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Improving social capital: a social network monitoring system

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Abstract: To increase communication and collaboration opportunities, members of a community must be aware of the social networks that exist within that community. This paper describes a social network monitoring system that enables users to register their interactions and visualize their social networks. The system was implemented in two distributed learning communities and the results have shown that this system facilitates collecting information about social interactions. Furthermore, the visualization of the social networks, given as feedback, appeared to have a positive impact on users, augmenting their social network awareness.
Key words: Social Capital, Social Networks, Awareness support, Distributed Learning Environments.

1. Introduction

Knowledge management (KM) takes an organizational perspective on learning, and the main problem it tries to address is the lack of knowledge sharing among members of the organization [Schmidt 05]. An increasing number of organizations are attempting to set up KM systems and practices to more effectively use the knowledge they have. Traditional KM strategies have been heavily based in the use of information technologies and have mainly considered knowledge flows as different levels of access to organizational stocks of explicit and codified knowledge resources [Garcia-Perez et al. 07]. However, improving efficiency and effectiveness demands more than sophisticated technologies — it requires attending the ways people seek out for knowledge, learn from and solve problems with other people [Cross et al. 01]. Supporting social network awareness has been point out as one of the strategies to increase knowledge sharing and collaboration opportunities.

We developed a social network monitoring system — the KIWI (Knowledge Interactions to Work and Innovate) system — that addresses simultaneously: gathering information about social networks, and promoting social network awareness. In this paper, we describe the KIWI system and discuss the first findings obtained after using it in two real world environments. We explore the social network data collected and present the results obtained from users' evaluation of system usability and its effects in their awareness and behaviour.

2. Social capital and social network awareness

Social capital refers to the stock of social trust, norms and networks that people can draw upon to solve common problems. While human capital refers to properties of individuals such as knowledge, social capital implies connections among individuals and the value accrued from these connections [Daniel et al. 02]. Knowledge is created and exchanged to a large extent through informal social interactions [Cross et al. 02][Ogata et al. 01][Storberg-Walker et al. 07] and knowledge flows depend on the connections between individuals and on their attitude

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about sharing knowledge [Inkpen et al. 05][Ipe 03][Lin 07] [Wang et al. 07].

In distributed communities, it appears very important to be aware of others in order to communicate and collaborate [Hu et al. 02]. Supporting awareness — to be aware of the ideas, knowledge, and activities of the others — has been used as one of the strategies to increase knowledge sharing and collaboration opportunities [DiMicco et al. 07]. Considering the importance of awareness, it is worth exploring which techniques can be used to support it [Otjacques et al. 06].

Different mechanisms were applied to build awareness of “who knows what” by distributing information about people’s expertise and it has proven effective in increasing knowledge awareness [Cross et al. 01]. But knowing that someone else knows something of relevance does little good if people cannot gain access to their knowledge and help just in time [Cross et al. 01]. Networks do not only provide access to resources but also to other actors who can help to give value to these resources. This accessibility is directly connected to social network awareness, which we understand as the awareness of social relationships within the group — the awareness of “who knows whom”. It seems helpful to map access relations at a network level to understand who is able to reach whom in a sufficiently timely way [Cross et al. 01]. In a virtual environment users must be able to perceive and compare the social patterns of activity. This will allow them to structure their social networks to maximise their benefits by getting closer to the existing resources and opportunities [Clark 06].

3. Social Network Monitoring System

The social network monitoring system developed depends on active participation of users in the data gathering process. According to system architecture (see Figure 1), the system provides users with a gathering tool for registering their interactions and automatically analyses and presents social network information through a visualization tool. Explicit social network information is extracted from a database through social network analysis (SNA) techniques. SNA provide a rich and systematic means of assessing informal networks by mapping and analyzing relationships among people [Cross et al. 01]. It can be a valuable analytical tool for examining complex social processes and then intervening at critical points within an informal network [Cho et al. 07] [Cross et al. 02]. In addition to its potential to go further in a systematic analysis of social network by researchers and/or community managers, the system supports social network awareness of users by making the hidden networks visible to all community, without abstracting or evaluating users’ behaviours.

