Students' social media usage, the role of tie strength and perceived task performance

Abstract The wide adoption of social media has encouraged university teachers to consider employing social media as new e-learning platforms. Through the use of a variety of social networking tools, students are able to express ideas, seek for collaboration and improve individual productivity. This research examined the role of social media in promoting students' communication in group and perceived group task performance. In addition, we examined the moderating effect of one of the important concepts in the online social network - tie strength. Based on the literature review and the social constructivism theory, we proposed a theoretical model and empirically tested the causal relationships between constructs in a survey. Data were collected from the students in one of the university courses of Global Business strategy, students were asked to reflect their opinions on social media usage, communication, tie strength and group performance. The data analysis results revealed that students' frequent social media usage leads to more communications among group members and the communication in group enhances students' perceived group task performance. What is more, tie strength was found to negatively moderate the relationship between social media usage and communication in group. Theoretical and practical implications were given to the field of social media in education.

Keywords Social media, Computer-mediated communication, tie strength, group task performance

Introduction

Social media is defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" (Kaplan & Haenlein, 2010, p. 61). The emergence of social media technologies has impacted the teaching and learning style in the higher education. From the students' perspective, a considerable proportion of the university students are "digital natives[1]" who were born into the digital world and grew up in the environment of technological advancement (Prensky, 2001). Digital natives not only have sophisticated skills in using digital technologies, but also developed new cognitive capacities and learning styles. Learning via social media is one of the new learning styles, which enables digital natives to personalize content, share and participate online, and interact with others on a collaborative basis

(Bannon, 2012; Yaros, 2009). Social media further help to create an informal and relaxing atmosphere and make learning effective (Dalton, 2009). From the educator's perspective, social media are contributing towards a disruptive[2] change in pedagogy, known as Pedagogy 2.0 (McLoughlin & Lee, 2011). Pedagogy 2.0 is a framework to achieve learning outcomes by exploiting the potential of Web 2.0 technologies. It emphasizes on collaboration, personalization, and user-generated content. Due to the advent of Pedagogy 2.0, instructions in the classroom are moving from the traditional "teacher-centered" approach to the "student-centered" approach[3], where students take initiative and responsibility to learn (Farkas, 2012). There is also a paradigm shift of the knowledge creation process in education, where knowledge is possibly generated by the users instead of being static and immutable. Students in the current context are becoming the "prosumers[4]" of knowledge, who may produce and, at the same time, consume knowledge (Mcloughlin & Lee, 2008). Due to the increasing importance of the pedagogic shift derived from the massive adoption of social media, it is important to explore the potential benefits of social media in pedagogy.

One of the notable features of social media is their ability to assist communication by real-time information exchange, including text, graphics, audios and videos. Social media assist people to engage in direct communication anytime and anywhere without the need to meet physically. In addition, social media outperform a large number of the counterparts in terms of cost efficiency which facilitates communication (Ellison, 2008). In the educational context, the increase in communication and interaction is attributable to the use of web technology (Andersen, 2004), and social media are such computer-mediated communication platforms to promote online connections, maintain relationships and boost communication between students. In addition, social networking sites like Facebook respond well to the particularities and requirements of the student-centered approach, where students take the initiative to create and develop their own learning style (Ioana, 2013). When given the chance, "digital natives" (students) tend to use social media to promote peer communication, collaboration and active learning.

Social media as pedagogic tools can not only facilitate communication but also influence students' task performance (particularly in a group) or learning outcomes. For example, Vanwynsberghe and Verdegem (2013) argued that students train themselves to perform better in a group (via social media) since they want to gain a positive evaluation or reaction by others. Meanwhile, Matzat, and Vrieling (2015) found that social media would be 'naturally allied' with three phases of self-regulated learning processes (the forethought phase, performance phase, and reflection phase), and the learning processes affect the learners' performance (Zimmerman, 2000). Moreover, social media also help improve the relationships between students and relationships between students and the instructors. This engenders a supportive social environment which is most likely to facilitate the learning outcomes (Klem & Connell, 2004; Reyes, Brackett, Rivers, White, & Salovey, 2012; Rimm-Kaufman & Chiu, 2007; Sturgeon & Walker, 2009). From a theoretical perspective, the social constructivism theory[5] (Bruner, 1990) explains the effectiveness of social media usage in education (Kelm, 2011). It suggests that learning works best when it takes place within a social environment, and learning itself is a significant indicator of individual and group performance (Kelm, 2011).

Tie strength in the social network influences the quality and level of communication (Gilbert & Karahalios, 2009), it is therefore necessary to consider the impact of social tie in the present research. The concept of tie strength was first introduced by Granovetter (1973) when examining the strength of interpersonal ties in the social network. He defined the strength of a tie as "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361). Acquaintances and friends with loose relationship are weak ties, while trusted friends and family are strong ties. Studies have shown that weak-tie social networks are more effective than strong-tie ones for sharing information and enhancing social activities (Granovetter, 1973; Levin, Cross & Abrams, 2004). The primary reason is that people with strong ties (due to their homogeneity) have too many overlaps, which reduce the need to communicate. However, people with weak ties may have a better chance to acquire and synthesize diverse pieces of information through interactions (Granovetter, 1973). Research has shown that weak ties can help friends to generate creative ideas via communication (Burt, 2004). The study of weak ties is especially meaningful in the social media context, since the computer-mediated networks are useful platforms in connecting these weak ties (Walther and Boyd, 2002). In view of these, we would like to study the role of tie strength in the educational context when using social media for communication purposes.

