

Who Knows Whom in a Virtual Learning Network? Applying Social Network Analysis to Communities of Learners at the Computer Clubhouse

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Abstract: Social network analysis can be used to describe influence, group dynamics and collaboration in learning networks. The current analysis focuses on a distributed community of learners' email communication and represents the first step in understanding the community's social dynamics. It focuses upon the online intranet presence of the Computer Clubhouse, a network of after-school computer learning centers. The paper presents network analysis and graphs that highlight characteristics of the relationships between the youth, such as strength of their ties, gender, and location of emailing dyads. Implications for future network analysis of learning communities are discussed.

Introduction

Social network analysis (SNA) can be used to describe influence, group dynamics and collaboration in learning networks. In other fields it has provided great insight on a range of social issues such as who gets hired for different positions in businesses (Erickson 2001), where power resides in organizations (Lin 2001), and how ideas flow through individuals and across communities (Valente 1996). The current analysis focuses on a distributed community of learners' email communication and represents the first step in understanding the community's social dynamics.

A social network is the social structure of people or organizations. Social network analysis (SNA) evaluates the structure of groups of people using statistical methods. Individual people are represented as nodes and connections between individuals as lines or edges. An edge could represent different intensities or types of relationships such whether a person knows another at all, how well they know each other, or whether one person likes or dislikes another. The general shape of the network can be described numerically or graphically, specifying who is connected to whom, how strong the connections are ("tie strength"), and who contacts others via intermediaries (Degenne & Forsé 1999).

This study describes the characteristics of the learners, the use of an online resource, and the email exchanges between members of the group. The email exchanges are analyzed in a network analysis that describes who emailed whom and how email connections are different throughout the network. These findings lay the groundwork for more extensive use of SNA techniques with this community and suggests the ways in which it can be useful in the learning more generally.

The study focuses upon the online presence of the *Computer Clubhouse*, a network of after-school computer learning centers where young people from under-served communities work with adult mentors to explore their own ideas (Computer Clubhouse web site n.d). The Computer Clubhouse network is composed of 107 centers supporting a total of about 20,000 youth members. Sixty-nine percent are in the United States. Thirty-eight percent are located in 21 other countries or political regions: Ireland, Northern Ireland, the Netherlands, Denmark, Germany, Israel, the Palestinian Territories, Jordan, South Africa, India, Taiwan, the Philippines, Australia, New Zealand, Mexico, Costa Rica, Panama, Columbia, and Brazil. A central overarching organization coordinates activities, goals, and information across the network, but within the network structure, each learning center functions independently and is run by its own Clubhouse Coordinator. Different clubhouses may have very different cultures in which youth engage in different activities such as using Photoshop filters to make portraits of themselves, creating 3D worlds using 3D Studio MAX and creating their own games using GameMaker.

A challenge in a distributed learning environment such as this one is coordinating the flow of information and encouraging interactions across locations. To address this need, the *Computer Clubhouse* has its own intranet called the *Village* (see Figure 1). Through the *Village* members of the community have the unusual opportunity to discuss who they are and what interests them, and to share their ideas and projects with youth around the world (Computer Clubhouse Village web site n.d).



Figure 1. The Computer Clubhouse Village

The *Village* is used to disseminate programmatic information, coordinate events, share the youth's creation and suggest activities and ideas to inspire new projects. It has five main sections: *Projects*, *People and Clubhouses*, *Software Studio* (an area that lists all the software available at the clubhouses, along with help and online software), *Talk* (which has discussion groups and email), and *Topic Tree* (information on various Clubhouse issues such as sustainability, tutorials, digital photography, web design, and gender equity.). From their homepages, members can post photo albums, galleries and describe who they are. With the *Village*, youth can get involved with new projects and interact with others outside their clubhouse in ways unimaginable without it.

Who Uses the Village

As of October of 2005, the *Computer Clubhouse Village* has over 3000 users. Eighty-two percent of *Village* users are youth members, while the remainder are adult coordinators, mentors, and other staff. An equal number of male and female members use the *Village* (1213 male and 1214 female). The mean age of the youth is 15.28 (see Figure 2.)