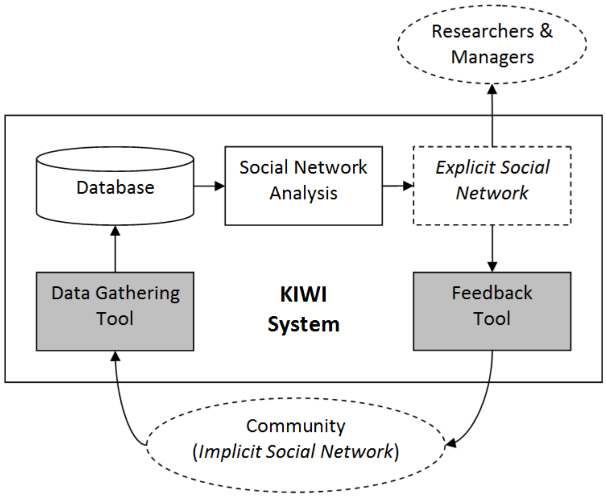

Figure 1. Monitoring System Architecture

By directly asking users about their interactions it is possible to monitor every kind of interaction, from face-to-face meetings to mail and chat interaction, without implying major changes to users' current behaviour (the imposition of new communication tools could change the existing spontaneous informal network and would not ensure that all of what was happening was being recorded). Although the required involvement in the data gathering process creates additional workload for users, potentially leading to a disparity between effort and benefit [Rittenbruch et al. 07][Van Baren et al. 04], we note two advantages of this strategy. First, this option can act as a filtering strategy which will increase the extraction of meaningful information and decrease the burden in analysis, instead of producing extensive data as most monitoring systems do, which in turn would require considerable effort to uncover significant relationships within the group [Chen et al. 03]. Second, this strategy is likely to promote individual responsibility, to strengthen trust among participants, and to improve self-awareness, selfdirection and self-management of their own activities [Zheng et al. 07].

3.1. Data Gathering Tool

The main requirement for the design of this tool was to minimize the additional workload for users. It is implemented through a simple Web-based page where a user sees a list of community members (identified by name and picture) and responds by clicking on those people with whom he/she has interacted (see Figure 2).

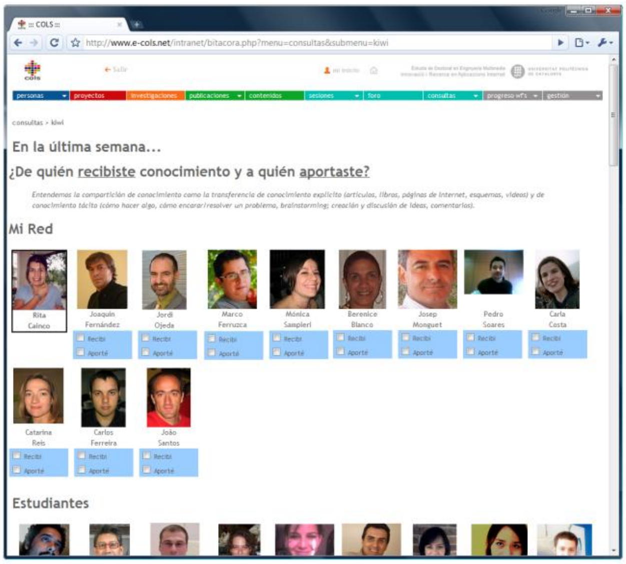

Figure 2. Data gathering tool interface.

At the top of page there are the questions and definitions that explain the interactions that should be registered. For each person, the user can identify different kinds of interactions. The layout of the interface adapts with ongoing use. After each user's first response, the community members selected in the previous sessions appear in a prominent area — *My Network*. In this way the effort for looking for regular co-workers is reduced and, at the same time, the user can be more aware of his/her regular network.

To implement this tool, two things are necessary: a) identify the community members that will be monitored and b) define what kind of interactions will be registered. After establishing the community participants it would only be possible to register interactions between these people.

3.2. Visualization Tool

In the visualization tool, social network diagrams are used to visually represent networks and uncover patterns of people's interactions (see Figure 3). To let users assess the effectiveness of their personal network, the visualization tool also provide graphical quantitative information (number of people in their individual network, frequency of interactions).

