest out-degree and in-degree scores (all with 0.02 out-degree scores).
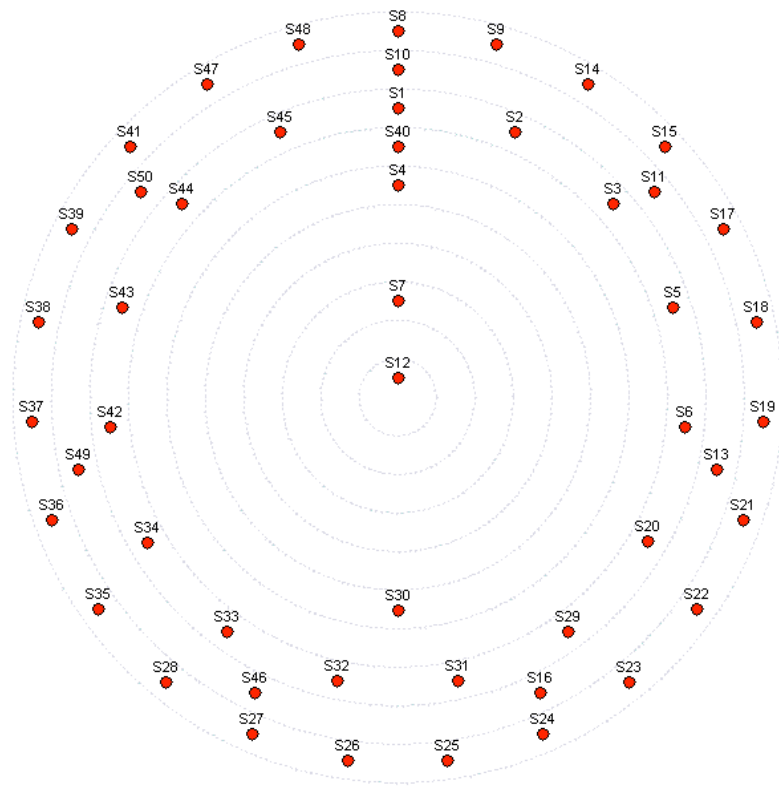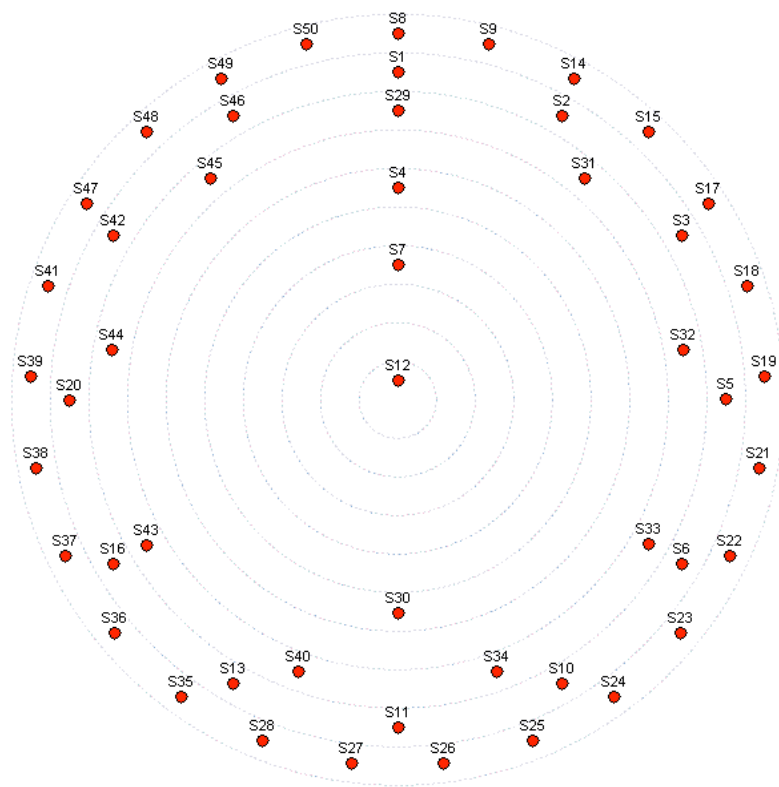
Figure 1 - Out-Degree Analysis Sociogram

Figure 2 - In-Degree Analysis Sociogram

In addition, a clique analysis was carried out (Figure 3) and it showed that fifteen different cliques (the majority of which are overlapping) of at least three actors each have been formed in this community.