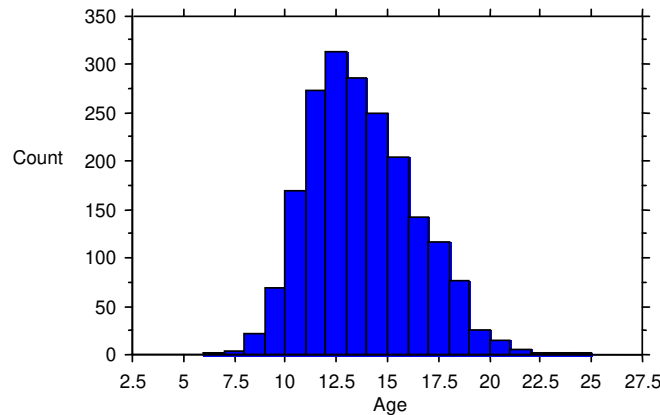


Figure 2. Count of Age of Members of the Clubhouse

Though youth from many countries use the *Village*, sixty-nine percent of the users are from the United States. Beyond that, five percent are from Columbia and the Philippines respectively, four percent from Mexico and Northern Ireland, respectively, and the remaining are from Australia, Brazil, China, Costa Rica, Denmark, India, Ireland, Israel, Jordan, the Netherlands, New Zealand, the Palestinian Territories, Panama, South Africa, and Taiwan. Seventy-nine percent of the youth describe their primary language as English, 13 percent Spanish, 3 percent Filipino and the remaining 4 percent all other languages including Chinese, Danish, Dutch, German, Hebrew, Hindi, Kannada, Portuguese, and Russian. Currently most of the *Village* content is in English though menu bars are available in many languages and some content is in Spanish.

How the Users are Connected Via Email

Of the 2427 registered youth users of the *Village*, 712 sent email between August 21 2005 and Sept 15 2005 when the current data was collected. These emails were between 1854 distinct pairs of users. Thirty-seven percent of these pairs were single emails that the receiver did not respond to. For these emails, it is possible that many members use the *Village* to reach out to others, perhaps outside of their usual circle, and do not get a response. Sixty-three percent of the emails were two emails within the pair. Two pairs of youth emailed each other 93 and 277 times respectively. These pairs may be using email more like instant messages.

In Figure 3, the graph on the left shows the entire social network of 712 youth with no adults including in any of the following analyses. Lines between members indicate that they exchanged emails. The width of the line indicates the number of emails sent between the two individuals. The relationships between the different shapes roughly indicate which members are more closely tied to others. From this graph we see two subgroups, one large cluster at the bottom left side and one smaller cluster near the top. We can see there are many members on the peripheries as well. Many of these peripheral members have tie strengths of 1: that is only one email was sent between the pairs. There are several explanations for these peripherals. First the senders could be “spamming” people. Second they could be social isolates. Third they could be more central to the network but not enough data has been collected. In the future, collecting more data and analyzing the directions of the emails will help to clarify this issue.

The graph on the right side of Figure 3 is identical to that on the left except it shows only ties with at least 3 emails sent between each pair. Comparing the stronger ties on the left with all ties on the right, one can see better where stronger ties exist. These ties are in the more central part of graph. There seems to be several members spanning the two cohesive groups with many relationships, some with strong and some weak ties. The members that bridge two distinct groups may be instrumental in spreading ideas through the different subgroups. (Granovetter 1973). The characteristics of these members and their groupings are presented next.