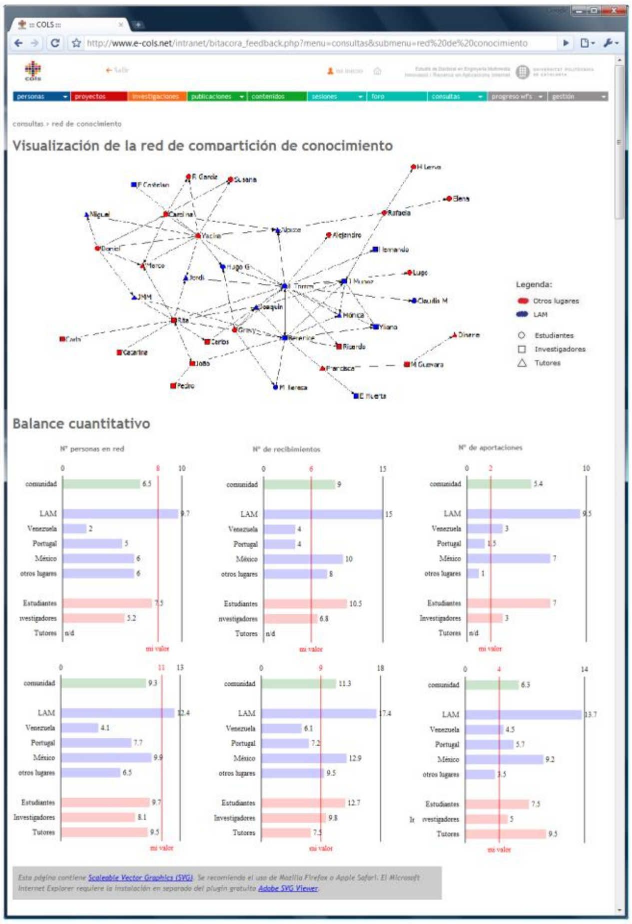

Figure 3. Visualization Tool Interface

The visualization tool works automatically from the system database, and provide two types of information:

a) Network diagrams. We used social network analysis software tool *NetDraw* [Borgatti 02] to visually represent all the social connections registered. Every week a new diagram is posted, presenting the social network accumulated in the past three weeks. In these network diagrams, each node in the network represents a person and each arc represents an interaction. Every interaction is represented, even if it was only registered by one person from the pair. Colours and symbols were used on nodes to give meaningful information.

b) Quantitative information. Six graphs were presented with weekly and cumulative information: number of contacts, number of each typo of interactions. Because the visualization tool is personalized and adapts to the user, both individual values and group values were presented to each user.

4. Method

The system was implemented in two different distributed communities: 1) the Multimedia Engineering PhD Programme of Polytechnic University of Catalonia, Spain (UPC); and 2) the Basic Education Distance Learning Course of Polytechnic Institute of Leiria, Portugal (EB).

The UPC community is a multidisciplinary team of 37 researchers that brings together different expert knowledge domains (engineers, designers, teachers, mathematicians, anthropologists, psychologists) with a central unit located in Barcelona, Spain, but with many members located on other countries (Venezuela, Mexico, Colombia, Portugal, Denmark, and USA). This community uses a web platform for information sharing and most communications occur outside this platform through mail, chat, and, in some cases, face-to-face meetings.

The EB community includes 19 students and 5 teachers and uses a typical e-learning platform for the daily course activities. Most student-teacher interactions occur in this platform, but student-student interactions occur mainly through mail and chat. All the community has face-to-face meetings at least one a month.

A preliminary analysis of both communities reveal a small satisfaction with the communication and collaboration occurring and that the participants longed for more interaction. These results gave support to the implementation of KIWI system in these communities.

The system was integrated into communities' web platforms and participants were asked to respond to KIWI data gathering tool every week, identifying those people with whom they interacted during that week. In the UPC group, we ask users about interactions that allowed knowledge sharing and each user had to classify the giving or receiving (or both) character of the knowledge transfer. In the EB group, each user had to classify his/her interactions according to their purpose: a) planning, b) working together, and c) help and support.

After using KIWI for eight weeks, users were requested to fill out an on-line survey to evaluate system usability and the effects of its usage on their awareness and behaviours.

5. Results

During the 8 weeks of each field test, the gathering tool was used a mean average of 4.5 times per person in UPC and 6.4 times per person in EB community. The individual mean average was 6.8 and 7.78 interactions by person by week (SD = 4.4 and 3.24), respectively. The time average of each response was 1.86 and 2.02 minutes. These results indicate how easy was to manipulate the gathering tool.