As social media are becoming increasingly popular among students, it is necessary to investigate the possible outcomes of the pedagogic use of social media. Specifically, this paper focuses on addressing two important research questions: whether the use of social media will influence communication among group members and their perceived task performance, and whether the tie strength will moderate the relationship between social media usage and communication in group. To address the above research questions, we built a theoretical model and empirically tested the relationships in the model by using a survey study. The research context would be a project-based learning[6] environment where university students form into small teams and discuss their group project (majorly) via social media platforms. In project-based learning, students pursue solutions to authentic problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, gathering information, collecting and analyzing data, drawing conclusions, and communicating their ideas and findings to others (Krajcik, Blumenfeld, Marxr, & Soloway, 1994). Additionally, students must organize, interpret and explain knowledge by themselves and employ team work during project learning (Nagel, 1996). The project-based learning context is suitable for our research aims since it is one of the student-centered pedagogies (Markham, 2011) that social media (as one of the computer supported collaborative learning tools) would possibly support (Hazari & Thompson, 2015). Many social media platforms (e.g., Facebook groups and Google Hanouts) provide embedded tools to create virtual communities, which facilities team members to seamlessly transit from face-to-face discussion to virtual communication and collaboration (Everson, Gundlach, & Miller, 2013). In the present research, students in the same (physical) group were asked to join the social media group at the beginning of the semester. At the same time, the lecturer was added into their individual groups to monitor their online

behavior and performance. The online discussion, coordination and collaboration continued until the groups finished their projects assigned by the lecturer.

The rest of the paper is organized in this way: first, previous literature on social media in the educational context and the properties of the strong and weak ties are explored. Second, the social constructivism theory as the major theoretical foundation is introduced. Third, the research hypotheses, model, and methodology are presented. At last, the research findings are discussed, the theoretical and practical implications are explained, and the conclusions are given.

Literature review

Social Media and Communication

Social media assist communication by real-time information exchange, which includes text, graphics, audios and videos. Pedagogic scholars have extensively studied the effect of social media on students' communication and collaboration (Hung & Yuen, 2010; Yaros, 2012). Social media, as new breeds of communication tools, promote online connection and relationship. A study conducted by Neier and Zayer (2015) illustrated that students were willing to use social media in education due to the nature of the increased interactivity - a primary motive of social media usage by digital natives (Kilian, Hennings, & Langner, 2012; Yaros, 2012). Hung and Yuen (2010) concluded that the use of social media is likely to foster a sense of community which can enhance communication between students. Ellison (2008) also depicted social media as "social lubricants", which provide a cost-efficient way for self-presentation and broadcast personal events to promote interaction and connection. Similarly, Vural (2015) believed that social media, with the ability to contact multiple people instantly, can better notify students of announcements, and facilitate communication, discussion and self-evaluation. To sum up, social media provide a convenient and cost-efficient channel (Ellison, 2008) for students to communicate.

Social Media and Task Performance

Social media also have a significant effect on task performance. In this research, task performance is roughly divided into two categories: individual's academic performance (or academic performance in general) and perceived group task performance. We start from discussing the first category first. In general, researchers in the area supported a positive relationship between social media usage and academic performance. For instance, Junco, Heibergert, and Loken (2011) observed that although two groups of the students had similar high school Grade Point Average (GPA), the group with Twitter usage in class demonstrated higher engagement and more increase in GPA. In addition, through a study on German students, Skiera, Hinz, and Spann (2015) discovered that students located in densely connected subnetworks earn better grades, and this is especially true for male students. Hung and Yuen (2010) observed that the use of social media could engender a sense of community which was fundamental to successful e-learning. Means, Toyama, Murphy, Bakia, and Jones (2009) pointed out that students receiving online

instructions have a better academic performance compared with their counterparts in the face-to-face context. What is more, social media also allow students to learn how to use technology to communicate, gain access to unlimited information, receive support when engaged in teamwork activities, connect with experts in a particular area, and receive immediate feedback (Fosnot, 2005). All these engagement, collaboration and interaction lead to improved task performance of students (Faizi, El Afia, & Chiheb, 2013; Hung & Yuen, 2010; Neier & Zayer, 2015; Schroeder & Greenbowe, 2009).

Nevertheless, there are also opposite views that social media usage is negatively related to the academic performance (Kirschner & Karpinski, 2010; Paul, Baker, & Cochran, 2012). For example, Huang (2014) directly mentioned that social media addiction and its symptoms have a significant negative impact on adolescents' academic performance. Kirschner and Karpinski (2010) further explained that the use of social media is a major reason for distraction that impairs students' academic performance. Using social media involves multitasking which undermines students' capacity to process information and engage in deeper learning (Junco & Cotton, 2012; Wood, Zivcakova, Gentile, Archer, De Pasquale, & Nosko 2012). What is more, Walsh, Fielder, Carey, and Carey (2013) reported that students who spent most time using social media had fewer academic behaviors (e.g., completing homework and attending class), a lower academic confidence and more problems affecting their school work. Besides the negative effect of social media, there is also a proportion of the studies that suggested no relationship between students' social media usage and the academic performance. For instance, Pasek, More, and Hargittai (2009) found there was no relation between Facebook use and grades. Kolek and Saunders (2008) revealed that there were no differences in the overall GPA between users and non-users of Facebook. Junco (2015) concluded that time spent on Facebook has no relation with GPA, especially for senior college students. Lambić (2016) claimed that there is no correlation between the frequency of Facebook usage for general purposes and academic performance.