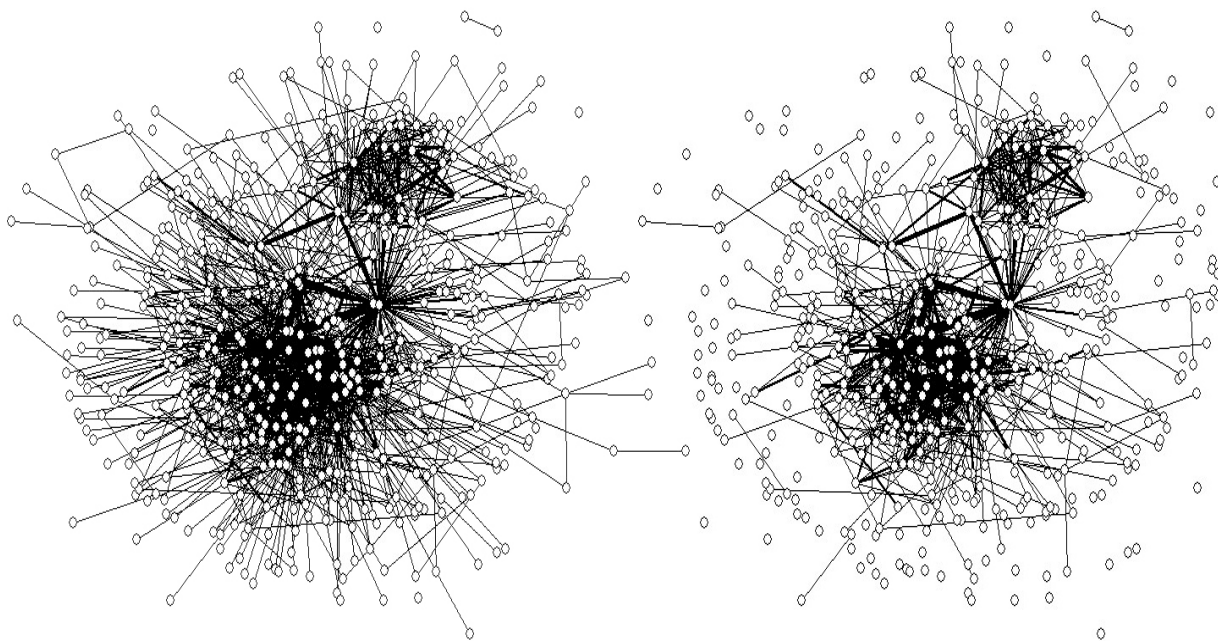


Figure 3. All Tie Strengths versus Strong Ties Only

Figure 4 is the same basic graph as those in Figure 3 except a *gray line* between two shapes demonstrates that emails were exchanged between two youth *in the same clubhouse* whereas a *black line* indicates they are *at different clubhouses*. Many ties, including strong ones, were made between members in different clubhouse, including the ones connecting the two subgroups. From this graph it seems the Village is succeeding in its goal to connect youth with others outside their neighborhood clubhouse.

What about connections made within clubhouses? The graph reveals that many of the weaker ties on the extreme perimeters of the network are connections within clubhouses. This result is hard to interpret. It is possible that these members simply emailed others who don't use Village. Connections were also made within clubhouses on the perimeters of the two subgroups whereas the center is composed of connections across clubhouses. These ties may be instrumental in getting information through the network (Granovetter 1973). The next graph addresses the same concept of regions, but considers countries instead of clubhouses.

