2015

Understanding the Impact of Mobile Social Networks on a Collaborative Setting

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UNDERSTANDING THE IMPACT OF MOBILE SOCIAL NETWORKS ON A COLLABORATIVE SETTING

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Abstract:

Today's mobile technologies and the use of social networks are pervasive, however, studies on mobile social networks in a collaborative setting at school are still scant. In this research-in-progress paper, we propose a research framework which explores how two important aspects of social networks including *network Eigenvector centrality* and *network reciprocation* influence user enjoyment and their knowledge self-efficacy, which are likely to affect their attitude towards using mobile technologies to connect with their peers, and further impact their academic performance in a collaborative task setting. A brief theoretical background and hypothesis development are presented. A study plan is then described at the end.

Keywords: social networks, mobile collaboration, mobile learning

I. INTRODUCTION

Due to the dramatic increase of mobile devices use, it is becoming crucial to understand the influence of networks on the massive spread and transmission of information in the networks and communication reciprocity (Miritello et al., 2011; Onnela et al., 2007; Palla et al., 2007). The degree of the social network node measures the numbers of people with whom an individual participant interacts (Marsden, 1987). In general, the degree distribution is skewed with a long tail, indicating that most users have only a few connections, while a small minority has hundreds of connections (Newman, 2003). In fact, within the same network, not all the connections take the same level of important role. For this reason, in social networks, each tie has a given strength that quantifies the attention or the flow of information through the connection. Exploring the strength of the ties in social networks can help in the understanding of the structure of the network, but also the dynamics of many phenomena that involves human behaviors such as information sharing and social influence (Hill et al., 2010; Onnela et al., 2007; Watts, 2004). Although numerous social network studies have been conducted, this stream of research in a mobile context is still scant. Therefore, in the current study, we focus on investigating the contribution of social networks developed among mobile users on their performance in a mobile collaborative task setting.

Research (Kindermann, 2007) has shown that students whose social network consisting of more engaged peers at school can show an increase, or at least stability in their classroom engagement. This positive peer effect is of great interest to educators, and in the past few decades, more research has been conducted to examine peers' influence on student school engagement and performance (Verroneau & Dishion, 2010). However, the mechanisms by which this change occurs are still elusive. With the SNA techniques, it is promising to examine multiple aspects of students' social network in order to promote higher enjoyment and self-efficacy with mobile technology in group collaborative learning, which in turn are likely to result in higher intention to use the technology and the performance of the students. Therefore, we embarked this study at a school setting. We assume that this study may make a difference in terms of finding out how students' social networks are structured, and what kind of position that

an individual has in the classroom regarding their use of mobile technology. By understanding how the peer network characteristics of the students influence their way of mobile collaborative learning, we can ultimately develop more successful intervention practices to improve the achievements of the students with mobile technologies in group settings.

This research-in-progress paper is structured as follows: following the introduction, a brief theoretical background is presented, and then a research framework focusing on how mobile social networks influence student performance is proposed with a set of hypotheses. Then a study plan is proposed to examine this phenomena.

II. BRIEF THEORECTICAL BACKGROUND

Social network analysis (SNA) is a particularly promising approach, as it explores the nature of social context through examining the meaningful social connections, and provides a view of mapping the connections of an entire social network and opening up a window into the mechanisms of social interactions by the examination of local connections of targeted individuals. One key aspect of network that may shed more light on the mechanisms of influence is that of *centrality*, which refers to as those individuals within a network who are more highly connected and have greater control of information flow through the network (Borgatti, 2005). In the context of SNA, centrality refers to the location of nodes or actors, which in our context would refer to students in class. Centrality in social networks was first introduced by Bavelas (1984) to analyze communication in small groups. He hypothesized that structural centrality within the network would influence communication and power. The structure of networks, including centrality, has been proved to be influential in small groups (Russo, 2005).

Through a control in an information flow as well as an exposure to multiple attitudes and ideas, a more central individual may be the key to influencing peer networks, in that individuals with high centrality scores are more likely to be leaders with key conduits of information. More specifically, *eigenvector centrality*, in essence, denotes the extent to which an individual is a big fish connected with other big fish in a big pond. It is a measure of how close an individual is to actors who are linked to others. Eigenvector centrality is calculated by assessing how well connected an individual is to the parts of the network with the greatest connectivity. Individuals with high eigenvector scores have many connections, their connections have many other connections, and so on to the end of the network. High eigenvector centrality individuals are leaders of the network. They are often public figures, with many connections to other high-profile individuals. Thus, they often play the roles of key opinion leaders and shape public perceptions. A related example of this is Google's page rank algorithm, which is closely related to eigenvector centrality calculated on websites, for measuring the importance of web sites pages based on links to them.