Besides registering their interactions once a week, users were invited to access the visualization tool for receiving feedback on their community's interactions. The visualization tool was used 9.92 and 15.3 times per person during the 8 weeks, showing that users often accessed KIWI just to visualize their social network.

5.1. Social Networks Data

In this section we present a small piece of the total data collected to illustrate the potential of the system on given relevant and useful information about the communities' social networks. We use SNA tools *UCINet* [Borgatti et al. 02] and *NetDraw* [Borgatti 02] for representing and analyzing the collected data. To better understand the structural importance and prominence of each person, nodes are sized according to individual's degree (diagrams A) and betweenness (diagrams B). Degree refers to the extent to which an individual has numerous connections to other members. High degree centrality seems important, because it has been shown that it is positively associated with performance through the improvement of individual's access to resources [Cho et al. 07]. Betweenness captures the property of frequently lying along the shortest path between pairs of persons. In diagrams (B) large nodes identify those people who constitute access bridges for those who are not directly connected. Members occupying these positions seem to have more control over diverse resources located in multiple sub-groups [Cho et al. 07].

Figure 4 displays all connections registered in UPC community, showing a cohesive network (density=0.667[1]) with no isolated subgroups except a single individual (he answered KIWI gathering tool several times informing that there were no interactions). People from the local group are at network centre and show higher degree of interaction. This group include PhD supervisors (triangles). They act as a bridge inside community, but there are also people at distance group (red) with a central role in network's accessibility.

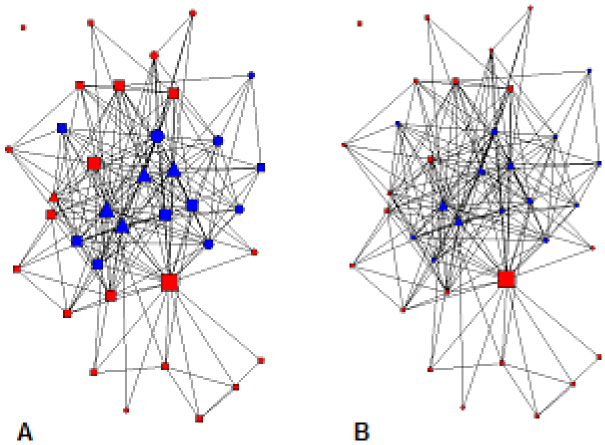

Figure 4. UPC social network: evidencing members' degree (A); evidencing members' betweenness (B).

Figure 5 displays the EB social network, revealing a more cohesive network (density = 1.656) with all people strongly connected to each other. This network has a less hierarchical structure, despite the central position of teachers (in blue) and of one student that appears to have an important role in the community dynamics.

[1] Network density is the proportion of lines present in the graph to the maximum number of lines possible and it's often interpreted as a measure of cohesion of the group.

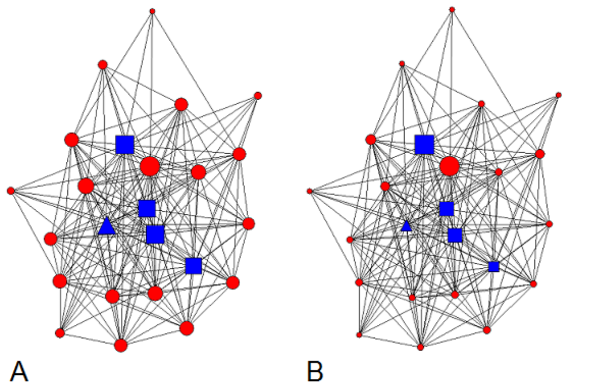

Figure 5. EB social network: evidencing members' degree (A); evidencing members' betweenness (B).

Other patterns could be extracted from the network database considering, for example, the frequency and type of interactions.

In the UPC group, users were more likely to assume knowledge receiving (62%) than knowledge giving (38%). This could show that people tended to be more aware when receiving from others than when giving. It was also noted that supervisors, besides higher number of contacts, have higher levels of weekly interactions. In the EB group, most interactions registered were for help and support (43%), followed by 29% of interactions to planning, and 26% for working together. In this community, teachers also showed higher levels of weekly interactions for planning and working, but interactions for helping and supporting were mostly registered by students.