From the above discussions, it is observed that research on the relation between social media usage and academic performance has yielded mixed results. There are several possible reasons to explain the disparate findings. First, study purposes. Most of the prior studies did not distinguish the purposes of social media usage in their studies. For example, when social media usage involves leisure or entertainment (instead of pure academic and curricular) purposes, the relationship between social media usage and academic performance tends to be negative (e.g., Junco & Cotton, 2012; Walsh, et al., 2013). Second, degree of usage. Most studies showing a negative relationship examined the cases when students were over-involved, obsessed and addicted to the social media (e.g., Huang, 2014; Kirschner & Karpinski, 2010). Third, subject (student) age or year of study. Compared with adolescents (in high school), college students have a better control toward the social media usage. Therefore, college students, especially the senior students do not seem to be influenced by social media compared with their junior peers (e.g., Huang, 2014; Junco, 2015). Fourth, the mixed results were also due to the nature, design and measure of different studies. Studies conducted in the earlier stage are usually descriptive and exploratory in nature (e.g., Kirschner & Karpinski, 2010). There is also inconsistency in the measures of the academic performance and social media

usage. For instance, Facebook use was measured by time spent on site (Junco & Cotton, 2012), the frequency (Lambić, 2016), or by splitting users and non-users (Kirschner & Karpinski, 2010); grades were measured either through self-reported survey (Kolek & Saunders, 2008) or through data collected from the official channel (Junco & Cotton, 2012). To clarify the ambiguity in the literature, we echoed the call from prior researchers (to provide more empirical support on the relationship between social media usage and college students' academic performance), and proposed a positive relationship between these two constructs.

As discussed before, the current research context is a project-based learning group, the task performance therefore is more relevant to the group performance (though individual performance would also influence group performance) when group members finish the group project (mainly) through the social media platform. In the extant literature of social media (for pedagogic purpose), there are however few efforts investigating students' group performance under the new social learning environment. Hazari and Thompson (2015) is among the few studies trying to understand the group processes in the social media-enabled learning context. They identified a positive relationship between technology-based learning environment (including social media) and the perceived group performance. Consequently, they called for further study on group behavior in the context of today's technology-based learning environment. Due to the scarcity of similar research in the literature, we used the self-reported evaluation of the project performance to measure the perceived task performance. We further tested the relationship between social media usage and students' individual performance (as measured by GPA) to distinguish the effect of social media on group and on individual.

Communication and task performance

Communication is fundamental to team work and is of pivotal importance to team performance. (Loughry, Ohland, & Woehr, 2014). Many previous studies have addressed the relationship between communication (in general) and task performance. For example, Fransen, Kirschner, and Erkens, (2011) argued that high quality and task-specific communication is important in all stages of team work. Pöysä-Tarhonen, et al. (2016) and Vora and Markóczy (2012) demonstrated that improved communication in terms of content, frequency, quality and responsiveness help to improve group learning ability and overall task performance. Similarly, Baldwin, Bedell, and Johnson (1997), Chapelain, Morineau, and Gautier (2015) and Pöysä-Tarhonen, Elen, and Tarhonen (2016) all proved that the groups with a higher level of communication are more likely to achieve better group performance. In the context of online communication, Santhiveeran (2005) discovered that integrating online communication into the classes could enhance perceived convenience of learning, and boost students' participation and critical thinking. Imlawi, Gregg, and Karimi, (2015) also believed that with the proper combination and utilization of rhetorical and relational communication processes in an online environment, students can be motivated to learn and demonstrate a greater level of satisfaction about the course. In addition, Baker and Woods (2004) posited that increased immediacy and cohesiveness in online communication could influence online communication quality and learning. Lastly, the computer-mediated communication among students

could nurture a positive word-of-mouth and lead to a higher rating of their instructors (Edwards & Edwards, 2013), which motivates students to learn. Though prior research has extensively examined the positive effect of face-to-face communication or online communication on task/academic performance, few of them tried to investigate the relationship between communication and task performance under the social media context. The current research intends to fill in this gap.

Tie Strength

As social media enable students to communicate online in their social networks and social tie is a crucial factor in the social networks, it is necessary to consider the tie strength when investigating the effect of social media usage. There are two types of the ties in the social network: strong ties and weak ties (Granovetter, 1973). People with strong ties are emotionally interdependent and typically provide trust and emotional support to each other. Strong ties were also said to be more effective in tackling complicated projects (Hansen, 1999) and forming teams for information dissemination (Shi, Adamic, & Strauss, 2007). Compared with strong ties, weak ties are the individuals that are less emotionally attached. They function as the "bridges" that connect different social circles, support information diffusion and provide access to diverse sources of information (Granovetter, 1973). Although strong ties tend to provide more emotional support, the information overlap due to the gravitation towards homogeneity limits the inflow of different viewpoints (Botwin, Buss, & Shackelford, 1997). In contrast, weak ties could enhance the creativity by providing non-redundant information and more complexed information processing behaviors (Perry-Smith, 2014). They are more likely to provide objective feedback while the same ability is restricted by strong ties due to the interdependent nature of the relationships (Wright, 2012). Due to the above, weak ties could also facilitate cooperation (Melamed & Simpson, 2016), knowledge creation (Wang, 2016) and are instrumental for new learning (Chung & Paredes, 2015).

