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Social network analysis in virtual learning community at faculty of information technologies (FIT), Mostar

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Abstract

FIT has a large virtual community, developed for DL students, but including the growing number of in-situ students. Through the last five years, most of the students have accepted and used FIT Community Server (FITCS) for interactions, but the extent of knowledge sharing was never measured. It was determined that FITCS is a small-world scale-free network, with several hubs: some administrators and some spammers. Now we determined characteristics of the social network, such as density, centrality, degree, closeness and betweenness, for overall communication in first two semesters and for two subjects in order to estimate knowledge sharing.

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1. Introduction

FIT Community Server (FITCS) exists for several years. It was originally designed for distance learning students, but in time it became the most popular way of communication for all FIT students. FITCS consists of several units, and one of them is reserved for communication on FIT courses. That part was designed for knowledge and information sharing. Naturally, one might ask if students actually use FITCS for knowledge sharing, and if yes, in which extent. In order to answer those questions, it was necessary to investigate if FITCS has characteristics of a social network, identify actors in the network according their roles, and to check if roles of the principal actors are adequate to those they should have in a knowledge sharing community.

After identifying the questions, we designed a scientific project in order to answer them. The first phase of the project consists of modeling communication with a graph, and deployment of social network analysis to check the following hypothesis:
H1: Educator and technical staff has proper roles as recommended in a knowledge sharing community.
H2: Stars of the social network are the most successful students.
H3: FITCS supports knowledge sharing.

We used data from FITCS for communication on first year courses in 2007/8 academic year, and modeled it into three networks (one network and two sub-networks):
- N: Overall first year communication.
- N1: Communication on Introduction to programming - fall semester course, sub-network of N.
- N2: Communication on Programming 1 - spring semester course, sub-network of N.

First year students were the target population for this research because even if they are experienced in communication on various forums, they have never used it for knowledge sharing. The other important reason for choice of freshmen is a high dropout rate, for which we want to explore any possible reason in order to lower it.

One of the biggest problems in knowledge sharing at FITCS is existence of so-called spammers (spammers are actors with very high vertex-degree who tend to write posts irrelevant to the topic). Results of a previous research [N. Bijedic and S. Burak, 2006] show they are among the most interactive actors. Additionally, authors have experienced that other students do not support such behavior, and that spammers often cause other actors to give up communication on a topic. Both students and educators have expressed their disapproval by petitioning administrators to ban spammers.

Another problem we recognized is that not all of the educators were actively participating in knowledge sharing at FITCS (results of internal quality assurance surveys). On the other hand, students rely very much on communication with educators, especially for help in interpretation of syllabus, problem solving, and homework. Again, results of internal quality assurance surveys indicate that students want confirmation that their work was well done. Authors find such behavior adequate for freshmen, especially in the frame of their average age.

In order to formulate a general picture, we investigated overall first year communication, and afterwards we focused on particular courses networks, N1 and N2. These courses were chosen because students find them difficult, and often team up on their own in order to complete them. The choice of one fall and one summer semester course was to enable us to follow the social network development.

The research's purpose is to analyze state of the art at FITCS as virtual learning community, in order to give recommendations for more adequate use. In particular, the goal is to determine proper roles for teaching and support staff.

2. Methods

The research was carried out at FIT, Mostar, after the end of the 2007/8 academic year, when 293 freshmen were enrolled. We collected data from FITCS, for the period from 1.10.2007 until 30.9.2008, and modeled them into three networks (N, N1 and N2). Network N has 273 vertices, N1 143, and N2 99.

We accessed data from FITCS database exported into MS Excel spreadsheet, added the necessary node identification, exported data into Matlab, and created adjacency matrices.

