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Frameworks for Analyzing Computer-Mediated-Communication in e-Learning

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Abstract

Computer-Mediated-Communication (CMC) is fast becoming a big part of our daily lives. More and more people are increasingly using the computer to communicate and interact with each other. The internet and its advantages of connectivity, enable CMC to be used from a plethora of applications. Most common uses of CMC include email communication, discussion forums as well as real time chat rooms and audio/video conferencing. By communicating through computers and over the internet, online communities emerge. Discussion boards and other CMC applications offer a huge amount of information and the analysis of this data assists in understanding these online communities and the social networks that form around them.

There have been various frameworks by different researchers aimed at analyzing CMC. This paper's main objective is to provide a complete overview of the models and frameworks available that are being used for analyzing CMC in e-Learning environments. The significance of the proposed presentation is that it aims to provide the reader with up-to-date information regarding these methods. Advantages and disadvantages of each of the CMC analysis methods are presented and suggestions for future research directions are made. Finally, these suggestions are applied to characteristic scenario in e-Learning.

1 Introduction

The focus of this study is to introduce the reader to the concept of Computer-Mediated Communication (CMC) and Online Communities. Furthermore, we discuss the various types of CMC analysis that can take place. The purpose of each framework is described along with its strengths and weaknesses. The paper begins with a literature review of CMC and Online Communities, and continues with the evaluation of the existing frameworks. Finally, we draw conclusions based on the advent of new technologies and platforms that are available, as to whether or not these frameworks are up-to-date in analyzing CMC as it exists today.

1.1 CMC

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 computers and networks. As Metcalfe (1992) points out, communication is the internet's most important asset and e-mail is the most influential aspect. 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 board services that are electronically-distributed, almost instantaneous, written communication has for many people supplanted the postal service, telephone, even fax machine. All these applications where the computer is used to mediate communication are called Computer-Mediated Communication or CMC.

"Computer-Mediated Communication (CMC) is 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. Studies of CMC can view this process from a variety of interdisciplinary theoretical perspectives by focusing on some combination of people, technology, processes, or effects. Some of

these perspectives include the social, cognitive/psychological, linguistic, cultural, technical, or political aspects; and/or draw on fields such as human communication, rhetoric and composition, media studies, human-computer interaction, journalism, telecommunications, computer science, technical communication or information studies" (December, 1997, pp.1).

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).

CMC has its benefits as well as it limitations. For instance, a benefit of CMC is that the discussions are potentially richer than in face-to-face classrooms, but on the other hand, 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.

Table 1: Advantages and Disadvantages of CMC (SCOTCIT, 2003).

CMC	
Advantages	Disadvantages
• Time and place independence • No need to travel to the place of learning • Time lapse between messages allows for reflection • Speakers of other languages have added time to read and compose answers • Questions can be asked without waiting for a 'turn' • It allows all students 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 peer learning • Answers to questions can be seen by all - and argued... • Discussion is potentially richer than in a face to face classroom • Messages are archived centrally providing a database of interactions which can be revisited • The process of learning becomes more visible to learners and tutors	• Communication takes place via written messages so learners 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

1.2 Online Communities

Through the use of CMC applications, online communities emerge. As Korzeny pointed out even as early as 1978, the new social communities that are built from CMC, are formed around interests and not physical proximity (Korzeny, 1978). Another point to note, is that CMC and the Internet give people around the world the opportunity to communicate with others who share their interests, as unpopular as these interests may be, which does not happen in the 'real' world where the smaller a particular scene is, the less likely it will exist. This is due mainly to the internet's connectivity and plethora of information available and posted by anyone anywhere in the world.

The term online community is multidisciplinary in its nature, means different things to different people, and is slippery to define (Preece, 2000). The relevance of certain attributes in the descriptions of online communities, like the need to respect the feelings and property of others, is debated (Preece, 2000). Online communities are also

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

For purposes of a general understanding of what virtual communities are, we present Rheingold's definition. "Virtual 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).

There are many reasons that bring people together in online groups. These include hobbies, ethnicity, education, beliefs and just about any other topic or area of interest. Wallace (1999) points out that meeting in online communities eliminates prejudging based on someone's appearance, and thus people with similar attitudes and ideas are attracted to each other. People are using the internet to make friends, colleagues, lovers, as well as enemies (Suler, 2004).

