Poster: Studying The Social Networks in Educational Forums

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***Abstract*—This research aims to carry out a topological study of social networks located in university forums of the Moodle platform. Graphs are built visualizing the structure of the nodes and links and calculating statistical parameters such as: degree, betweenness centrality, clustering coefficient, PageRank, EigenVector centrality and assortativity. The communities' structure was also estimated. This study analyzes how students and faculties work and socialize in the educational environment, which help to know more precisely the level of involvement of each student as well as to improve some learning and methodological aspects. Several subjects and forums are analyzed (theoretical and practical contents).**

Keywords–social networks; graph; topological study

I. INTRODUCTION

Virtual Educational Platforms help to increase the motivation of the students in the courses, providing mechanisms to facilitate the interaction between students and teachers. These platforms include applications such as: content management, collaborative communication and monitoring and evaluation tools, administration utilities, as well as other functionalities such as notebook, content searches, etc. Several research exists about tools used for online teaching blogs, discussion boards, wikis and 3D virtual [1][2]. Studies on Learning Management Systems (LMS) have also been carried out [3][4]. There also are investigations that pretend to gain some insight into how teachers and students use the LMS. The interaction between students in online discussion Forums has been studied in detail using Social Network Analysis [5] and other methods [6][7]. This paper analizes the social interactions that happened in Moodle, when this platform was used in the context of a university course. Several topological parameters and the structure of communities were calculated. 14 forums each with an average of 115 students were studied. Three types of forums were considered: news and questions forums, practical exercise forums and theoretical content forums.

II. ANALYZING THE SOCIAL NETWORKS

The XML file of the Moodle forums was analyzed and processed using software programs implemented in Python. These programs were designed, built and tested, following the typical life cycle of any software component. The interactions in each forum were represented in a graph G = (V; S), where V is the set of nodes corresponding to students and faculties and S is the set of links between them. The package networkx was used in order to analyze the structure of the social network. The following parameters [8][9], and their statistical distributions were calculated:

A. Betweenness centrality

The betweenness centrality of a node n can be defined as:

$$b(n) = \sum_{u \neq n \neq w} \frac{\sigma_{uw}(n)}{\sigma_{uw}} \quad (1)$$

Where
σ_{uw} is the total number of shortest paths from node u to node w
$\sigma_{uw}(n)$ is the number of those paths that pass through n

B. Node clustering coefficient

The clustering coefficient C(n) of a node n can be defined as:

$$C(n) = \frac{2 * t(n)}{d(n) * (d(n) - 1)} \quad (2)$$

Where
t(n) is the number of triangles containing n.
d(n) is the degree of n

C. EigenVector centrality

The EigenVector centrality of a node n can be defined as

$$x_n = \frac{1}{\lambda} \sum_{j=1}^{N} x_j = \frac{1}{\lambda} \sum_{j=1}^{N} Aij * xj \quad (3)$$

Where
A_{ij} is element ij of the Adjacency Matrix, such as A_{ij}= 1 if node i is attached to node j and 0 otherwise. This equivalent to $A * X = \lambda * X$ where λ is the largest EigenValue associated with A and X is its associated EigenVector.

D. PageRank

The PageRank centrality, PR, of a node n can be defined as:

$$PR(n) = (1 - \alpha) + \alpha * \sum_{w \in V : w \to n} \frac{PR(w)}{k(w)} \quad (4)$$

Where α, damping parameter, $\in$ [0,1]
$PR(w)$ is the PageRank of the node w which is linked to n.

E. Assortativity

Assortativity of a network evaluates the probability of connection between pairs of nodes [9].

 ISBN: 978-1-61208-793-1

TABLE I. IN EACH FORUM, AVERAGRE MÍNIMUM DISTANCE BETWEEN NODES <L>, AVERAGE BETWEENESS <B>, AVERAGE PAGERANK <PR> (CONSIDERING α=0.85), AVERAGE EIGENVECTOR CENTRALITY <EV>, AVERAGE DEGREE <K> AND AVERAGE CLUSTERING <C> VALUES.