As part of the ego-centered analysis for this case study we look in more detail at the results for two of our actors: S12, who is the most central actor in our SNA analysis i.e. with the highest out-degree score, and S9, an actor with the smallest out-degree score. It is worth noting that both members joined the discussion board at around the same time.
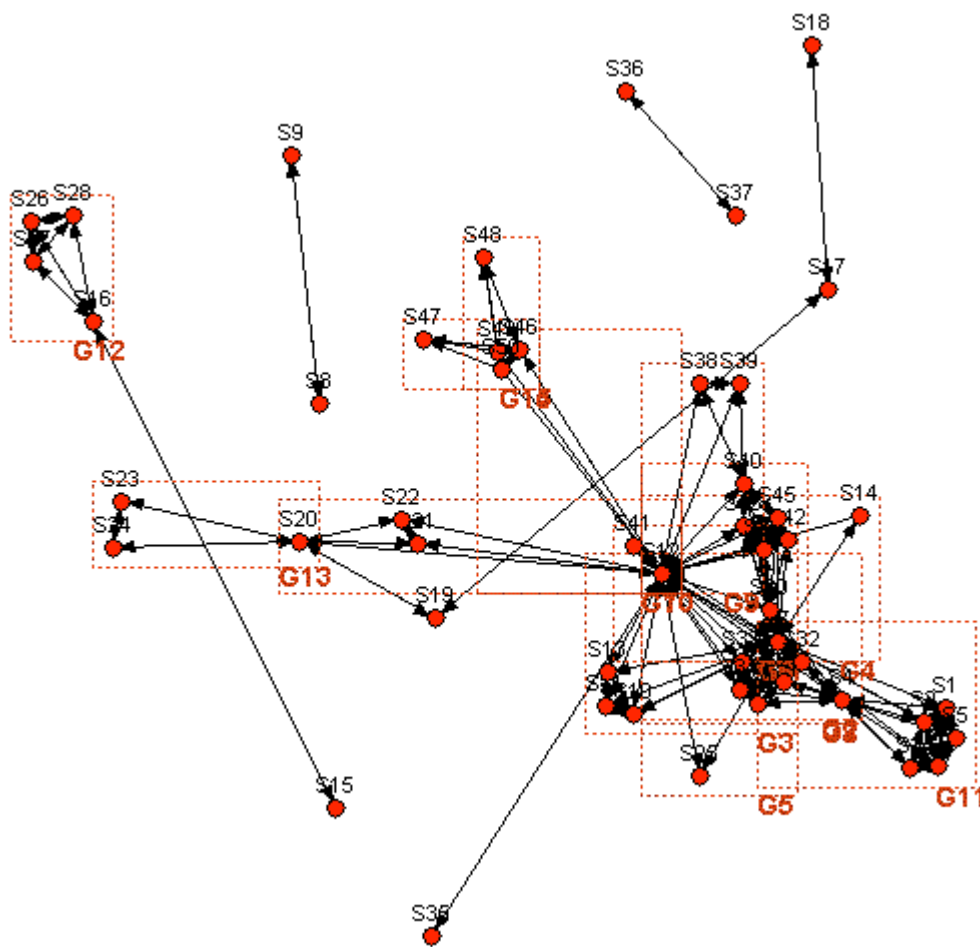
Figure 3 - Clique Analysis Sociogram