2.1. Mathematical model of networks

We modeled communication with a graph (undirected), as following: nodes of the graph are active FITCS actors (students, educators and administrator). There exists an edge between two nodes if the two actors wrote posts in the same topic. Graph is undirected for we assume that all who participated in a topic have read all the previous posts, and consequently decided to start communication. That is, a post is not only an answer to the previous post, but it is an answer to a part of the previous communication. The edges are not weighted because it was more important to find out if the actors have communicated and with how many others, then to quantify communication between two actors (N. Bijedic at al., 2007).

2.2. Social network analysis

We performed social network analysis in Ucinet 6 for Windows (version 6.204). The parameters we calculated and interpreted can be divided into parameters of the network and those describing a particular node. To gain insight into overall communication of the analyzed networks, we determined network components, and calculated: average distance, density, clustering coefficient, cohesion, average closeness, and average betweenness. For description of communication of actors in focus, we determined egocentric networks, and calculated degree, closeness, and betweenness [John Scott, 2007]. As additional information, we calculated distributions of degree frequencies, and determined position of actors in focus with regard to them.
3. Results

In this section, we present results for educators and selected successful students (three per network). We did not present results for any of the identified spammers.

Table 1 shows results necessary for understanding of overall communication in the analyzed networks. The two components recognized in all three networks, are consequences of existence of isolated vertices (4 in network N, 1 in network N1 and 4 in network N2).

On the other hand, centrality measures presented in Table 2 serve for the analysis of roles of the actors in networks N, N1 and N2.

In order to analyze positions of actors, we constructed egocentric networks for six educators and several students. It turned out that educators 1, 2, 5 and 6 are stars in their egocentric networks, while educators 3 and 4 have the roles of moderators. All three students from Table 2 were stars in their egocentric networks.

The distribution of degree frequencies in networks N, N1 and N2 was far from normal, and could be classified as scale-free even if the power, p, is quite low (N1: p=-1.84, R²=0.79; N1: p=-1.31, R²=0.79; N2: p=-1.99, R²=0.87).

### Table 1: Parameters of social networks

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N1</th>
<th>N2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average distance</td>
<td>1.90</td>
<td>1.80</td>
<td>1.93</td>
</tr>
<tr>
<td>Components</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Density</td>
<td>0.18</td>
<td>0.25</td>
<td>0.17</td>
</tr>
<tr>
<td>Clustering coefficient</td>
<td>0.23</td>
<td>0.80</td>
<td>0.78</td>
</tr>
<tr>
<td>Cohesion</td>
<td>0.58</td>
<td>0.61</td>
<td>0.53</td>
</tr>
<tr>
<td>Closeness</td>
<td>54.37</td>
<td>56.78</td>
<td>52.66</td>
</tr>
<tr>
<td>Betweenness</td>
<td>7.83</td>
<td>56.23</td>
<td>43.94</td>
</tr>
</tbody>
</table>

4. Discussion

With regard to the number of enrolled freshmen in 2007/8 academic year, we can say that the majority accepted communication at FITCS. Bearing in mind that not all actors in N were freshmen, we come to estimate of 85-90% freshmen actually shared knowledge via FITCS. Therefore, we can say that students are interested in such communication, and consequently that FITCS has predisposition for knowledge sharing.

### Table 2: Centrality measures in networks N, N1 and N2. In this table * indicates maximal value, while # indicates central position in the network, which is equal to the role of a star in the social network.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N1</th>
<th>N2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree 1</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Degree 2</td>
<td>98%</td>
<td>97%</td>
<td>95%</td>
</tr>
<tr>
<td>Degree 3</td>
<td>99%</td>
<td>98%</td>
<td>96%</td>
</tr>
<tr>
<td>Degree 4</td>
<td>97%</td>
<td>96%</td>
<td>94%</td>
</tr>
<tr>
<td>Betweenness</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
</tr>
</tbody>
</table>
Results presented in Table 1 show low density, (general level of linkage among the points in a graph) small average distance, and quite high cohesion for all three networks. Such characteristics are typical for human communication, and indicate small world property. Therefore, we can conclude that FITCS is a typical online society.