In pedagogy, since group-based project has become a common assessment mode among college students, it is necessary to explore ideal approaches to form into groups and to achieve better group results. As interaction and relationship among group members are very important to a successful group result, the factor of tie strength should be considered before assigning group work to the students. There has been a limited and/or indirect discussion on the effect of social ties in the pedagogy. For instance, Baldwin et al. (1997) identified that centrality in the communication network could improve the academic performance of the students. Moreover, some scholars discovered that social ties can partially contribute to the academic achievement through the "peer effect", and that there is a positive relationship between the average peer academic performance and the individual performance (Lyle, 2007; Mayer & Puller, 2008; Poldin, Valeeva, & Yudkevich, 2013). Emotional support provided by the social ties can influence students' academic performance as well. For example, the sense of attachment derived from peer relationship could spur engagement and competency and lead to better academic outcomes (Fass & Tubman, 2002); and social anxiety undermining students' academic achievement can be alleviated by the social ties (Christina & Teena, 2015).

Prior researchers have investigated the effect of social media and social ties in the educational context. However, there are still several gaps in the literature: (1). although many pedagogic studies have examined the effect of social media usage, most of such studies focused on the social effects or the process of social media usage, e.g., engagement, collaboration, and communication (Faizi, et al., 2013; Hung and Yuen, 2010; Schroeder & Greenbowe, 2009). Few attentions were paid to the study of the social media's impact on the academic outcomes (e.g., task performance, learning outcomes, grade, etc.) (Mingle & Adams, 2015); (2). for the studies that examined the social media's impact on academic performance, there is an ambiguity on the exact nature (positive/negative/no correlation) of the relationship; there are even few studies that have examined the effect of social media usage on students' group performance in the project-based learning context; (3). there is a scarcity of the studies on the effect of the tie strength when investigating students' collaborative behavior on social media to finish a certain task; (4). prior research has studied the relationship between face-to-face communication or online communication and students' performance, few of them have explored the relationship in the social media context. In view of these, the present research aims to investigate the effect of social media on not only the social process (communication), but also the direct academic performance of the students (perceived group performance and individual performance). We would further introduce the concept of tie strength as a moderator in the relationship between social media usage and communication in group. Specifically, we propose that social media usage will have a direct impact on students' communication in group and perceived task performance, and the tie strength will moderate the relationship between social media usage and communication in group.

Theoretical foundation-Social Constructivism Theory

The social constructivism theory has its root in the educational field. Unlike other learning theories that focus solely on how individuals construct knowledge (Piaget, 1953), social constructivism emphasizes the factor of social interaction (Vygotsky, 1978) while learning. Social constructivism theory believes that learning is a social process and that constructing knowledge within a social context is beneficial due to the larger sum of cognition in groups (Bruner, 1990; Lave & Wenger, 1991; Mishra, 2014; Slavin, 1995). In recent years, there has been an emerging trend of the social constructivism research focusing on the role of social technologies and social media in facilitating the generation of socially constructed knowledge (e.g., Gaytan, 2013). The strengths of social media coincide with the principles espoused by social constructivists (Kelm, 2011). For example, Churcher, Downs, and Tewksbury (2014) illustrated that social media lead to the formation of the online community of practice for learning. Mcloughlin and Lee (2010) further mentioned that social media facilitate participation, communication, collaboration and the construction of personal meaning which satisfy the learning condition of the social constructivism. Social constructivism theory is especially appropriate to explain team performance, since learners tend to construct knowledge as a collective activity (Löfström & Nevgi, 2006). Social media encourage people to work in groups, and group members working together can correct each other's misunderstanding and can make much

more progress on tasks (Hiler & Paul, 2006). In other words, in the project-based/team-based learning, students find it convenient to receive and give feedbacks to each other through social media. From the teacher's perspective, the use of social media in a team-based pedagogy significantly enhances the teaching and learning process as it allows the educator to tap into the digital learning styles of the students in groups (Rasiah, 2014). To summarize, social constructivism delineates the importance of social interaction in knowledge construction and social media can help create a social environment as depicted in the social constructivism theory. In the current research, social constructivism theory, as the most important theoretical lens, is used to support the hypotheses between social media usage and its consequences (communication in group and perceived task performance).

Hypotheses development and research model

Based on the theoretical foundation and the literature review, the four research hypotheses were developed as below. Social media provide the capacity to exchange contents and eliminate the need of physical appearance for communication. They are expected to facilitate interactivity, online social connection and self-presentation, which result in increased communication (Greenhow & Robelia, 2009; Ledbetter, Mazer, DeGroot, Meyer, Mao, & Swafford, 2011; Neier & Zayer, 2015). The relationship between social media usage and communication has been extensively elaborated by prior researchers in the educational field (e.g., Hung & Yuen, 2010; Vural, 2015; Yaros, 2012). Besides the empirical results, the relationship could also be supported by the social constructivism theory, which emphasizes the critical importance of culture and social context for cognitive development (Vygotsky,1978). It maintains that knowledge is constructed through the interaction with others, and social media provide a modern computer-mediated platform for students to interact, communicate and learn (from their team members in this case). Based on the above empirical and theoretical discussions, we hypothesize that social media usage can positively influence communication in group.