Another important aspect of social network is network reciprocation, which is regarded as one of the main drivers in network formation, along with popularity (making friends with those who have many friends) and triadic closure (making friends with friends of friends) (Schaefer et al., 2010). Reciprocation links in a network are important in the emergence of relationship and make the relationship more stable (Hallinan, 1978; Runger & Wasserman, 1980). In a study conducted in a primary school, experimental evidence underlines the role of reciprocation (Conte et al., 2009) in the dynamics of social network formation. The reciprocation process draws its strength from the norm of reciprocity, which is "a universal structure of human morality" (Gintis et al., 2008; Henrich et al., 2001) and helps to create stable social systems by providing a starting mechanism for relations in situations where there are no established rules for social interaction (Gouldner, 1960).

III. PROPOSED RESEARCH MODEL

In this study, we aim to link these two important aspects of social networks in a mobile collaborative task setting at school to explore their effects on students' perceived enjoyment and knowledge self-efficacy with mobile technologies which are likely to influence student attitudes of

using mobile technologies for learning and furthermore impacting their academic performance. Therefore, we propose the following research framework (Figure 1) to understand this mobile social networks in a school setting, in particular on a set of collaborative tasks among student groups who intensively use mobile tablets for study.

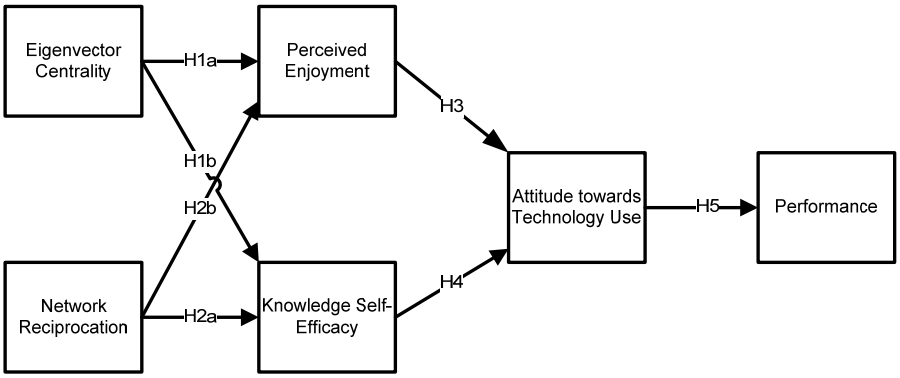

Figure 1: Proposed Research Model

In the next section, we briefly present the rationale on our hypotheses development presented in the above research framework.

Hypotheses

Bonacich (1972) proposed that to be more central, one not only has to be close to all other members of a network, but also to be connected to other well-connected nodes. In this way, one can be highly central even if they do not have a lot of connections as long as they are connected to highly connected friends. By bridging multiple central groups, these individuals hold a lot of power, or influence on the other nodes. This pattern of relationships may provide entertainment value of the individual and perception of higher perception of knowledge self-efficacy while participating in a collaborative task.

Eigenvector Centrality and Perceived Enjoyment

Self-determination theory (SDT) (Deci & Ryan, 1985) is a theory of human motivation based on the notion that humans come with innate psychological needs that must be met in order to nurture curiosity and interest in the context within which they are embedded. In this proposed study, the network relationships represented by the Eigenvector Centrality of students who are highly connected with others through the mobile technology can contribute to influencing other students to a higher perception of enjoyment, while working with mobile technology for learning purposes in class. This pattern of behavior is likely to provide pathways and avenues for students to make their own decisions and follow their representative figure, which appears as Eigenvector Centrality. Among students whose enjoyment is influenced by peer-influenced interactions (Collins & Madson, 2006), research has shown that students whose social networks at school tend to consist of more engaged peers, show an increase in their classroom engagement, and are more likely to comprehend the materials and achieve at a higher level (Kindermann, 2007). Thus, we propose:

H1a: A positive relationship will be obtained between Eigenvector centrality and perceived enjoyment.

Eigenvector Centrality and Knowledge Self-Efficacy

The eigenvector weights contacts according to their centralities. Eigenvector centrality takes into account the entire pattern in the network. Eigenvector centrality is a measure which takes into account not only the size of one's group, but also accounts for how interconnected that group is with the complete network. Eigenvector centrality has the benefit of taking into account the relative centrality of an individual node's connections, and weighting its score accordingly. As such, being connected to other highly connected individuals will in turn lead to a higher eigenvector centrality score. For those who have high eigenvector centrality scores, it is likely that they need to be constantly connected with his peers on the networks, and therefore, they are assumed to have high-level self-efficacy with technologies. In today's mobile world, it is also likely that they are proficient in using mobile technologies as well. Therefore, we hypothesize:

H1b: A positive relationship will be obtained between Eigenvector centrality and knowledge self-efficacy.