There are 4 isolated vertices in N (1.4 %), 1 in N1 (0.7 %), and 4 in N2 (4 %). Even if these percentages are small, the bare existence of isolated actors rises a question: “Why no one answered their posts?” Possible answers are: “The questions already existed, or were not interesting to other actors”. In all, we can conclude that there was no deliberate isolation, and the communication was adequate.

Since networks have scale-free property, the existence of hubs is expected, and it is expected that there are gatekeepers. Identified hubs are some of the most expected students, some of the educators, administrator and some of the spammers. Bearing in mind vulnerability of network to exclusion of gatekeepers, we can say that FITCS is safe as long as educators communicate.

The above discussion gives strong indications that there exists knowledge sharing. In order to be sure, we have to analyze characteristics of most interesting nodes (actors).

### 4.1. Social network roles

FITCS administrator is the ultimate hub and star in network N, not a hub in network N1 but still with above average communication, and absent from N2. Such a role is probably the consequence of personality, but is inappropriate and unnecessary in a knowledge sharing community. The only explanation for such a role could be compensation, for some of the first year educators did not take part in FITCS at all [Pedro A. Willging, 2005].

As for educators 1 and 2, they share responsibilities for courses analyzed through N1 and N2. From Table 2 it is obvious that educator 1 is the star of N1, while educator 2 has marginal role, and educator 2 is the star of N2, while educator 1 has marginal role. The role of educator 1 in N1 can be justified to some extent, for N1 is describing communication on a first semester course, and freshmen had no previous experience with online knowledge sharing. The roles of these educators are identical to their in-class roles, so we can conclude they were very enthusiastic. Of the four remaining educators, two are stars in their egocentric networks, and two have roles of moderators.

Therefore, we can accept or reject H1 only partially. It seems that the role in the communication depends very much on the personality. We accept H1 for three educators (if we accept that role of educator 1 in network N1 is close to proper), but we still have to reject H1 for administrator and the remaining three educators. Nevertheless, these very enthusiastic roles of educators strongly support the assumption of knowledge sharing at FITCS, in spite of the population of freshmen that are not mature enough to prefer knowledge sharing to other means of socialization.

Naturally, most of the stars of the networks are students. Some of them are more and some less successful. Typical example is Student 3 from Table 2, who was successful in course corresponding to N1, and less successful in the other (corresponding to N2). This indicates that students communicate if they are preparing the exam, and tend to be more silent if their knowledge is less. The other two students (1 and 2) from Table 2 were among the most successful students in all courses, and their roles as stars in N, N1, N2 and educators’ egocentric networks are adequate for extrovert personalities. The roles of all three students strongly support the assumption of knowledge sharing. We also want to emphasize that there are very successful students that are not so extrovert, and are not obvious stars, but their communication is above 75% of overall communication.

The above discussion indices we should accept H2.

In the end, we think that there is enough evidence that support the assumption of knowledge sharing in N1 and N2. The fact that actors have similar roles in N, leads to conclusion that knowledge sharing existed in N. Therefore we accept H3 for all three networks.
5. Conclusion

Results of this research are not in favor of H1. Nevertheless, this online community is specific for it consists of mostly young freshmen. Therefore, results of the research conducted on smaller groups of master students may not be applicable on the community we analyzed. On the other hand, hypothesis H2 is confirmed. Some of the most successful students, with extrovert personalities, are the stars of the three analyzed networks.

Finally, we can say that H3 is confirmed too. The facts that most of the students, 85-90%, have accepted this way of communication, and that there exist very small number of isolated vertices, together with properties of the three analyzed networks and determined roles of identified actors all support the statement FITCS is a knowledge sharing community.

Recommendations based on this research should be to ban spammers, to authorize educators to control content and ban spammers, to motivate educators to support online knowledge sharing, to educate educators about their proper role in such a community, and to motivate successful students with introvert personalities to be more active in knowledge sharing.

References

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