Preece, Rogers and Sharp (2002) state that an online community consists of people, a shared purpose, policies and computer systems while identifying 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.

2 CMC Analysis Frameworks

As mentioned earlier, the Internet plays a vital role in socially connecting people worldwide. The virtual communities that emerge have complex structures, social dynamics and patterns of interaction that must be better understood. Through the use of CMC we are provided with a richness of information and pools of valuable data ready to be analysed.

There are various aspects and attributes of CMC that can be studied. Three important and widely used types of CMC analysis are Content Analysis, Human-Human Interaction Analysis and Human-Computer Interaction Analysis.

2.1 Content Analysis

Content analysis is an approach to understanding the processes that participants engage in as they input messages (McLoughlin, 1996). There have been several frameworks created for studying the content of messages exchanged in CMC. Examples include work from Archer, Garrison, Anderson & Rourke (2001) and McCreary's (1990) behavioural model which identifies different roles and uses these roles as the units of analysis. Furthermore, in Gunawardena, Lowe, and Anderson's (1997) model for examining the social construction of knowledge in computer conferencing, five phases of interaction analysis are identified and these are: (I) Sharing/Comparing of Information; (II) The Discovery and Exploration of Dissonance or Inconsistency among Ideas, Concepts or Statements; (III) Negotation 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. Henri (1992) has also developed a content analysis model for cognitive skills and is used to analyze the process of learning within the student's messages. Mason's work (1991) provides descriptive methodologies using both quantitative and qualitative analysis.

In the case of e-learning for example, a useful framework is the Transcript Analysis Tool (TAT) (Fahy, 2003) as it offers:

- A student-centred approach
- It works with Gunawardena's model
- It was built on weaknesses of other models
- It uses the sentence as the unit of analysis

2.2 Human-Human Interaction Analysis

Over the years there have been several models by different researchers for analyzing interaction. It is important to note that the type of interaction studied in this case is interpersonal interaction, more specifically the human-human interaction that takes place through the use of CMC. Examples of Interaction Analysis models include but are not limited to Bale's Interaction Process analysis (Bales, 1950; Bales & Strodbeck, 1951), the SIDE model (Spears & Lea, 1992), a four-part model of cyber-interactivity (McMillan, 2002) and Vrasidas's (2001) framework for studying human-human interaction in Computer-Mediate Online Environments. We have found the technique called Social Network Analysis (SNA) to be more suitable for analyzing CMC in e-Learning and explain it in more detail.

2.2.1 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 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 behaviour of netwok members is affected by their positions and connections (Garton, Haythornhwaite & Wellman, 1997; Wellman, 1997; Hanneman, 2001; 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

2.2.2 Aim and goals of SNA

"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 organisation

2.2.3 Limitations of SNA

Preece et al (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

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). As SNA is useful in collecting important actor relationship data, HCI techniques can be used to supplement some of its limitations.

2.2.4 SNA approaches

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).

SNA data is represented using matrices, graphs and sociograms.

2.2.5 Units of Analysis and network characteristics

There are several characteristics of social networks many of which will be investigated when we use SNA in our unified model. The following are important units of analysis and concepts (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.

2.3 Human-Computer Interaction Analysis

A working definition of Human-Computer Interaction (HCI) as provided by ACM SIGCHI (2002, pp.8) is: "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them". The focus is on the interaction between one or more humans and one or more computational machines (ACM SIGCHI, 2002) HCI is a multidisciplinary subject which draws on areas such as computer science, sociology, cognitive psychology and so on (Schneiderman, 1998). The concept of HCI consists of many tools and techniques that are used for information gathering and evaluation. The data collected in conjunction with data collected from other frameworks assists in assessing the online communities of courses and learning more about the users while collecting their feedback. Methods for CMC data analysis include: Questionnaires, Interviews, Personas and Log Analysis.

3 Methodology

For our case study we used a synthesis of quantitative (SNA) and qualitative (questionnaires) methods and applied them to a Computer Aided Language Learning (CALL) course. Data was collected directly from the discussion board of "Learn Greek Online" (LGO). LGO is a student centered e-Learning course for learning Modern Greek and was built through participatory design and distributed constructionism (Zaphiris & Zacharia, 2001). In an ego-centered approach to SNA, we have carried out analysis on the first 50 actors (in this case the students of the course) of the discussion forum for Lesson 1 in the Greek 101 (Elementary) course of LGO and tabulated these interactions in the form of a network matrix.