Network Reciprocation and Knowledge Self-Efficacy

The social interaction ties based on the social theory present a channel through which resources such as information and knowledge can flow. The improvement of close relationships with others is regarded as a means of facilitating effective knowledge sharing (Chow & Chan, 2008). The daily mobile interactions between students with their close groups contribute to a supportive

exchange environment in the learning process, which reinforces the network reciprocation. The participants in the group can increase their self-efficacy with mobile technology. The participants will also gain confidence in their ability to provide useful knowledge to others (Chen & Hung, 2010). Self-efficacy in this way can direct the behavior aimed at archiving the given tasks. The network reciprocity based on the mobile technology is therefore likely to play a key role in pooling knowledge inside the group to help others gain confidence of using mobile technologies.

H2a: a positive relationship will be established between network reciprocity and knowledge self-efficacy.

Network Reciprocation and Perceived Enjoyment

Based on the social exchange theory, there is an expectation for reciprocity in the interactions regarded as a major motive for participants to contribute (Homans, 1958). The reciprocal exchange is based on unilateral resource giving (Molm & Cook, 1995). By applying a SNA, we examine the existence of reciprocity within the context of group learning enabled by the technology. In our case, the communications among the students using their mobile devices daily represent a social aspect that influences their learning, where reciprocity will play a role. Sociability recognizes a human's tendency to socialize with others, and emphasizes its playful characteristics as a pleasurable experience (Simmel & Hughes, 1949). It causes an individual to give sociable values to others as much as the person receives reciprocal values from these others engaged in the interactions (Junglas, 2013). The reciprocity that characterizes the students with the selected peers in their school networks has the potential to trigger their enjoyment of group learning tasks via interacting with their peers constantly through their mobile devices. Thus, we hypothesize:

H2b: a positive relationships will be established between network reciprocity and perceived enjoyment.

Perceived Enjoyment and Attitudes toward Technology Use

Within the framework of the TAM model, Davis et al., (1992) suggested that perceived enjoyment is similar to intrinsic motivation which drives the performance of an activity. Perceived enjoyment has a significant effect on the intended use of new technologies (Davis et al., 1992). Based on the analysis of four different types of mobile service (i.e., SMS, contact, payment, and gaming), Nysveen et al. (2005) conclude that people's intention to use mobile services as well as their attitudes toward the actual use is significantly affected by the enjoyment. In their study of mobile data services, Hong et al. (2006) show that perceived enjoyment is a significant predictor of the intended adoption of mobile data services in the areas of communication, information, and entertainment. These findings suggest that perceived enjoyment is likely to influence users' attitude about technology use. Therefore we suggest the following hypothesis:

H3: Perceived enjoyment will have a significant influence on attitudes towards technology Use.

Knowledge Self-Efficacy and Attitudes toward Technology Use

An individual's confidence in performing a specific task significantly influences behavior (Ajzen, 1991). Self-efficacy refers to individuals' beliefs about their ability and motivation to perform specific tasks (Bandura, 1986, 1997). More specifically, individuals who believe that they can master a certain skill or an activity tend to have higher intention to perform the activity. Previous studies have found that higher levels of self-efficacy with respect to computers lead to higher

levels of behavioral intention and the usage of information technology (Compeau & Higgins, 1995; Gist, Schwoerer, & Rosen, 1989). Thus, we propose:

H4: Knowledge self-efficacy has a positive effect on attitudes toward technology use.

Attitudes toward Technology Use and Performance

Attitudes towards using the problem-solving system was found to enhance student performance at school (Hwang, Wu & Chen 2012). We assume this statement will also hold in our study context.

H5: Attitudes toward technology use will have a significant influence on performance.

STUDY PLAN

We plan to conduct a set of field experiments to examine the proposed research model with approximately 500 students at multiple schools which have actively adopted mobile technologies for teaching and learning in their curricula. We split students into small study groups in different classes. We will analyze the existing student social networks involved in mobile technologies, such as mobile tablets, and set up some experimental groups by asking students to work on a set of collaborative tasks aligned with their current curricula, in addition to assigning a control group with a traditional classroom setting without mobile SNA for comparison. This study is currently ongoing. By the time when the SIGED meeting will be held in Dec., we should be able to report our empirical findings with the SIGED participants.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Bandura, A. (1986). Social foundations of thought and action. *Englewood Cliffs, NJ, 1986*

Bandura, A., & McClelland, D. C. (1977). Social learning theory.

Bavelas, A. (1948). A mathematical model for group structures. *Human Organization, 7*(3), 16-30.

Bonacich, P. (1972). Factoring and weighting approaches to status scores and clique identification. *Journal of Mathematical Sociology, 2*(1), 113-120.