First, through a close look at the clique data (Table 4) we can see that S12 is a member of 10 out of the 15 cliques, whereas S9 is not a member of any; an indication of the high interactivity of S12 versus the low interactivity of S9. In an attempt to correlate the actors' position in the SNA sociogram with their self reported attitudes towards teaching and learning we looked more closely at the answers these two actors (S12, S9) provided to the ATTLS. Actor S12, answered all 20 questions of the ATTLS with a

score of at least 3 (on a 1-5 Likert scale) whereas S9 had answers ranging from 1 to 5. The overall ATTLS score of S12 is 86 whereas that of S9 is 60. A clear dichotomy of opinions occurred on 5 of the 20 questions of the ATTLS. S12 answered all 5 of those questions with a score of 5 (strongly agree) whereas S9 answered them with a score of 1 (strongly disagree). More specifically, S12 strongly agreed that:

1. S/He is more likely to try to understand someone else's opinion than to try to evaluate it.

2. S/He often find herself/himself arguing with the authors of books read, trying to logically figure out why they're wrong.

3. S/He finds that he/she can strengthen his/her own position through arguing with someone who disagrees with them.

4. S/He feels that the best way achieve his/her own identity is to interact with a variety of other people.

5. S/He likes playing devil's advocate - arguing the opposite of what someone is saying.

S9 strongly disagreed with all of the above statements. These are all indications that S12 is a 'connected knower' (CK) whereas S9 is a 'separate knower' (SK).

Table 4 - Clique analysis of the LGO discussions

Cliques	Actors
K1	S12, S7, S30, S40, S43, S44, S45
K2	S12, S7, S30, S4
K3	S12, S7, S10, S11, S13
K4	S12, S7, S14
K5	S12, S7, S25
K6	S12, S7, S41
K7	S12, S20,S21, S22
K8	S12, S29, S4, S30, S31, S32, S33, S34
K9	S12, S38, S39, S40
K10	S12, S46, S49, S50
K11	S1, S2, S3, S4, S5, S6, S7
K12	S16, S26, S27, S28
K13	S23, S20, S24
K14	S47, S46, S49, S50
K15	S48, S46, S49, S50

This case study showed that the combination of quantitative and qualitative techniques can facilitate a better and deeper understanding of online communities. SNA was found to be a very useful technique for visualizing interactions and quantifying strengths and dynamics in online communities. In combination with the ATTLS, it was possible to identify the key players of the e-Learning community.

These members' roles show them to be more powerful and central in the discussions. Identifying their characteristics enables us to make re-enforcements to the community by making other participants more active in the discussion board communication. This active learning approach could in-turn, improves the pedagogical value of e-Learning within these communities.

4.2   Game communities and activity theoretical analysis

The main motivation of the second case study arises from the more general area of computer game-based learning. Game-based learning has focused mainly on how the game itself can be used to facilitate learning activities but we claim that the educational opportunity in computer games stretches beyond the learning activities in the game per se. Indeed, if you observe most people playing games, you will likely see them downloading guidelines from the Internet and participating in online forums to talk about the game and share strategies. In actuality, almost all game playing could be described as a social experience, and it is rare for a player to play a game alone in any meaningful sense (Kuo, 2004). This observation is even more evident in Massively Multiplayer Online Role Playing Games (MMORPGs) which has been discussed earlier in this chapter. For example, the participation in a MMORPG is constituted through language practice within the in-game community (e.g. in-game chatting and joint task) and out-of-game community (e.g. the creation of written game-related narratives and fan-sites). The learning is thus not embedded in the game, but it is in the community practice of those who inhabit it.

4.2.1 Types of game communities

Therefore, we believe that the study on computer games should be expanded to include the entire game community. Computer game communities can be categorized into three classes which we have identified (Figure 4) (Ang, Zaphiris & Wilson, 2005) as:

Single Game-play Community: This refers to a game community formed around a single player game. Although players of a single player game like The Sims 2 and Final Fantasy VII play the game

individually, they are associated with an out-of-game community which discusses the game either virtually or physically.

Social Game-play Community: This refers to multiplayer games which are played together in the same physical location. It creates game communities at two levels: in-game and out-of-game. Occasionally, these two levels might overlap. The out-of-game interaction might be affected by issues beyond the specific game system; for example, the community starts exchanging information about another game.