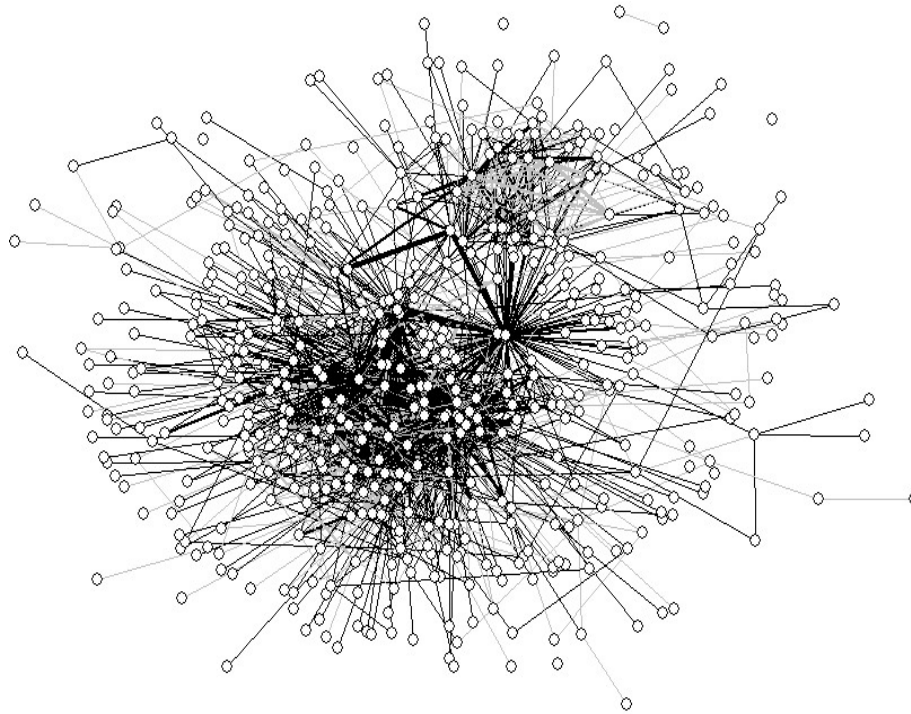


Figure 4. Emails Between Members from Different and the Same Clubhouses

Grey lines in Figure 5 demonstrate a connection within clubhouses, whereas black lines represent emails exchanged between countries. The shape of the nodes represents the country of the individual. The large subgroup that we noticed in previous graphs is primarily composed of triangles, representing the United States. The other large subgroup is composed of double triangles, representing the Philippines. As one would expect, there are far fewer connections between countries than there are between clubhouses. Still a few connections are scattered throughout. In particular, members communicate between the US and the Philippines. Since the network staff does not report any particular activities, this finding is unexpected. It will be interesting to see if this pattern continues over time and whether additional connections develop between these countries and others.

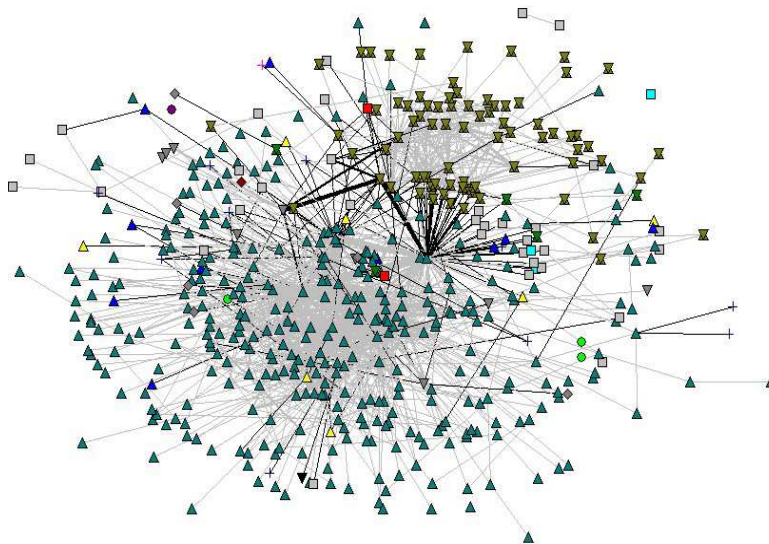


Figure 5. Emails between Members in Different Countries

Figure 6 shows the gender of email communicators. Every square represents one girl and every triangle represents one boy. A gray line between two shapes demonstrates that emails were exchanged between two youth of the same gender, whereas a black line indicates a connection across genders. From the graph we can see that communication between different genders is far more common than same gender. Perhaps we are observing flirting? We also see that girls email more than boys and appear more centrally located than boys. The bridges between the two main subgroups are girls from the US emailing with boys from the Philippines.