Borgatti, S. P. (2005). Centrality and network flow. *Social Networks, 27*(1), 55-71.

Chen, C., & Hung, S. (2010). To give or to receive? factors influencing members' knowledge sharing and community promotion in professional virtual communities. *Information & Management, 47*(4), 226-236.

Chow, W. S., & Chan, L. S. (2008). Social network, social trust and shared goals in organizational knowledge sharing. *Information & Management, 45*(7), 458-465.

Collins, W. A., & Madsen, S. D. (2006). Personal relationships in adolescence and early adulthood. *The Cambridge Handbook of Personal Relationships,* , 191-209.

Compeau, D. R., & Higgins, C. A. (1995). Application of social cognitive theory to training for computer skills. *Information Systems Research, 6*(2), 118-143.

Conte, A., Di Cagno, D. T., & Sciubba, E. (2009). *Strategies in Social Network Formation,*

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace1. *Journal of Applied Social Psychology, 22*(14), 1111-1132.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior* Springer Science & Business Media.

Gintis, H., Henrich, J., Bowles, S., Boyd, R., & Fehr, E. (2008). Strong reciprocity and the roots of human morality. *Social Justice Research, 21*(2), 241-253.

Gist, M. E., Schwoerer, C., & Rosen, B. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. *Journal of Applied Psychology, 74*(6), 884.

Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review,* , 161-178.

Hallinan, M. T. (1979). The process of friendship formation. *Social Networks, 1*(2), 193-210.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., & McElreath, R. (2001). In search of homo economicus: Behavioral experiments in 15 small-scale societies. *American Economic Review,* , 73-78.

Hill, A. L., Rand, D. G., Nowak, M. A., & Christakis, N. A. (2010). Infectious disease modeling of social contagion in networks. *PLoS Computational Biology, 6*(11), e1000968.

Homans, G. C. (1958). Social behavior as exchange. *American Journal of Sociology,* , 597-606.

Homans, G. C. (2013). *The human group* Routledge.

Hong, S., Tam, K. Y., & Kim, J. (2006). Mobile data service fuels the desire for uniqueness. *Communications of the ACM, 49*(9), 89-94.

Hwang, G., Wu, P., & Chen, C. (2012). An online game approach for improving students' learning performance in web-based problem-solving activities. *Computers & Education, 59*(4), 1246-1256.

Junglas, I., Goel, L., Abraham, C., & Ives, B. (2013). The social component of information systems—How sociability contributes to technology acceptance. *Journal of the Association for Information Systems, 14*(10), 585-616.

Kindermann, T. A. (2007). Effects of naturally existing peer groups on changes in academic engagement in a cohort of sixth graders. *Child Development, 78*(4), 1186-1203.

Marsden, P. V. (1987). Core discussion networks of americans. *American Sociological Review,* , 122-131.

Miritello, G., Moro, E., & Lara, R. (2011). Dynamical strength of social ties in information spreading. *Physical Review E, 83*(4), 045102.

Newman, M. E. (2003). Ego-centered networks and the ripple effect. *Social Networks, 25*(1), 83-95.

Nysveen, H., Pedersen, P. E., & Thorbjørnsen, H. (2005). Explaining intention to use mobile chat services: Moderating effects of gender. *Journal of Consumer Marketing, 22*(5), 247-256.

Onnela, J., Saramäki, J., Hyvönen, J., Szabó, G., De Menezes, M. A., Kaski, K., . . . Kertész, J. (2007). Analysis of a large-scale weighted network of one-to-one human communication. *New Journal of Physics, 9*(6), 179.

Palla, G., Barabási, A., & Vicsek, T. (2007). Quantifying social group evolution. *Nature, 446*(7136), 664-667.

Runger, G., & Wasserman, S. (1980). Longitudinal analysis of friendship networks. *Social Networks, 2*(2), 143-154.

Russo, T. C., & Koesten, J. (2005). Prestige, centrality, and learning: A social network analysis of an online class. *Communication Education, 54*(3), 254-261.

Schaefer, D. R., Light, J. M., Fabes, R. A., Hanish, L. D., & Martin, C. L. (2010). Fundamental principles of network formation among preschool children. *Social Networks, 32*(1), 61-71.

Simmel, G., & Hughes, E. C. (1949). The sociology of sociability. *American Journal of Sociology,* , 254-261.

Véronneau, M., & Dishion, T. J. (2010). Predicting change in early adolescent problem behavior in the middle school years: A mesosystemic perspective on parenting and peer experiences. *Journal of Abnormal Child Psychology, 38*(8), 1125-1137.

Watts, D. J. (2007). A twenty-first century science. *Nature, 445*(7127), 489-489.