H1: Social media usage is positively related to communication in group

Social media communication is a new type of computer-mediated communication. Communication via social media will lead to improved group task performance due to the following reasons: first, when using social media to communicate, group members tend to form social communities to collaborate with each other; the asynchronicity[7] of social media allows students to present themselves conveniently and deliberately (Bill, 2008; Güler, 2015). Second, with a sufficient communication in a project, group members can better state the thoughts and the rationale behind, and explain and understand the ideas of others (Friedman & Antal, 2005); they are also likely to experience more positive effect and receive diverse source of information to finish a certain task (Druskat & Kayes, 2000; Losada & Heaphy, 2004). Third, some specific capabilities (e.g., unlimited exposure to peer progress, archiving and backtracking) attained through social media transformed the landscape of interpersonal and group communication, minimized the cost for face-to-face meetings, and therefore enhanced students' collaborative learning and academic performance (Güler, 2015). Besides communication in the social media context, online communication/communication in general was also proved to have a

significant impact on group task performance (e.g., Brooks & Young, 2015; Imlawi et al., 2015). With these, we proposed H2.

H2: Communication in group is positively related to perceived task performance.

Based on the social constructivism theory, constructing knowledge in a social context is beneficial to the learning outcomes (Bruner, 1990; Vygotsky, 1978). Knowledge is constructed via the individual interaction with other group members. Such an environment embraces the interactivity, engagement, collaboration and student-centered approaches (Airasian & Walsh, 1997; Paris, 2011). Löfström and Nevgi (2006) designed eight principles to describe how the use of innovative technologies applies to the social constructivism, and these principles coincide with the way that social media enhance learning (Kelm, 2011). Greenhow and Lewin (2016) also commented that social media practices are well aligned with social constructivist view of learning. In the project-based learning, group members usually harness the potential of social media to generate "collective intelligence" (Anderson, 2007). Empirical studies have also showed that the use of social media could enhance students' academic performance (Hung & Yuen, 2010; Junco, et al., 2011; Means, et al., 2009; Skiera, et al., 2015). With the above discussions, we proposed H3.

H3: Social media usage is positively related to perceived task performance.

Although by nature, social media are used to facilitate group communication, when the factor of social ties are taken into consideration, the effect of social media usage on communication in group will be slightly different. In this research, we proposed social media's impact on communication will be stronger when the group members have weak ties, while the effect will be weaker when members have strong ties. The reasons are presented as below: weak ties are bridges that connect different social networks and provide diverse source of information. The non-redundant and non-overlapping information owned by different group members facilitates the diffusion of information (Granovetter, 1973; Perry-Smith, 2014). Strong ties, on the other hand, tend to provide overlapping thoughts due to the pursuit of homogeneity (Botwin et al., 1997). This may limit the diversity of information transferred and consequently influence the nature and content of communication. People with strong ties are expected to have similar knowledge pool and cognitive process toward a certain task. Due to this, they may not need more communication to collaborate in the group project. Compared with this, people with weak ties tend to create novel ideas, sufficient communication with others holding different viewpoints becomes a must in the group setting. This is depicted in Granovetter (1973)'s work as: weak tie relationships enhance social activities, information sharing and the possibility of social mobility. With the above discussions, we proposed:

H4: Tie strength will negatively moderate the effect of social media usage on communication in group.

Figure 1. presents our research model. There are totally four constructs and four hypotheses in this model.

Insert Figure 1 about here

Research methodology

Construct operationalization

The original set of the survey instruments were developed based on the literature review and the formal discussions with faculty members who have used social media as a teaching and learning tool in their classes. We used twenty-two items to measure the four constructs in the research model. The definition, measurement and the source of each construct are shown in Table 1. Besides the items of social media usage, all the rest items (for communication in group, tie strength, and perceived task performance) were measured by a 5-point likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree". The items measuring social media usage were on a scale of 1(very rare) to 5 (very frequent). There were no reverse questions in our measures.

Insert Table 1 about here

Social media usage: Social media usage in the present study is defined as the frequency for people to perform social interaction and information exchange on the social networking sites. We borrowed the definition and measure of social media usage from Hughes, Rowe, Batey, and Lee (2012). The students were expected to answer how frequent do they use social media in general to finish the tasks on the list.

Communication in group: We used ten items from Lowry, Roberts, Romano, Cheney, and Hightower (2006) to measure the communication within the groups. Lowry et al. (2006) have specifically studied the in-group communication mode under the environment of computer-mediated communication. Five dimensions (group discussion quality, communication appropriateness, richness, openness and accuracy) were used to measure the group communication quality in their work. For the purpose of this study, we deleted some duplicated items in each dimension and used ten items to measure different aspects of the communication in the social media context.

Tie strength: Tie strength is used to assess the level of closeness of the relationship between the group members. Based on Granoveter (1973), tie strength has four dimensions: amount of time, intimacy, intensity and reciprocal services. This research borrowed the questions from Gilber and Karahalios (2009), which was among the first to map the social media data with the concept of tie strength. They used five questions to assess the tie strength among the participants via the online social network.

