# Dynamics of email communications among university students throughout a semester

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## ARTICLE INFO

## ABSTRACT

Email is considered as one of the most widely accepted computer-mediated communication tools among university students. Evidence from the present literature shows that students make a significant amount of their course-related communications (e.g. discuss a topic with peers) using this tool. This study explores the dynamics of an email communication network, which was evolved among 34 university students throughout a semester, using measures of social network analysis and network simulation. These 34 students were doing a masters-degree course. They made 621 course-related email communications throughout the semester which consisted of 15 weeks including 13 semester-weeks, 1 week for mid-semester vacation and 1 week vacation before the final examination. From the analysis of this email communication network, it is found that: (i) students make an increased number of email communications with their peers at the end of the semester compared to the beginning of the semester; (ii) students' communication network becomes sparse or decentralised over time during a semester; (iii) students have different levels of network participation at different times during a semester; and (iv) the reliabilities of the predictive power of *reciprocity* (i.e. an actor's tendency of making reciprocal relations with other actors of the network), *indegree-activity* (i.e. effects of an actor's present *indegree* on its future *outdegree*) and *outdegree-activity* (i.e. effects of an actor's present *outdegree* on its future *outdegree*) parameters of simulation models are changing significantly throughout the semester. Interpretations of these findings are also discussed in this paper.

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## 1. Introduction

Email communication, which represents a means of interpersonal communication (Absalom & Marden, 2004), has been used widely in tertiary education (Huang, 2011; Robinson & Stubberud, 2012). Since email communication has more correct, detailed, arranged and longer expression, it has been seen as the most useful and preferred tool for computer-mediated communication (Levy, 1997). Despite the rapid growing of the popularity and user acceptability of other social mediums (e.g. Mobile phone and Facebook) the overall trend of the use of email communication by university students has been increasing significantly since its inception (Judd & Kennedy, 2010; Li, Finley, Pitts, & Guo, 2011; Littlejohn, Margaryan, & Vojt, 2010). Although email is considered a 'low-tech' communication medium (Gonglewski, Meloni, & Brant, 2001), students mostly depend on email communication as an alternative to face-to-face meeting for course-related conversations and discussions with their peers and teachers (Vrocharidou & Efthymiou, 2011).

Using measures of social network analysis (SNA) and network simulation, this study aims to explore the dynamics of an email communication network that was evolved among university students throughout a semester. A social network can be defined by a set of actors (points or nodes) that may have relationships (edges or ties) with one another (Wasserman & Faust, 2003). Networks can have few or many actors, and one or more kinds of relations between pairs of actors. The tie (or link) between actors can vary in frequency, strength and type. Graphs are often used to represent descriptions of social networks compactly and systematically. SNA is defined as mapping and measuring

of relationships in a social network among actors. SNA has been successfully applied to explore networks and the involvement of their participants by evaluating the locations of actors in the network (Uddin & Hossain, 2011; Wellman, 1996). The pattern of relationships between actors can be operationalised as structural variables, such as centrality which focuses on the relative position of actors and their connectivity within a network structure (Wasserman & Faust, 2003).

In order to explore how the structure of a network evolves over time, simulation modelling of social networks (or, network simulation) has been utilised with great acceptance in recent research (Celik et al., 2011; Menges, Mishra, & Narzisi, 2008). This modelling approach can emulate the behaviour of individuals and can predict their behaviour over time. When analysing over time data, for instance, real world data at time 1 and time 2 can be used to initialise the simulation model. Based on this initialisation, the simulation model can then predict data at time 3. Moreover, network simulation can explain the micro-mechanisms that guide and direct the dynamics of the complete network under consideration (Snijders, Van de Bunt, & Steglich, 2010).