To carry out the social network analysis we used an SNA tool called “NetMiner for Windows (http://www.NetMiner.com)” 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 measure 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).

4 Results

The out-degree results of the social network analysis are depicted in figure 2 in the form of a sociogram. 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 outdegree and in-degree scores. This is an indication that these students are also the most active members of this discussion board 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 indegree scores (all with 0.02 out-degree scores). In addition, a clique analysis was done (Figure 2) and it shows that 15 different cliques (the majority of which are overlapping) of at least 3 actors each have been developed in this discussion board. As part of this study we look in more detail at the results from two of our actors. S12, who is the most central actor in our SNA analysis i.e. with the highest our-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. First, through a close look at the clique data (Table 2) we can see that S12 is a member of 10 out of the 15 cliques wherease 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 stated 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 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 with a score of 5 (strongly agree) whereas S9 answered them with a score of 1 (strongly disagree). i.e. S12 strongly agrees 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.

These are all indications that s/he is a 'connected knower' (CK) whereas S9 is a 'separate knower' (SK).

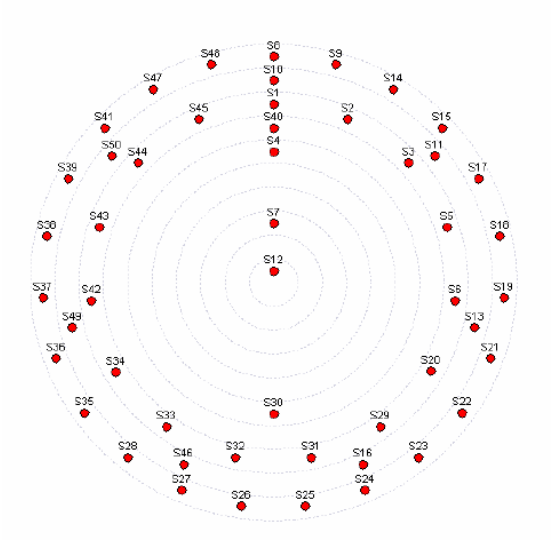

Figure 1: Out-Degree Analysis Sociogram

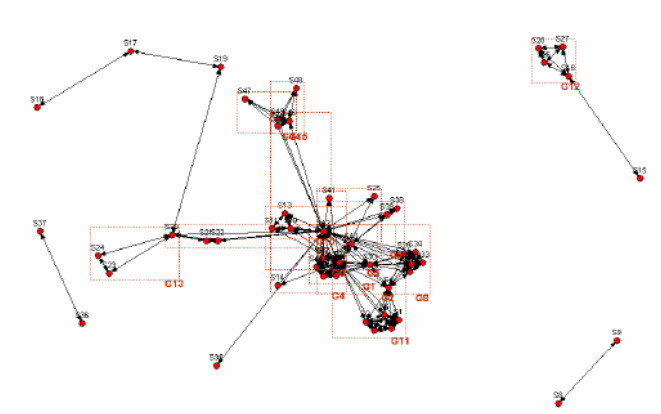

Figure 2: Clique Analysis Sociogram

Table 2: Clique analysis of the LGO discussions

Cliques	Actors
K1	S12,S7,S30,S40,S42,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	S2,S3,S4,S5,S6,S7,S1
K12	S16,S26,S27,S28
K13	S23,S20,S24
K14	S47,S46,S49,S50
K15	S48,S46,S49,S50

5 Disucssion/Conlusion

It is apparent from our research that most existing frameworks make either a qualitative or quantitative analysis of CMC, but rarely do we see a mixture of these techniques. Also, some models can only be used on only synchronous or asynchronous communication, but not both. Our opinion is that it is important that a unified framework is developed, for the complete evaluation of all aspects of online communication. As new teaching methods and different learning activities emerge, new types of interaction and evaluation are necessary. The analysis of CMC should take all these updates into consideration, and incorporate them into future CMC analysis models.