Distributed Game-play Community: This is an extension of social game-play community, but it emphasizes the online multiplayer game in which multiple sessions of game are established in different geographical locations.
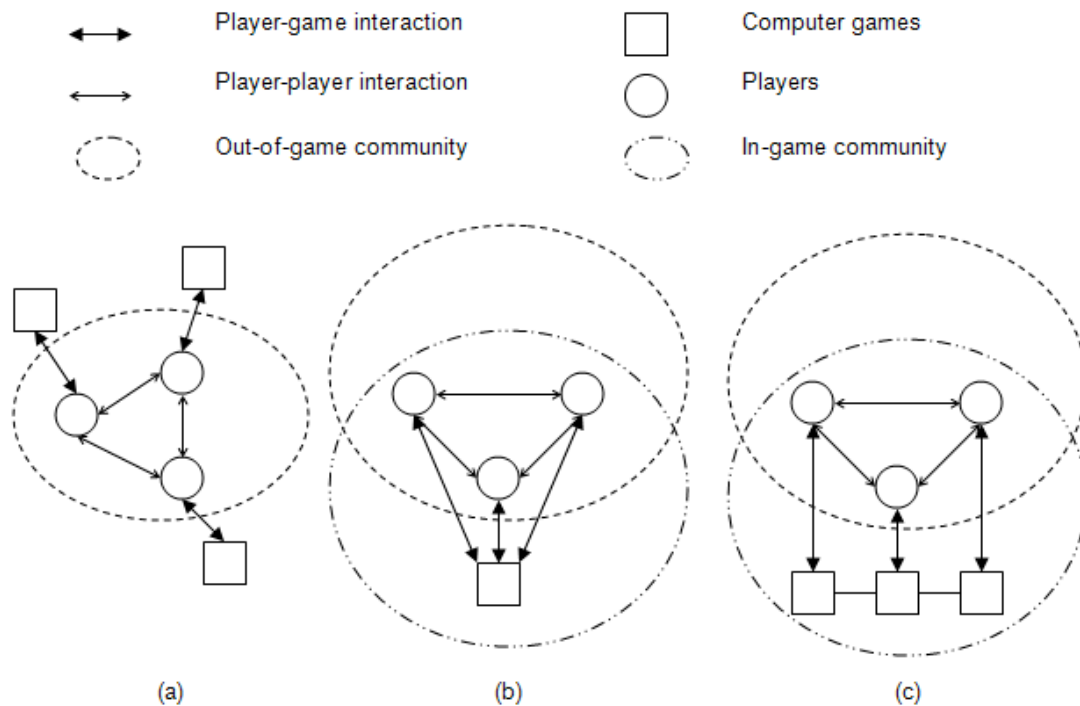
(a) Single game-play community (b) Social game-play community (c) Distributed game-play community

Figure 4 - Types of Game Communities

The study of game communities, especially out-of-game communities, from the perspective of education is still very much unexplored. We believe the potential of games in education is not limited to what is going on in the game. Educators could benefit by studying games as a social community because games are now becoming a culture that permeates the life of everyone, especially the younger

generation. Black (2004) has investigated the interactions among participants in a virtual community of Japanese comic fans which involve a lot of reading and writing throughout the site. She examines how the community of fans helps each other with English language writing skills and with cross-cultural understanding. In this section we have pointed out that game communities can emerge from both single-player and multiplayer games. We believe that by further studying the social interaction in the game community, we will be able to utilize games in learning in a more fruitful way. In the next section, we apply and evaluate one of these models of game communities to a specific scenario in knowledge building using activity theory.

4.2.2 Activity theory

In this case study, we demonstrate how activity theory can be used to analyze an out-of-game community around a single player game which is based on constructionist activities as proposed by Papert (1980). Papert claims that even for adults, learning remains essentially bound to context, in which knowledge is shaped by the use of external supports. His approach helps us understand how learning is actualized when individual learners construct their own favorite artifacts or object-to-think-with (Papert 1980).