5.1. Users' Social Network Awareness

After the field tests, users were request to answer to an on-line survey that intended to evaluate the usability of the system and the effects of its usage in users' social network awareness and behaviours. The questionnaire had 13 items with a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3=agree/disagree, 4 = agree, 5 = strongly agree). Table 1 summarizes survey's results.

Items (1) to (4) focused on the evaluation of the system efficiency. Users answered that the time and intellectual effort required to contest KIWI was hardly any (items 1, 2), confirming that, despite the lower rates in EB group, the data gathering tool was very simple and easy to use. However, some users noted some effort and difficulty in understanding all the information displayed in the visualization tool (items 3, 4), which indicates that the graphics provided could be slightly complex or that too much information was being given. This difficulty could have some negative effects in the reflection and interpretation process and deserve future attention and improvement.

Table 1. Survey's results on evaluating the system's usability and the effects of its usage in users' social network awareness.

		M	SD
1. There was a few time effort to contest the KIWI every week.	UPC	4.57	0.73
	EB	3.57	1.45
2. I had to make hardly any intellectual effort to contest KIWI.	UPC	4.61	0.58
	EB	3.60	1.24
3. I had to make hardly any intellectual effort to understand the information about the social networks.	UPC	3.45	0.96
	EB	3.14	1.17
4. I could understand all the information displayed in the KIWI System.	UPC	3.36	1.09
	EB	3.79	1.05
5. The reflection I had to make to contest KIWI made me more aware about my interactions and my role in the community.	UPC	4.35	0.83
	EB	4.13	0.83
6. The information displayed was relevant for me.	UPC	3.77	0.92
	EB	3.71	0.83
7. The information displayed improved my awareness about the others and their interactions.	UPC	3.87	0.81
	EB	4.29	0.61
8. The information displayed improved my awareness about my interactions and my role in the community.	UPC	4.04	0.98
	EB	4.07	0.91
9. My participation in this study gave me more motivation to interact with others.	UPC	3.48	0.90
	EB	3.2	0.86
10. My participation in this study gave me more motivation to help others.	UPC	3.43	0.84
	EB	3.00	0.47
11. My participation in this study gave me more motivation to ask for help.	UPC	3.41	0.96
	EB	3.00	0.47
12. I found positive and useful the reflection I had to make to contest KIWI.	UPC	4.09	0.90
	EB	4.07	0.59
13. I'm satisfied with my participation in this study.	UPC	4.13	0.81
	EB	3.73	1.10

We used items (5) to (8) to evaluate the effectiveness of the system in augmenting users' social network awareness. Users acknowledged an improvement on their awareness and this was especially significant when users were registering their interactions (item 5). In the UPC group, the system also had a slight impact in users' motivation to interact, to help others and to ask for help (items 9, 10, 11).

In a general way, users were very satisfied in using KIWI system and considered that the reflection required was positive and useful and the information provided was relevant to them.

6. Conclusions

Results have shown that users can easily use KIWI system to give information about their social networks and that the collected data allowed displaying relevant information about these networks. The analysis of the collected information revealed some interesting patterns inside each community, as the more hierarchical structure of UPC group, or the identification of a few members acting as access bridges between people that are not directly connected. These results deserve further attention in the future and more deepen analysis seems necessary to understand communities' interactions patterns.

Users from the two real world scenarios considered positive and useful the reflection they had to make when using KIWI and acknowledged an improvement on their social network awareness. The option of using participants' perceptions in the gathering process appears to have the advantage that users select and register the interactions they believe to be significant, producing a meaningful and self-relevant explicit social network.

Our study had some limitations that should be acknowledged, namely the reduced time of implementation and the fact that there was not sufficiently control on measuring how users interpret the information received. There were reports on difficulty in understanding all the social network information. This fact points out the need for future work on improving the visualization tool. And, once social structures change over time, as do their effects on individuals [Cho et al. 07], further and longer research is also needed to explore the effects of social network awareness in promoting communication and collaboration. The KIWI system could be implemented in organizations that, while not based on teams' work and group tasks, desire strategies to improve communication and knowledge sharing. Further work based on other real world scenarios is also needed to validate the system versatility in adapt to diverse communities.

Acknowledgments

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