Perceived task performance: Tuckman (1975) defined performance as the apparent demonstration of understanding, concepts, skills, ideas and knowledge of a person and proposed that grades clearly depict the performance of a student. In this research, we operationalized group task performance as the effectiveness with which the group project is undertaken (Henttonen, Janhonen, & Johanson, 2013). Specifically, it measures the effectiveness of completing the group project as perceived by the group members. To measure the newly-developed construct, we collected the group members' self-reported perception of their group project grade and performance in

general. For students' individual academic performance/academic performance in general, we used students' self-reported GPA, since GPA is the most common measure of academic performance of the college students (Junco, 2015). It was also said to be the "sole measure" of academic performance used in the literature on Facebook (Junco & Cotton, 2012; Kirschner & Karpinski, 2010).

Data collection

Data were collected from one of the senior-level undergraduate courses in one of the universities of Hong Kong. The subject was selected due to the diversified background of the students in the class. There were nearly equal portions of the international students, mainland Chinese students and Hong Kong local students. We believe the diversified profiles of the students could help to further understand the tie strength in the current research. At the beginning of the semester, the lecturer asked the students to form into a group of five to six people. Each group was requested to create a Facebook group and invite the subject lecturer to join their groups. Through Facebook group, students were required to discuss their projects, respond to group members' comments, and share or upload audio, video, music, or files related to the project. They would then deliver a final project report based on the communication and collaboration via the Facebook platform. The final report would be assessed by the format of a group presentation. The lecturer, on the other hand, served as facilitator and monitored the process by providing feedback, answering questions, and assessing milestones that had been established to ensure groups were on the right track throughout the semester. In the last teaching week of the semester, the predesigned questionnaires were distributed to 150 students in three classes of the subject. After the data cleansing, 135 completed questionnaires were used for the final data analysis. The profile information of the respondents is shown in Table 2.

Insert Table 2 about here

Data analysis

Data analysis strategy: The research model was tested by two statistical software: SPSS (v. 20) and SmartPLS (v. 3.2.4) (Ringle, Wende, & Becker, 2015). Firstly, the data from the questionnaire were input to SPSS in order to carry out the reliability test and factor analysis. Secondly, SmartPLS was applied to test the measurement model, structural model, the moderating effect of the tie strength and the mediating effect of communication in group.

Reliability test and exploratory factor analysis: Since there are newly developed constructs in the research model, we used SPSS to have the first round assessment of the internal consistency and construct validity. The initial assessment of the reliability resulted in the elimination of three items (COMM7, COMM10, and PTP3) from the scale. After double-checking with the questionnaire content, the three items were removed from the final data analysis. The data were then rerun for the exploratory factor analysis. The analysis used the Varimax rotation, and factors were

set by eigenvalues greater than 1. The factor analysis results identified four dimensional factors in the data set.

Measurement model: Partial least squares (PLS) structural equation analysis was used to test the measurement and the structural model. PLS allows a smaller sample size or data with non-normal distributions (Chin, 1998), it is therefore suitable for the data analysis of this study. SmartPLS (v. 3.2.4), as a mature and widely used PLS software, was employed to test the research model. The first step in PLS is to assess the internal consistency and convergent validity of the constructs. Table 3. shows that all the composite reliability values are greater than the accepted value (0.70) (Fornell & Larcker, 1981) and the square roots of the Average Variance Extracted (AVE) are more than the recommended threshold (0.5) (Hair, Anderson, Tatham, & Black, 1998). These results demonstrated a good reliability, consistency and convergence of the constructs.

Insert Table 3 about here

Discriminant validity indicates the extent to which a given construct is different from other constructs. One criterion for adequate discriminant validity is that the construct should share more variance with its measures than with other constructs in the model (Barclay, Thompson, & Higgins, 1995). Table 4 illustrates that all scores of the square roots of the AVEs are greater than the correlations between corresponding constructs. A second way to evaluate convergent and discriminant validity is to examine the factor loadings of the indicators. Indicators should load higher on their own construct than any other factors (Chin, 1998). Table 5 shows the loadings and cross loadings of the indicators, which confirms the discriminant and convergent validity of the constructs.

Insert Table 4 about here

Insert Table 5 about here

Structural model: Upon confirming the measurement model, we tested the structural model and the hypotheses by using SmartPLS (v. 3.2.4). The theoretical model and hypothesized relationships were estimated by using 500 iterations of bootstrapping. Table 6 presents the results of path coefficients in the research model. From Table 6, we can see that 3 out of 4 hypotheses are significant. The path coefficients of H1 (between social media usage and communication in group) and H2 (between communication in group and perceived task performance) are significant at 0.01 level, and H4 (between the interaction effect and communication in group) are significant at 0.05 level. No significant path was found between social media usage and perceived task performance. As for the R-square (shown in Figure 2), the values for the two important dependent variables in the structural model are 0.28 and 0.23 respectively. This means social media usage and the interaction of social media usage and tie strength contribute to 28% of the variance in communication, and all the independent variables together explain 23% of the variance in perceived task performance.

Insert Table 6 about here

Insert Figure 2 about here

To further test the relationship between social media usage and students' individual academic performance/academic performance in general, we ran a linear regression model with social media usage as the independent variable and WGPA as the dependent variable. The statistical analysis result showed no significant relationship between social media usage and WGPA (t=1.058, p=0.293).