Although Papert's theory provides a solid framework for understanding children's and even adults' ways of learning by designing, it does not offer a systematic framework for analysing the construction activities within a learning community. Analyzing constructionist activities can be useful as it could help inform constructional design for educational purposes. The most significant analysis includes the learning within a community as well as the development of an individual. We are also interested in finding out how tools such as computers help learners construct artefacts and knowledge. Hence, we would like to draw from the Vygotskian naturalist approach which emphasizes human activity systems. Lev Vygotsky (1930) formulated a theoretical concept which is very different from the prevailing understanding of psychology which was dominated by behaviorism at that time. This new orientation was a model of tool-mediation and object-orientedness. He proposes the classic triangle model to demonstrate the idea of mediation:
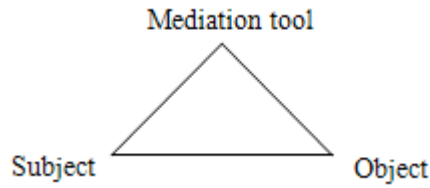
Figure 5 - Vygotsky's mediation

In Figure 5, the subject is the individual engaged in the mediated action, the mediating artifact or tool could include physical artifacts and/or prior knowledge of the subject. The object is the goal/objective of the activity. Although constructionist learning relies very much on computational tools, the concept of mediation is not explicated. Figure 5 shows explicitly that the relationship between the subject and the object is no longer straight forward, instead it is mediated by the tool. For example, when building a website, the subject is working towards an objective (e.g. to add a table in the webpage) using not only the computer (external tools) but also her internal understanding of how websites and computers work (internal tools).

Leont'ev (1978) extends this notion of activity to differentiate between an individual action and a collective activity by proposing a hierarchy of activity (Table 5). Collective activity is connected to the object of the whole community, of which each individual subject is often not consciously aware. An individual action is connected to a conscious goal. Below the collective activity and individual action there is the level of operations that are dependent on the conditions in which the action is performed. Thus, an activity system can be analysed at three levels: the activity level which is oriented toward the object/objective and carried out by the whole community; the action level which is directed at the individual goal, as well as the operation level which is elicited by conditions and is performed unconsciously.

Table 5 - Hierarchy of activity

Unit of Analysis	Stimulus	Subject	Language learning example
Activity	Object	Community	Engage in a meaningful conversation

Action	Goal	Individual	Sentence construction
Operation	Conditions	Unconscious	Word selections, grammar rules

This hierarchy is crucial in explaining the learning process in an activity system. We would like to illustrate an example of this hierarchy in learning a foreign language (Table 5). The overall objective is to be able to engage in a meaningful conversation. In the beginning, the learner has to work on the grammar and the choice of words at a conscious level. When the learner has reached a higher proficiency level, these actions are transformed into operations. The learner no longer needs to select appropriate words and check grammar rules deliberately as these have been learned thoroughly and are now operating unconsciously. The consciousness of the learner is now focused on expressing himself properly depending on the objective of the conversation. Grammatical rules become invisible to the learner and he is only selecting appropriate goals to be achieved. Therefore, it can be inferred that activity theory treats learning as the shift from the higher level (action) to the lower level (operation) in the hierarchy.

Drawing on work by Vygotsky and Leont'ev, Engeström (Engestrom 2001) views all human activities as contextualized within an interdependent activity system. Engeström adds collective mediation to Vygotsky's tool mediation and presents the triangle model of activity system (Figure 6).

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                              tool

