Abstract – The general available tools for analyzing interactions in online discussion forums appear to be insufficient to characterize groups of medium/large dimensions, as they are limited to provide general information of participation, access statistics and message posting. Our research contributes for analyzing and characterizing asynchronous online interactions applying the Social Network Analysis methodology, by providing e-learning platforms with an interactive graph – the iGraph – that illustrates, and analyses, students’ interactions. In a graphical interface embedded in an open source learning management system we combine real-time graphs and numerical indicator to provide the educator with a more thorough understanding of relations between course participants. Preliminary results indicate that the iGraph enables an insightful characterization of the interactions between actors and their participations in discussion forums.

Index Terms – Interaction Graph, Social Network Analysis, e-Learning Forums, iGraph.

I. INTRODUCTION

Current leading learning management systems (LMS) provide access to messages posted in online discussion forums, but usually only enable a general analysis of the posts, such as, calculating the number of accesses (reads) or displaying the number of posted messages. However, when an educator/teacher needs a more complete and thorough evaluation of group interactions, the existing tools are clearly insufficient and inept for groups of medium or large dimensions. This situation is particularly enhanced in a world-wide level when different cultural, social and learning styles are present.

We introduce a system that can be coupled with open-source LMS, which provides a graphical interface to the interactions that are established in these forums. This interface – the iGraph – is based on numeric indicators and on graphical representations that will complement the interpretations regarding the behaviors of the participators that interact in these settings. In this paper we describe how we applied Social Network Analysis (SNA) methodology to create the iGraph; we describe two initial studies to prove its functionality; we present our plan for assessing its value in real-world e-learning environments during real-time courses, and finally we present our preliminary conclusions.

II. NETWORK ANALYSIS IN WEB-BASED LEARNING

Our research is based on a relational approach to online interactions, by adjusting SNA to discussion forums. More specifically, we refer to two types of relations, one that allows us to analyze interactions (“replies to”) and another for analyzing the participations in discussion threads (“participates in the discussion”).

Interactions between participants can be observed whenever actor $X$ posts a message directed to, or as an answer to, actor $Y$. In that case, we draw an arrow from $X$ to $Y$, illustrating this interaction. Similarly, participations in discussions occur whenever actor $X$ posts a message in a discussion $I$. In this case, a line is drawn from actor $X$ to discussion $I$.

I. Interaction and participation visualization

Figure 1-a illustrates the interactions between actors in a discussion forum and Figure 1-b, how actors participate in each discussion thread. In the interaction graph, Vertices are labeled with the corresponding actor; distinguished by color, red for women and blue for men; the larger the vertex, the more replies sent by the actor. We also chose to add this number to the labels of each actor, using the code: `<actor>:<numberOfMessages>`. As for the Arcs, lines that join the vertices are thicker when two actors exchange a greater number of replies; in order to see if the replies between two actors are equal, tie strength is labeled with the weight of these replies, so that the number of sent replies is situated near the vertex; in situations where an actor replies to himself, a loop is drawn over this vertex.

In the participation graph, the vertices are made up of two sets: the set of threads, represented by squares, and the set of actors, represented by circles; labels in squares
indicate discussions and the actor that initiated that discussion, according to the code: D<discussionNumber>:<actorThatInitiated>. As for the arcs, the weight of the line is a measure of the number of participations – the bigger this number, the thicker the line will be.

II. Numerical Indicators

Besides representing the interactions/participations using graphs, we also selected a set of numerical indicators used in SNA, which we found to be the most suitable for applying to discussion forums.

At a local perspective, central actors are found using measures like Centrality Degree (CD) (a count of the number of connections that an actor maintains with other actors). Finding the highest CD results may help us locate the most active actors in a forum. This indicator also measures In Degree (ID) and Out Degree (OD). The highest ID may reveal the most popular actors (they tend to receive information from more actors), while the OD, may reveal more influential actors (they tend to send information to a higher number of actors).

Group involvement is studied by finding Cliques in a network, seen when a group of actors has all possible connections between them. On the other hand, at a global point of view, the Density results point out network connectivity, expressed by the ratio of connections present among the possible. High levels of connectivity lead to a wider distribution and circulation of information.

In addition to identifying the centrality of certain nodes, it is possible to analyze to which extend some actors contribute to the centralization of a network, by the Centralization Index (CI). Density and CI are, therefore, complementary indicators: while the first estimates network cohesion, the second reveals if this cohesion is concentrated around central actors [1]. Centrality measures are seen as fundamental attributes of a social network. Even though the definition of centrality is not consensual and the development of different methods for its measurement, we assumed Freeman’s [2] procedures to calculate centrality (CD and CI).

III. THE iGRAPH SYSTEM

The iGraph [3] system uses the LMS forums to mine for posted messages and presents to the teacher an interface that can be embedded in a web page (as shown in Figure 2), or presented in a new window. It comprehends the graph itself in the top left, and the numerical indicators in the top right. The Centrality Degree is divided into input and output cases: the former is the number of actors that respond to an actor, while the later is the number of actors to which an actor replies. The Centralization Index is also divided into input and output cases, and expressed in percentage. The use of isolated nodes makes the graph include nodes that do not have any link to another node.

Below the graph, it is possible to select any forum that is created in the scope of the current online course and the mode for the iGraph. It is possible to show cliques of n vertices. In its present version, each actor is assigned a letter which is resolved to his (her) actual name in the box at the lower right.

IV. CONCLUSIONS AND FUTURE WORK

The iGraph functionality has been already assessed through the results found in two case studies that were conducted, using discussion forums in a continuing education event (case study I) and a higher education subject, taught to graduate students (case study II). The previous results indicate that the iGraph is a suitable environment to characterize the interactions between actors and their participations in discussion forums, leading to the confirmation of the instrument as a facilitator in the rapid identification of situations, such as: actors more or less active; distinction of positions and roles; identification of different ways of organization/interaction in groups; characterization of the interactions of a group or of a community as a whole. Currently the iGraph has been already embedded in an e-learning platform and proven to be operating, however, testing is still at a primary level. We look forward to evaluate the iGraph system in real educational context and gather the educator’s insights and perceptions of its practical application.

REFERENCES