OF COLLABORATIVE LEARNING: AN APPROACH FOR EMERGENT LEADERSHIP ROLES IDENTIFICATION

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ABSTRACT
During the interaction of a collaborative learning team, students usually participate in a variety of roles such as leader, follower and isolator, etc. These roles should be recognized and monitored carefully, especially the team leader, so that the collaboration might be engineered and supported appropriately. Identifying emergent leadership roles in a collaborative learning team is challenging because the roles are normally distributed and shifted among team members over time. In this paper, the emergent leadership role is the most prominent member from different points of social network views including: having the most expert power in the team so that the good respond from team members can be expected, locating relatively close to every team member so that the control message will be reached all members quickly when necessary and bridging between any pairs of team members so that the chance of having new connections of new pairs can be highly obtained. Therefore, the leadership index is proposed here as the combination of degree of centrality, closeness and betweenness. The communication patterns from the pilot study are examined and the result shows that the leadership index is sufficient enough to distinguish the leader from team members.

KEYWORDS
Collaborative Learning, Emergent Leadership Roles, Social Network Analysis

1. INTRODUCTION
An emergent leadership role is a person who started out with the same status as any member in a group of peers, but who gradually emerges as leader in the perceptions of other members by providing leadership service they value [Galanes et.al, 1997]. Conventional leadership theories focusing on the single individual, such as trait and behavior theories, seem not successful for identifying the leaders of a collaborative learning team [Sudweeks et.al., 2005], while one focusing on group interaction like functional theory seems better suit because of the changing of work culture from centralized and hierarchical to geographical and distributed environment. Additionally, a collaborative learning team normally composes of members who have relatively equal knowledge and status so it is more likely to have multi-leaders distributed and shifted among team members over time [Misiolek, 2004]. This makes understanding how leaders emerge in a collaborative learning team even more challenging. Discovering emergent leadership roles precisely not only benefits to the appropriate group collaboration support, but also to the pedagogical implication of technology-mediated learning environments designed to foster emergent leadership to the team members.
2. RELATED WORKS

Because the leadership theory focusing on group behaviors is more appropriate for classifying the emergent leaders of the team in geographical and distributed environment, therefore, there have been some attempts applying the concept of functional theory to classify students’ role in the virtual team recently. Singley(1999) examines the particular use of developed icons called Collabicons and classifies students into 5 different roles including observer, apprentice, specialist, coach and leader. The leader, for example, normally initiates new idea by sending “How about” Collabicon and evaluates the work products by sending “Thumbs Up” Collabicon. Soller(2001) identifies set of collaborative conversation skills and defines the characteristic of different roles according to the majority use of those conversation skills such as advisers normally use “Inform” conversation skill while “Request” conversation skills are mainly used by questioners. Sudweeks et.al.(2005) has found that emergent leaders normally send more and longer task related messages than non-leaders, while Heckman et.al.(2005) has found that they also normally initiate more communications for all kinds of communications including social, task process and task product communications. Although, from those methods, the interactions among team members are mainly focused and the leadership functions needed for group achievement are finally obtained, the trust and the acceptance from team members could not be revealed directly. Trust and acceptance from team members are important because the leader will not be able to conduct the team to achieve the goal unless the good collaborations from team members. In this paper, an approach for identifying the emergent leadership roles of a collaborative learning team taking a look at the team members’ side is presented. Instead of paying attention to the leader’s side and clarifying how the leader interacts to team members, the perceptions from team members are considered to clarify how team members interact to the team leader.

3. METHODOLOGY

3.1 Social Network Analysis

Social Network Analysis (SNA) [Wasserman,(1999)] provides the methods for both individual and structure analysis. Three basic measurements of SNA for describing the positions of individual in the social network are: Degree of centrality is defined as a number of direct connections to others. The shared degree of each node simply divides degree of actor x, \( d(x) \), by the total connections, which is \( \sum d(x) \).

\[
D(x) = \frac{d(x)}{\sum d(x)} \quad (1)
\]

Betweenness identifies if the actor lies on several paths among other pairs of actors. Where n is the total number of nodes, the normalized version of betweenness for the undirected network is

\[
B(x) = \frac{b(x)}{(n-1)(n-2)/2} \quad (2)
\]