The moderating and mediating effect: The moderating effect of tie strength was tested by using SmartPLS. In table 6, the path coefficient of the interacting effect was -0.12 and was significant at 0.05 level. This confirmed the existence of the negative moderating effect of the tie strength. To further test the moderating effect, we used Excel to plot the two-way interacting effect of tie strength (in Figure 3). From this figure, it is observed that for high tie strength, low social media usage reports a higher level of communication in group (3.73) than that of high social media usage (3.71). For low tie strength, high social media usage reports a higher level of communication in group (3.80) than that of low social media usage (3.42). This confirms the negative moderating effect of tie strength in communication in group.

Insert Figure 3 about here

The mediating effect of communication in group was tested using a series of regression models. Since the model to be tested involves the moderated effect, we used SmartPLS (NazimAimran, Afthanorhan, & Razali, 2015) to generate the results of the path coefficients in these regressions. Following Baron and Kenny's (1986) approach, a construct is believed to be a mediator when the following conditions are held: (1) the independent variables affect the mediator in the first regression; (2) the independent variables are shown to affect the dependent variable in the second regression; (3) the mediator affects the dependent variable in the third regression; and (4) the effect of the independent variables on the dependent variable must be less in the third equation than in the second. A full mediation effect is demonstrated when the independent variable has no effect on the dependent variable due to the involvement of the mediator. Otherwise, the mediator is believed to have a partial mediation effect (Baron & Kenny, 1986). The results of the multiple regressions are presented in Table 7.

Insert Table 7 about here

Table 7 presents a pattern of the full mediation effect of communication in group. First, the path coefficient between social media usage and communication in group (0.475) is significant at 0.01 level. Second, social media usage significantly influences perceived task performance in the second equation (with a path coefficient

of 0.310). Third, communication in group affects perceived task performance significantly in the third regression (model 2); and the absolute value of the path coefficient of social media usage (0.108) is significantly lower than that of the second regression in model 1. Meanwhile, the path coefficient of social media usage - perceived task performance is not significant (p=0.188) after involving the mediator (communication in group) in the third regression equation. This means conditions one, two, three and four are all satisfied in these paths and communication in group fully mediates the path between social media usage and perceived task performance. To further assess the significance of the mediating effect of communication in group, Sobel test (Sobel, 1982) was conducted. The Z-value of communication in group (3.829) is significant at 0.01 level, which confirmed the mediating effect of communication in group in the path.

Discussion

This research aims to investigate the role of social media usage in the effectiveness of students' communication in group, and perceived task performance. We hypothesized that social media usage have a direct impact on students' communication in group, and perceived group task performance; and the strength of ties will negatively moderate the relationship between social media usage and communication in group.

The data analysis results provided support for most of our hypotheses in the research model. First, the results indicate that social media usage is a significant predictor of communication in group. This result is consistent with the prior pedagogic research that social media as computer-mediated communication tools assist in students' communication (Hung & Yuen, 2010), increase the interactivity within groups (Yaros, 2012), foster a sense of communication community (Vural, 2015) and enhance relational support and self-presentation (Greenhow & Robelia, 2009). In addition, this relationship was proved to be well-supported by the social constructivism theory which emphasizes the critical role of the social environment (via social media in this case) in students' learning process.

Second, students' communication via social media was found to positively influence the perceived group task performance. This means the more communication is made among the group members (on the project), the better the group will perceive about the outcome of their group work. This result is in line with the literature on communication in general (e.g., Imlawi, et al., 2015; Pöysä-Tarhonen, et al., 2016) and communication in the social media context in particular. For example, in the social media context, scholars have proved that due to the asynchronicity of social media, students could feel free to communicate efficiently and deliberately, and thus enhance collaborative learning and academic performance (Güler, 2015; Losada & Heaphy, 2004).

Third, contrary to our hypothesis, social media will not directly influence students' perceived task performance as a group. The data analysis results showed no significant relationship between social media usage and perceived group task performance, and social media usage and academic performance in general. This result is consistent with a smaller portion of the past research (e.g., Junco, 2015; Lambić, 2016) that there is no significant difference in grades between frequent

social media users and non-frequent social media users. However, it is inconsistent with the majority of the literature indicating either a positive (e.g., Faizi, et al., 2013; Isidore, 2016) or negative (e.g., Huang, 2014; Michikyan, et al., 2015) relationship between social media usage and students' learning outcomes. What is more, the result is also not upheld by the theory of social constructivism which promotes a positive role of social media in students' learning. One possible explanation for the non-significant positive relationship could be: students may use social media tools for the purposes other than achieving serious academic goals. In other words, the sole use of social media may not affect students' academic performance, but "how" students use them will. If the students use social media for engaging or information-retentive purposes, the use itself can lead to an enhanced level of perceived task performance (Wang, Woo, Quek, Yang, & Liu, 2012). This means, when the students use social media for a serious discussion or communication within the group, the use itself will influence the perceived task performance indirectly. This conclusion was confirmed by the full mediating effect of the communication in the present research: frequent social media usage does not necessarily lead to a higher perceived task performance, unless the mediating role of communication is taken into consideration.

Last, our results provide some evidence that tie strength among the group members will negatively moderate the effect of social media usage on communication in group. This means social media's impact on communication in group will be stronger when group members have weak ties with each other, while the effect will be weaker when members have strong ties. This result is consistent with Granovetter (1973) and Perry-Smith (2014)'s prediction, and demonstrates/reconfirms the power of weak ties in the group-based social networking environment, and in the educational field in particular.