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            subject  ⟍ /_____||_____\ object  ----------▶ Outcome
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                          /__╲_||_╱__\
            rules          community      division
                                          of labour
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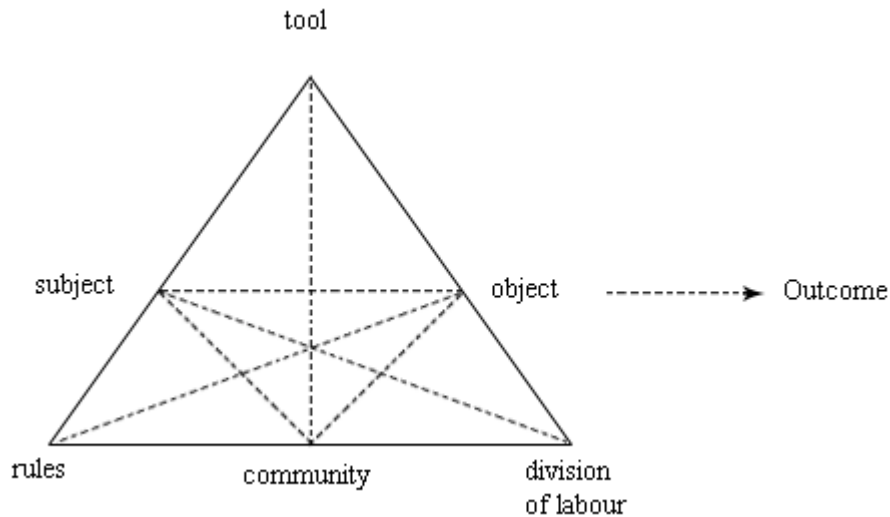
Figure 6 - The triangle activity system diagram

In the diagram, the subject is the individual or a group who are selected as the point of view of the analysis. The object refers to the raw material or the problem space at which the activity is directed and which is transformed into outcomes with the help of external and internal tools. Tools are the concepts, physical tools, artifacts or resources that mediate a subject's interactions with an object. The community refers to those with whom the subject shares the same general object. The division of labor (DOL) is the classification of tasks among the members on the community while the rules are the regulations, norms and conventions within the activity system.

Constructionist learning can be described and visualized through this activity triangle. Mediated by the tool and the community, the learner externalizes her initial stage of knowledge through object construction. The individual externalization (mediated by the tool) can be broken down into actions and operations. Actions are directed toward a personal goal and are carried out with careful deliberation. For example (Figure 7), in a book writing activity, the author (an expert word processor user) will operate (e.g. typing) the word processor at the unconscious level and consciously act on the book (to select appropriate words, construct meaningful sentences and paragraphs) she is writing. At a certain point, the author encounters a new condition with the word processor which she is not familiar with: say to insert a table into the book. Under this new condition, a breakdown is said to have happened. The conscious effort of the author is not anymore placed on the book itself but instead is now placed on the word processor (e.g. to achieve the action: insert tables, the author performs the

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operation: read help files). Once the author has thoroughly learned about the table insert, she can again act on the book consciously and development is said to have happened.
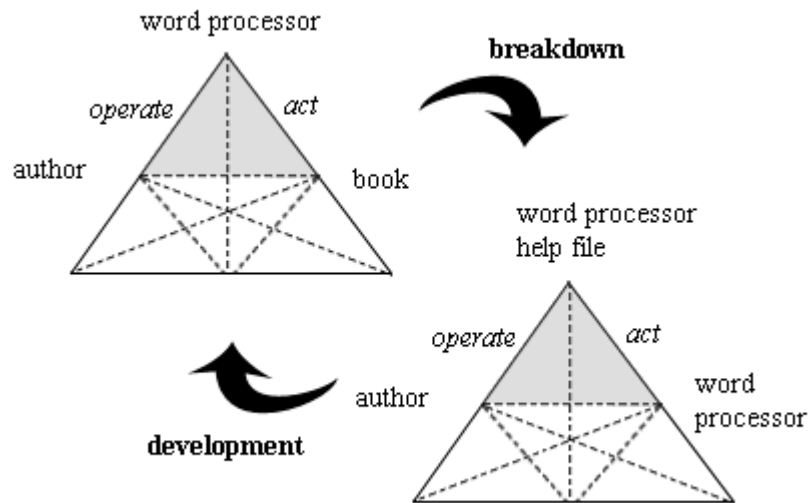

Figure 7 - The transformation of individual action-operation

4.2.3 Activity theoretical analysis for constructionist learning

We have conducted a study to analyze a Wiki-based game community using activity theory. The goal of this study was to demonstrate the usefulness of activity theory in researching online communities. The collaborative construction activity in a Wiki-supported community devoted to writing a game guidebook is examined. Activity theory is used as an analytical tool in order to investigate this community. In this section, experiences and challenges from the analysis are reported in order to give some insights into how activity theory can be helpful for online community research.