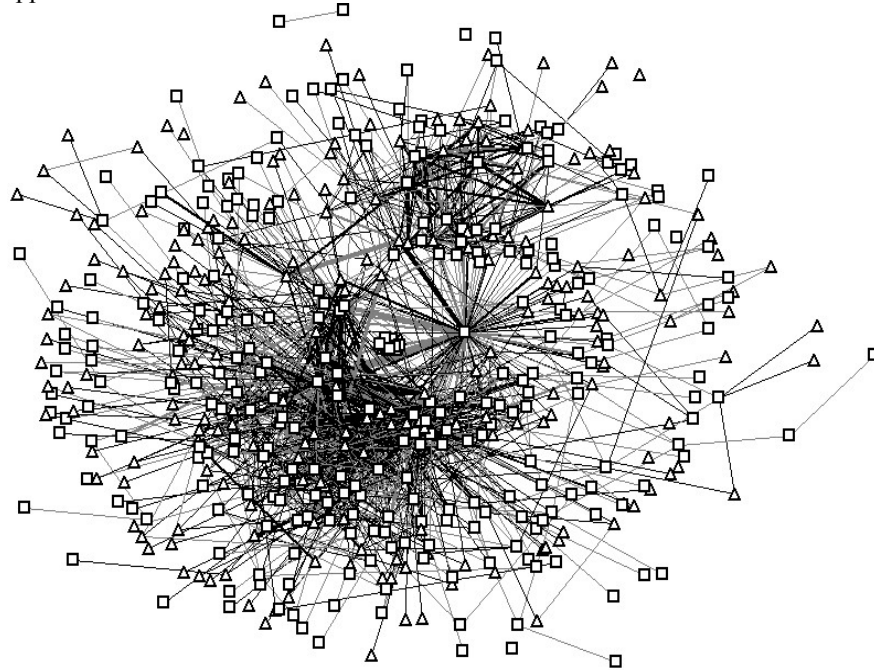


Figure 6. Social Network and Gender

From these series of network graphs we have a picture of what happens with email on the village. Two subgroups emerged primarily representing members from the US and the Philippines, respectively. A few members connect these two groups while an encouraging amount of communication occurs between clubhouses and even countries. It is likely that the youth are emailing with others they have never met in person. It is exciting that some pairs email intensively and interesting that girls seem to email more but cross gender communication is far more common than within gender.

Future Work

Understanding the ways groups of learners interact with one another is tricky. Researchers interested must unpack a complexity of individuals' processes and development, and the multiple social interactions that influence them. SNA is an exciting tool for learning science researchers interested in group dynamics, group influences, and the social aspects of learning. It provides methodologies for addressing how learners in a community interact with each other, gain knowledge from, and influence each other's learning.

This exploratory analysis of who is connecting with whom on the Computer Clubhouse Village is a first step in understanding how networks of learners function. Viewing the graphs and exploring the statistics provides an understanding of overall communication trends across the network. A few analyses will improve the understanding of members' communication:

- *Changes over time:* This includes what changes, what remains the same, and what precipitates change (such as school vacations or special Clubhouse events).
- *Direction of email:* How much do members send versus receive email and what does this say about their contribution to and gain from the network?

- *Cohesion*: How well connected is the network overall and how connected are particular groups? Do regions, gender or ages characterize cohesive subgroups?
- *Email Content*: Ask members what they discuss including projects, personal preferences, differences between their worlds, and whether they flirting.

Once the nature of the relationships are better understood, the next step will be to explore project-related data. SNA allows researchers to understand how ideas move through a network through a process called diffusion of innovation. "Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system." (Rogers 1983 quoting Beal & Bohlen 1955). Analysis of the flow of innovation might help researchers understand how ideas are adopted in learning communities, how network structure influences who adopts, and the factors that influence widespread adoption. In the case of the Village, this includes who posts projects, who looks at them, who creates their own version of a project, and who adopts project ideas into a new space. Are the youth who email a lot considered active social participants within their clubhouses? How much are active emailers considered active project creators? What role do they have in the transference of project ideas? This type of work would be profoundly exciting for those who are interested in how groups of learners influence one another.

Conclusions

This paper considers the structure of the *Computer Clubhouse* social network by looking at email: who emails whom and how much members email people outside their clubhouse. These analyses help to describe the nature of a community of distributed learners. The author argues that these types of analyses are only a first step in applying SNA to learning communities and as this work progresses, it may uncover insights into how ideas move through a network of learners and how learners influence each other.

References

- Computer Clubhouse website*. (n.d.). <http://www.computerclubhouse.org>
- Computer Clubhouse Village website*. (n.d.). <http://village.computerclubhouse.org>
- Degenne, A and Forsé M (1999). *Introducing Social Networks*. Sage Publication, Thousand Oaks, CA.
- Erickson, B. (2001). *Good Networks and Good Jobs: The Value of Social Capital to Employers and Employees*. Lin, et al (eds.), *Social Capital: Theory and Research*. Aldine de Gruyter, New York.
- Granovetter M (1973). The Strength of Weak Ties. *American Journal of Sociology*, 78 (May): 1360-1380.
- Lin, (2001). Building a Network Theory of Social Capital. Lin, et al (eds.), *Social Capital: Theory and Research*. Aldine de Gruyter, New York.
- Rogers, E (1995) *The Diffusion of Innovations*, 4th Edition. The Free Press, New York.
- Valente T (1996) Social network thresholds in the diffusion of innovations. *Social Networks*, 18: 69-89.

Acknowledgments

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