This paper has demonstrated the application of Social Network Analysis (SNA) in a computer aided language learning course of Modern Greek. Furthermore, an Attitudes Towards Thinking and Learning Survey (ATTLS) was carried out. Both of the methods used had the same results. More specifically, the results of the SNA showed certain students to be more central in the discussions and these findings were matched by the results of the ATTLS which identified the same individuals as the 'connected knowers'. In the future we plan to extend this study with incorporations of more methods towards a unified framework.

Suggestions to Researchers
This study showed the use of SNA as a mechanism for better exploring the dynamics of online learning communities. Future research directions could include a more detailed comparison of the ATTLS questionnaire with SNA results plus the comparison of the SNA results with other forms of standardized questionnaires (e.g. the Constructivist Online Learning Environment Survey - COLLES).

Suggestions to Practitioners
The approach provided in this paper can be a useful methodology for developers and maintainers of online communities as it can provide insights about the dynamics of their community and will enable them to develop strategies for strengthening the centrality of students with low ATTLS scores, especially since ATTLS surveys could be administered prior to any online interaction of the actors.

References

ACM SIGCHI. (1992). Curricula for Human-Computer Interaction. New York, NY: the Association For Computing Machinery.

Archer, W., Garrison, R.D., Anderson, T. & Rourke, L. (2001). A framework for analysing critical thinking in computer conferences. European Conference on Computer-Supported Collaborative Learning, Maastricht, Nerthelands.

Bales, R.F. (1950). A set of categories for the analysis of small group interaction. American Sociological Review, 15, 257-263.

Bales, R.F & Strodbeck, F.L (1951). Phases in group problem-solving. Journal of Abnormal and Social Psychology, 46, 485-495.

Beidernikl, G. and Paier, D. (2003): Network analysis as a tool for assessing employment policy. In Proceedings of the Evidence-Based Policies and Indicator Systems Conference 03. London, July 2003

Borgatti, S. (2000). What is Social Network Analysis. Retrieved on November 9, 2004 from http://www.analytictech.com/networks/whatis.htm

December, J. (1997). Notes on defining of computer-mediated communication. *Computer-Mediated Communication Magazine*, (3):1

Dekker, A.H. (2002). A Category-Theoretic Approach to Social Network Analysis. Proceedings of Computing: The Australasian Theory Symposium (CATS) Melbourne, Australia, 28 Jan to 1 Feb 2002

Fahy, P. J. (2003). Indicators of support in online interaction. International Review of Research in Open and Distance Learning. 4(1).

Ferris, P. (1997) What is CMC? An Overview of Scholarly Definitions. *Computer-Mediated Communication Magazine, (4): 1*

Galotti, K. M., Clinchy, B. M., Ainsworth, K., Lavin, B., & Mansfield, A. F. (1999). A New Way of Assessing Ways of Knowing: The Attitudes Towards Thinking and Learning Survey (ATTLS). *Sex Roles*, 40(9/10), 745-766.

Garton, L., Haythorthwaite, C., & Wellman, B. (1997). Studying On-line Social Networks. In Jones, S. (Eds.), Doing Internet Research. Thousand Oaks CA: Sage.

Gunawardena, C., Lowe, C., and Anderson, T. (1997). Analysis of a Global Online Debate and the Development of an Interaction Analysis Model for Examining Social Construction of Knowledge in Computer Conferencing, *Journal of Educational Computing Research*, 17 (4), pp397-431.

Hanneman, R. A. (2001). Introduction to Social Netwok Methods. Retrieved on November 9, 2004 from http://faculty.ucr.edu/~hanneman/SOC157/TEXT/TextIndex.html

Henri, F. (1992). Computer Conferencing and Content Analysis, In A. R. Kaye (Ed), Collaborative learning through computer conferencing: The Najaden Papers, 117-136. Berlin: Springer-Verlag.

Jones, S. (1995). Computer-Mediated Communication and Community: Introduction. Computer-Mediated Communication Magazine, 2 (3): 38.

Knoke, D., & Kuklinski, J.H. (1982). Network Analysis. Sage University Paper Series on Quantitative Applications in Social Sciences. Serious no. 07-001. Beverly Hills and London: Sage Pulications.