The analysis on online communities can be done through the lens of various concepts associated with activity theory such as the levels of activity hierarchy and different perspectives of the triangle model as explained in the previous section.

For instance, we can start our analysis with the most basic aspect of the constructionism by simply examining the relationship between subjects and the object. Then, we can analyze Vygotsky's mediation model of activity system consisting of individual actions and tools. The analysis is also

possible to be extended to the whole community of this system to include emerging rules as well as division of labor (DOL) that mediate the community. The focus can also be placed mainly on the constructionist concept of externalizing the internal meanings onto a sharable artifact through mediation. More specifically, we can look into (but not limited to) these aspects:

- Subject-object: What are the constructionist actions that act on the object and transform the object into outcome?

- Subject-tool-object: How do actions shift to operations and vice versa? How do tools mediate individual actions and operations? What is the nature of the mediating tools? How do they support knowledge building?

- Subject-rules-object and subject-DOL-object: What is the nature of implicit and explicit rules? How is DOL manifest in the community? How do rules and DOL support knowledge building?

Apart from its focus on both individual and collective development through action-operation transformation, activity theory also helps analyze the tools, capture the rules and the division of labor (DOL) which mediate these actions. These must be further explained in order to differentiate individual mediation and collective mediation. Taking the example of our study on game community, individual mediation places its emphasis on "how a user uses the tool to write the game guide, without taking into account how other users act in the community". In other words, it is about the affordance of the tool to support what an individual can do.

Collective mediation is about the community, which consists of two major components: rules and DOL. Rules define what can be done and cannot be done in a community. This should not be confused with the affordance of the tool. The tool might afford certain actions such as writing in abusive language, but the rules might want to ban this action. DOL is self explained: how the work load is divided among many users in a community.

Activity theory appears to be a promising framework as it gives an analytical lens on analyzing and interpreting the data. Activity theory provides different perspectives of analysis, as it casts different light on the collected data as researchers can examine it from many perspectives by focusing on

different sub-triangles of the activity system diagram. It also helps us examine learning process: how learning occurs individually and collectively through the transformation of hierarchy of activity from action to operation. Furthermore, both individual and collective aspects are given equal importance. Activity theory informs the development of the whole community as well as the individual development. It explains how individual development contributes to the community growth and vice versa.

Based on our study, individual actions help sharpen the mediation tool, while collective actions bring about new rules or refine existing rules that mediate the collective action. In short, activity theory is useful to analyze the community in the following ways:

- It helps understand the individual mediation process: subject-tool-object
- It clearly presents the collective mediation process: subject-community-object
- It reveals the emerging rules and division of labor in the community

In a Wiki space, knowledge is socially constructed; it is created individually with tools, negotiated and agreed within a community based on emerging rules and division of labor (DOL). It starts as a single unit of information (a page in this context) and grows organically and evolves into a complex and well structured set of knowledge. From our findings, we induce what contributes to the development of the community:

- users share some historical backgrounds: they already share some of the tools/rules before joining the community, they also share the interest on the same game
- users share the same object (goal) which is to build a game guide book
- a user's individual action: this goal-oriented individual action triggers negotiations that leads to the growth of the space
- the community's agreement on the object: not only share the same object, the community must be able to negotiate and agree on the object
- tools that support these actions and negotiations
- emerging rules that coordinate the activity
- DOL that divide the responsibilities

The evolution of a knowledge building community needs more than a group of devoted users who share the same object. It involves negotiation and agreement among the users on the object. Although every user tends to act toward their own goal, it takes the compromise of the entire community to agree on the object.

Activity theory helps online community researchers identify design issues at two aspects: the software application as tools as well as the social interaction within the community around the tool. It also reveals the development of the community building process from the individual and collective level through the shift of activity hierarchy. We thus believe that analyzing online communities with activity theory will yield fruitful results and give insights on online community design.