	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*	*F10*	*F11*	*F12*	*F13*	*F14*
<l>	1.22	1.13	1.34	1.01	1.78	1.15	1.85	1.11	1.13	1.18	1.02	1.15	1.85	1.94
<b>	0.007	0.007	0.012	0.009	0.007	0.013	0.008	0.006	0.015	0.013	0.006	0.008	0.010	0.002
<PR>	0.0002	0.0005	0.0090	0.0031	0.0042	0.0096	0.0063	0.0036	0.0107	0.0114	0.0043	0.0072	0.0078	0.0017
<EV>	0.0018	0.0013	0.0017	0.0078	0.0067	0.0100	0.0088	0.0056	0.0013	0.0238	0.0054	0.0086	0.0095	0.0025
<K>	16.10	15.01	13.01	65.0	16.12	8.10	12.13	15.67	25.20	12.30	18.50	20.13	15.25	10.13
<C>	0.912	0.813	0.912	0.812	0.910	0.876	0.950	0.876	0.910	0.923	0.987	0.887	0.988	0.865

TABLE II. IN EACH FORUM, NUMBER OF COMMUNITIES PER TEORETHICAL (T), PRACTICAL EXCERCISES (P) AND NEWS AND QUESTIONS FORUMS.

	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*	*F10*	*F11*	*F12*	*F13*	*F14*
T	2	-	-	2	-	-	3	3	2	2	-	-	-	-
P	-	5	4	-	5	4	-	-	-	-	6	-	-	-
NQ	-	-	-	-	-	-	-	-	-	-	-	2	2	2

III. RESULTS

Table I shows the average mínimum distance between nodes <l>, the average betweeness <b>, the average PageRank <PR>, the average EigenVector centrality <EV>, the average degree <K> and finally, the average clustering <C> values for each discussion forum. The Figure 1 shows as an example the betweeness distribution in the Forum F1.

We also measure the similarities between vertices by means of Walktrap Algorithm [3] which uses random walks on G to identify communities. This method creates a sequence of partitions (μ_k) 1≤k≥n, and chooses the best partition of the network, calculating Q_k for each partition and selecting the partition that maximizes this parameter. The modularity Q is defined as the fraction of edges within communities minus the expected value of the same quantity for a random network. The Table II depicts, in each forum, the number of communities per teorethical (T), practical excercises (P) and News and Questions Forums. It can observed that the highest number of communities happened for the practical exercises forums and the lowest number occurred for new and questions forums. The Figure 2 shows as an example the communities in the Forum F5 for the practical forum.

IV. CONCLUSIONS

The research allows to establish a methodology to analyze the interactions between students and faculties in educational forums.

The density and cohesion of the components have been studied. It has also identified the more participatory persons as well as the position that each of them occupies in the network as a whole (power relationships), which has been carried out through the analysis of different types of centrality (Betweenes, PageRank, Degree, EigenVector, Degree). Several groups of persons which are especially cohesive have also been detected. These persons and groups had a decisive influence on the results, particularly in the practical exercises. The forums related to news and general questions as well as those which refer to theorical contents presented less participation and communities. All forums were characterized by a low minimum distance between nodes, which facilitated the propagation of the answers and solutions. The nodes also presented a high average degree and assortativity. The obtained results show that this methodology allows to analize the interacts that happen in Virtual Educational Plaforms, which can help to improve the learning contexts increasing the participation and involment of the students.

This research can be continued by analyzing other topological parameters of the network. A study of the dynamical behaviour (changes in topology and node status over the time) can also be carried out.

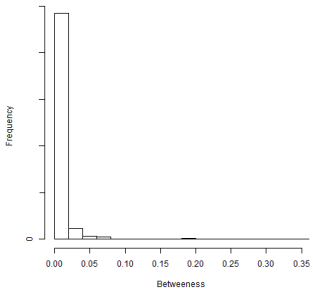

Figure 1. In Forum F1, betweeness distribution

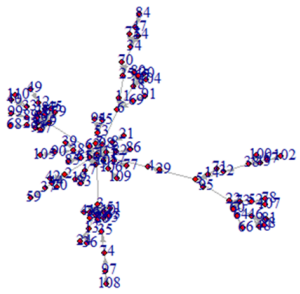

Figure 2. In Forum F5, communities for the practical forum

ACKNOWLEDGMENTS

This work was funded by Telefónica Chair at Francisco de Vitoria University.

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 ISBN: 978-1-61208-793-1