Finally, Closeness is the inversion of the shortest path between actors, \( d(x, y) \). The normalized version is defined as,

\[
C(x) = \frac{n-1}{\sum_{y \neq x} d(x,y)} \quad (3)
\]

3.2 Definition of Emergent Leadership Roles

In this paper, a leader is an information leader, who is defined as the most prominent individual in the team and usually located in strategic location within the social network. Normally, this individual has gained trust and acceptance from team members and those can be revealed by the basic measurements of SNA including degree of centrality, closeness and betweenness. Degree of centrality reveals the popularity of individual in the network through the occupied connections. Team members still maintain the interactions among each other; because of some benefits they still receive from such collaborations [Khien et.al, 2004]. Therefore, the individuals having the highest degree of centrality are more likely to have the most expert power in the team.
Next, Closeness reveals how close the individual to other team members. The individuals having highest closeness will be able to reach all (most) team members quickly when necessary. Finally, Betweenness reveals how often the individuals being in between several paths of pairs of actors. It implies how much the influence of these individuals to the ongoing collaborations and ensures the higher chance of having new connections from new pairs of actors. In conclusion, the leaders should occupy all characteristics mentioned before, so that all interventions from these leaders are expected to affect the team effectively in time. Therefore, the leadership index is proposed here as the combination of those social network data:

\[
\text{Leadership index} = D(x) \cdot B(x) \cdot C(x) \quad (4)
\]

And the individual having the maximum leadership index can be identified as a team leader. Additionally, the leadership index in equation (4) is the product of the mean values of all measurements, because of the evolution over time of those social network data.

4. EXPERIMENT

The pilot study was started with 15 students (3 teams and 5 persons per each), working on the special topics that they had not experienced before. These students did not know each other before and the team members were selected randomly. All teams were supposed to be the nutritionist teams and were assigned to propose the vegetarian diet plans for a teenager client, who is 18 years old Lacto-Vegetarian girl having anemia and short term concentration problem. They were expected to find out the plan for the first month helping their client keep controlling her weight without any effect from the nutrition lacking. The plan was handed in at the end of collaboration time, which is 4 weeks. The collaboration was taken through the virtual learning workspace named Future Learning Environment, FLE [UIAH Media Lab]. The participation under the discussion board named Knowledge Building was examined and represented as the value non-directional graph, which the value is the numbers of interactions among team members. For example, the collaboration pattern of team 3 after 4 weeks is shown in Figure 1.

![Figure 1. Collaboration pattern of Team 3 at the end of 4 weeks.](image)

At the middle and the end of collaboration time, team members were asked to name the team leader regarding to the leadership services they had perceived and they also can name themselves as leaders. Table 1 shows all social network data (D, C, B), leadership index (IN) and the number of votes as a team leader from team members of each individual at different periods of time (2nd and 4th week). It is shown that the leadership index can be used as a criterion to distinguish the team leader from team members; the one having maximum index normally named by team members. And there is also the case that there is more than one leader emerging at the same time with different leadership index values as it is shown in the case of second team at the end of 4th week. However, more experiments are still required to validate the proposed leadership index especially when the number of team members increases. Moreover, there are many of team members having the zero index (leadership index = 0). The zero indexes can not distinguish between whether team members do not participate actively or their participations are not prominent enough to be as a team leader. In another word, the zero indexes are not able to distinguish whether the individual is the follower or the isolator. Therefore, more criterions are probably required in order to achieve the more precise roles identification especially in the case that all roles of students are needed to be identified.
5. CONCLUSION

An approach for the emergent leadership roles identification for a collaborative learning team by using social network analysis is proposed in this paper. The leadership index, the combination of social network measurements including degree of centrality, closeness and betweenness, is used as the main criterion for identifying the team leader. The experiment shows that the leadership index is sufficient enough to differentiate the team leader from team members, even though more experiment is still required to validate the proposed index and some more criterions are also additional required to achieve the more precise roles identification.

REFERENCES

UIAH Media Lab : http://fle3.uiah.fi/

Table 1. Leadership index and number of votes at the end of 2nd and 4th weeks

<table>
<thead>
<tr>
<th>Team</th>
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<th>Measurements</th>
<th>Measurements</th>
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<td>D4(x) B4(x) C4(x) IN4(x) No. of votes</td>
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