There are studies found in the current 'computer and education' literature that explore students' email communication. These studies mostly examine research questions related to: (i) students' objectives for email communication, such as some students prefer emails to communicate with lecturers and university staff (Robinson & Stubberud, 2012), while others use emails for interpersonal communication and educational assistance (Dutton, 2012; Weiser, 2000); (ii) impact of email use on students' academic performance (Junco & Cotten, 2012; Leung & Lee, 2012); and (iii) preference towards email communication among students, such as impact of gender differences on email use (Debrand & Johnson, 2008; Hu, Zhang, Dai, & Zhang, 2012; Odell, Korgen, Schumacher, & Delucchi, 2000) and influence of students' present education-levels (e.g. adolescent students versus university students) on their attitude towards the usefulness of email communication (Taylor, Jowi, Schreier, & Bertelsen, 2011). There are other studies that explore impacts of various types of email messages (e.g. motivational, volitional and personalised) on different psychological aspects of students such as technology adaptation (Kim & Keller, 2011), self-regulation and self-efficacy (Hodges & Kim, 2010) and students' attitudes, habits and achievements (Kim & Keller, 2008, 2010). However, there is no study found in the current literature that explores how communication networks evolve among students throughout a semester.

The rest of this paper is organised as follows. Section two covers the detail of research methods followed (i.e. description of data source, SNA measures, and simulation model) in this study. This is followed by Section 3, where findings of this study are illustrated. Finally, Section 4 discusses the findings of this study and concludes this paper.

## 2. Research methods

### 2.1. Data source

This study utilises students' email communication network dataset for research analysis purposes. This communication network was evolved among 34 students during a university semester consisting of 15 weeks including 13 semester-weeks (for lectures and tutorials), 1 week of mid-semester vacation and 1 week vacation before the final examination. These 34 students were doing a masters-degree course, entitled Statistical Methods in Project Management, which was delivered in *face-to-face* mode. There is a lecture of 1.5 h and a tutorial of 15 h in each of the 13 semester-weeks. The course was maintained by *Blackboard WebCT*[2] which is a web-based tool for course management and is used by educational institutes for delivering courses through *online* and *face-to-face* (Ngai, Poon, & Chan, 2007). For all course-related communication, students were motivated and advised to communicate with other students as well as with the tutor and the lecturer of the course only through the designated email communication system of *Blackboard WebCT*. Using the email communication system of *Blackboard WebCT*, a student can send an email to a single recipient or a group of recipients. An email sent to a specific recipient is not accessible by others. That means the sender of an email decides who will be the receiver(s) of that email. However, the course coordinator can access, if required, all emails sent by students, lecturer and tutor. The students' email communication dataset used in this study was provided by the course coordinator who, prior to making it available for research analysis purposes, de-identified sender and receiver email addresses by applying an encryption algorithm for privacy reasons. An informed consent was also taken from each student before the start of the semester.

Students enrolled in this course (i.e. Statistical Methods in Project Management) as a part of the completion of a professional qualification degree, entitled *The Master of Project Management*. For this course, weekly lecture and tutorial time were from 6:00 pm to 7:30 pm (Thursday) and from 7:30 pm to 9:00 pm (Thursday) respectively. These schedules were chosen deliberately since most of the students, who took this course, were doing full time jobs. During the same semester, students of the cohort of this study (i.e. 34 students) could also enrol in other course(s), which were required for this professional degree, either in *face-to-face* or *online* mode. That means they did not have much time for in person course-related discussions even though they were doing a *face-to-face* course. They had to depend on email communication for most of their course-related discussions such as seeking help if they did not understand a topic, collaborating with others in doing group assignment and sharing the answers of weekly tutorial questions.

For research analysis purposes, the email communication network is divided into five micro *waves* (or *windows*), each of which consists of email communications of three weeks among students. Table 1 shows information about the duration of each *wave*. For analysing a given longitudinal (or over time) communication network, it is required to observe that network at different time points. The portion of the complete longitudinal network that has evolved between two consecutive observations is called a *wave* (or a *window*) (Krings, Karsai, Bernhardsson, Blondel, & Saramäki, 2012; Uddin, Hossain, et al., 2011; Uddin, Murshed, et al., 2011; Uddin, Piraveenan, Chung, & Hossain, 2013). The duration of three weeks for each *wave* was chosen because, in the research dataset, it was noticed that a minimum time of three weeks was required to evolve sufficient communication links among students so that a research analysis could be conducted using social network analysis and simulation models. Emails that pass a common message to all (e.g. introductory emails sent to all by most of the students in order to introduce themselves to the whole class) are excluded. Those emails that have a single recipient are considered for research analysis purposes as this type of emails reflect more intensive and directed communications (Uddin, Hossain, et al., 2011; Uddin, Murshed, et al., 2011). After these refinements, 621 emails were found in the research dataset.

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[2] http://www.blackboard.com/.