Krebs, V. (2004). An Introduction to Social Network Analysis. Retrieved November 9, 2004 from http://www.orgnet.com/sna.html

Korzenny, F. (1978). A theory of electronic propinquity: Mediated communication in organizations. Communication Research, 5, 3-23

Martinez, A., Dimitriades, Y., Rubia, B., Gomez, E., de la Fuente, P. (2003). Combining qualitative evaluation and social network analysis for the study of classroom social interactions, *Computers & Education* 41 (2003), pp353-368

Mason, R. (1991) Analyzing Computer Conferencing Interactions, *Computers in Adult Education and Training* 2 (3), pp161-173.

McCreary, E. (1990) Three Behavioural Models for Computer-Mediated Communication, Harasim, L. (ed) *Online education: perspectives on a new environment*. New York: Praeger.

McLoughlin, C. (1996). A learning conversation: Dynamics, collaboration and learning in computer mediated communication. In C. McBeath and R. Atkinson (Eds), Proceedings of the Third International Interactive Multimedia Symposium, 267-273. Perth, Western Australia, 21-25 January. Promaco Conventions

McMillan, S.J. (2002). A Four-Part Model of Cyber-Interactivity: Some Cyber-Places are More Interactive Than Others. New Media and Society, 4(2), 271-291.

Metcalfe, B. (1992). Internet fogies to reminisce and argue at Interop Conference. InfoWorld.

Preece, J. (2000) Online Communities: Designing Usability, Supporting Sociability. John Wiley and Sons: Chichester, UK

Preece, J., Rogers, Y. & Sharp, H. (2002) Interaction Design: Beyond Human-Computer Interaction. New York, NY: John Wiley & Sons

Rheingold, H. (1993). The Virtual Community: Homesteading on the Electonic Frontier. Reading: Addison-Wesley.
Rice, R. E., Grant, A. E., Schmitz, J., & Torobin, J. (1990). Individual and network influences on the adoption and perceived outcomes of electronic messaging. Social Networks, 12, 17-55.

Rice, R. (1994). Network analysis and computer mediated communication systems. In S. W. J. Galaskiewkz (Ed.), Advances in Social Network Analysis. Newbury Park, CA: Sage.

Schneiderman, B. (1998). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Reading, MA, Addison Wesley Longman

SCOTCIT. (2003). Enabling large-scale institutional implementation of communications and information technology (ELICIT). Using Computer Mediated Conferencing. Retrieved November 2, 2004 from http://www.elicit.scotcit.ac.uk/modules/cmc1/welcome.htm
Spears, R. and M. Lea (1992) 'Social Influence and the Influence of the Social in Computer-mediated Communication', in M. Lea (ed.) Contexts of Computer Mediated Communication, pp. 30-65. London: Harvester Wheatsheaf.

Scott, J. (2000). Social Network Analysis: A handbook. Second edition. London: Sage

Suler, J. (2004). The Final Showdown Between In-Person and Cyberspace Relationships. Retrieved November 3, 2004 from http://www1.rider.edu/~suler/psycyber/showdown.html

Vrasidas, C. (2001). Studying human-human interaction in computer-mediated online environments (pp. 118-127). In Manolopoulos, Y. & Evripidou, S. (Eds). Proceedings of the 8th Panhellenic Conference on Informatics, Nicosia, Cyprus.

Wallace, P. (1999). The Psychology of the Internet. Cambridge: Cambridge University Press.

Wellman, B. (1982). Studying personal communities. In P. M. N Lin (Ed.), Social Structure and Network Analysis. Beverly Hills, CA: Sage.

Wellman B. (1992). Which types of ties and networks give what kinds of social support? Advances in Group Processes, 9, 207-235.

Wellman, B. (1997). An Electronic Group is Virtually a Social Nework. In Kiesler, S. (Ed.), Culture of the Internet. Hillside, New Jersey: Lawrence Erlbaum Assoc. 179-205.

Zaphiris, P., Zacharia, G. (2001). Design Methodology of an Online Greek Language Course. Ext. Abstracts CHI 2001, ACM Press.

Zaphiris, P., Zacharia, G., Rajasekaran, M. (2003). Distributed Constructionism through Participatory Design. In Ghaoui, C. (Ed) E-education Applications: Human Factors and Innovative Approaches, Idea Group Publishing, London, UK