Finally, we must reiterate the fact that activity theory itself is not limited to what is presented in the triangle diagram as proposed by Engeström. Although his model is tremendously useful, it overlooks several significant concepts of activity theory. One major limitation is the static representation of activity theory. The triangle diagram represents only a snapshot of a particular time, thus making it hard to analyze the activity across time. It is understood that Engeström's model is intended to be open so that it can be used in various domains but this has proven to pose a serious difficulty among the practitioners as some researchers have started to operationalise it so that it is more practical in day-to-day methodology (Korpela, Soriyan et al. 2000; Barab, Hay et al. 2001; Mwanza 2002). Hopefully with the increasing attention drawn by activity theory, the theory will be expanded and operationalized to fit the purpose of HCI research in general and online community in particular.

5   Discussion and Conclusions

 This chapter looked at the definitions of computer mediated communication and online communities and pointed out the multi-disciplinary nature of the definitions and the way online communities are being analyzed and studied. In section 2 we introduced the different types of CMC and online communities and put special attention to Wikis and game based communities. These two relatively new types of communities exhibit new modes of interaction that are worth studying further. In section 3, we provided an overview of some of the most commonly used techniques and theoretical frameworks for analyzing online communities. Then in section 4 we used two case studies to

demonstrate the use of those techniques. Although both of our case studies focus on e-learning communities, communities have been used in a multitude of disciplines. Empathic online communities for example seem to be gaining a lot of momentum, with people supporting each other. Online communities are widely used for general entertainment and current affairs discussions as well. Professional communities (e.g. business, art, industry specific) are also being formed within the online environment.

The study of online communities is flourishing, primarily due to the increasing popularity of online services and tools that provide the construction of such networks of users. The study of such complex communities requires the use of a synthesis of methodologies and theoretical foundations. In our first case study we demonstrated how Social Network Analysis can be used to model and visualize online community interactions, in the second one the theoretical foundations based on activity theory were applied to the domain of game-based communities.

At the beginning of the Internet technology, online communities were solely used for synchronous (often just chat) or asynchronous (most commonly discussion board) textual interaction. This is no longer the case as people are interacting in online communities using new and more innovative interaction paradigms. Game-based communities for instance allow users to represent themselves (through the use of 3D avatars) visually in virtual environments which are often depicted as a fantasy and unrealistic world. They can navigate, change or even create the virtual world (and thus the context of the community) they interact with. As such, the traditional boundary between author and reader is distorted as the designer (authors) is not the one and only who determines what the system is like. Rather, the participants (readers) are co-constructing the virtual world as they are not anymore using the tool to communicate; they are creating and interacting with a virtual environment through witch they can meet, socialize, work with others. Preece (2000) was the first to identify and stress this important social dimension of online communities. Now, this online sociability is becoming more mature and more central to the online communities with which we interact with.

This new paradigm of interaction poses new challenges for researchers and practitioners. The importance of appropriate representation of emotions and other social cultural cues in online

communities is now becoming even more important. With textual interfaces there was an attempt to represent these social cues through the use of emoticons. How can this, for example, be transferred to the domain of virtual game communities? Do we want our avatars to behave like us or do we want them to have some alternate and illusionary identities with extraordinary abilities or unusual behaviors? How can we come up with new interfaces and new interaction paradigms that can facilitate this better, in order to cope with the new demands from the users in such online communities?

A second area which is gaining popularity is the research of online communities, or Internet research. Content analysis and query based techniques were sufficient if what we wanted was a first good impression of the interactions taking place in an online textual community. This is not anymore the case. Studying the sociability of a game-based community, for example, requires the synthesis of more techniques. We might want to immerse ourselves in that community, engage in long term ethnographic studies of its environment and get the first hand experiences of what happens in it. We might have to employ a social cultural theoretical frameworks (e.g. Activity Theory) to get a better understanding of the way people behave, differently from the real world, in these inherently social environments. We might have to quantify, through the use of Social Network Analysis for example, the dynamics of the networks and sub-groups that evolve around these communities.

The possibility of online communities is unlimited with the emergence of more mature and imaginative virtual worlds. Only by treating them in equality with their physical counterparts which encapsulate the practices of economy, politics, ideology and everyday life, can we research and study them intellectually.

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