Theoretical and pedagogic implications

There are several theoretical implications for the current research. First, it is among the few studies that simultaneously investigated the effect of social media usage on students' learning process (communication in group) and learning outcome (perceived task performance). While a majority of the prior studies examined heavily on the process aspect of using social media, e.g., engagement, collaboration, and communication, this research took one step forward and verified communication as not only a direct consequence of using social media but also a significant mediator in the path of social media usage and perceived task performance.

Second, the general social media usage among students will not necessarily lead to the enhanced task performance and academic performance in general. This echoes the research results of Junco (2015) and Lambić (2016) that there might be no significant differences in grades between frequent Facebook users and non-frequent Facebook users. The overall results indicate that the effectiveness of using social media in education depends largely on the way and the objective of using them -- it is only through a serious and high quality of communication among the group members can the effectiveness of using social media be maximized.

Third, prior studies discussed intensively on the role of communication in promoting online and offline group work; however, few of them examined the nature of communication among group members in the social media context. This study is

among the few studies that explored the role and impact of communication in the online social media groups. What is more, communication in the present study was found to be a significant mediator between social media usage and perceived task performance.

Fourth, this research introduced the concept of tie strength to the educational field. It is among the first to emphasize the role of tie strength, especially the weak ties in the communication process of the students. Contrary to our natural perception, the results proved that a weak tie between two groupmates will strengthen the communication quality when using social media, and a strong tie between two students will weaken the communication. In other words, this research brings a new perspective to computer-supported collaborative learning by considering the relational closeness of the students.

Last, the social constructivism theory was employed as the theoretical foundation of the current research. The social constructivism theory has a long history in the educational field; however, the application of the theory under the social media context is relatively new (e.g., Gaytan, 2013). The present study confirms the explanatory power of social constructivism theory in social media's effect on communication in group; nevertheless, the explanatory power on perceived group task performance was proved to be marginal.

For the pedagogic implications, this research extended our understanding of the project-based learning in small teams that was conducted online and supported by interactions via social media. Specifically, it contributes to the grouping strategies of the classes that rely heavily on the online group discussions via social media. When forming project groups, besides the homogeneous or heterogeneous considerations (Lou, Abrami, Spence, Poulsen, Chambers, & d'Appollonia, 1996), educators should also consider the relationships between the students. If a teacher could identify two students with a stronger relationship than others, it would be ideal to assign them to different groups intentionally. We believe this kind of the grouping method (instead of self-grouping or random grouping) could raise the communication effectiveness and eventually lead to a better academic outcome. This research also proved that the sole adoption of social media as a teaching and learning facilitator might not necessarily lead to the improved performance of the students. It is the way and objective of using social media that matters. Educators should pay special attention to the academic aims when college students decided to use social media to communicate and collaborate.

Limitations and future research

There are several limitations to this study, requiring further examination and additional research. First, the cross-sectional survey was conducted in one subject's classes among senior undergraduate students. The cross-sectional nature could only capture a snapshot of the research issues at a given point in time, but could not depict the evolutionary process of some important constructs (e.g., tie strength and communication in group) in the research model. In view of this, we would suggest employing the longitudinal research design with data collected over multiple periods to understand the social effects when using social media for educational purposes.

Second, the cross-sectional survey is prone to the common method bias due to the single informants of the survey. Further research should obtain multiple types or sources of data points (e.g., collecting the data on perceived task performance from the subject lecturer) to avoid the common method bias.

Third, due to the limitation of accessing the students' academic results, we were not able to collect the actual marks of the group projects. This leads to a potential weakness when measuring students' real group task performance. We would suggest future research use objective (actual marks) measures to supplement the subjective measures of the perceived task performance in the current research.

Fourth, since the phenomenon under investigation somehow involved group-level of the concepts (e.g., communication in group and perceived task performance), we would suggest future research advance the research model at the group level and conduct multi-level data analysis to examine the relationships among the constructs across levels.

Fifth, the measure of communication in group should be reconsidered. Ideally, to get a comprehensive view of communication, the construct of communication should be treated as a higher-order construct measured from five different sub-dimensions. We call for future research in the field to have a deeper investigation on the measure of this construct.

Sixth, though we have tried to diversify the background of the students in the class, it would be more ideal to study the tie strength in the business or broader social environment where respondents may have a real physical distance, diversified personalities, characteristics, nationalities and relationships, and rely heavily on the social media to collaborate with each other. The current research design somehow restricts the scope of studying tie strength into a smaller group of the students who most likely have already known each other for long.

Last, for the practical consideration, this study only tested the causal relationships with one type of the social media tools (Facebook), further studies should consider testing the same model with other famous social media platforms (e.g., google plus) to re-confirm the research results.

Conclusions

Social media as an emerging computer-mediated communication and collaboration tool are contributing to a disruptive change in pedagogy. This study seeks to contribute to the growing body of research by proposing a framework for evaluating the effectiveness of social media usage among college students and the influence of the tie strength in students' group communication. The research results corroborated the findings of the past research that social media usage will significantly influence the communication effectiveness and communication in group will affect the perceived group task performance. A major contribution of this study lies in the moderating effect of the tie strength. It is among the first to introduce the concept of tie strength in students' online project collaboration. The result revealed that a lower level of tie strength could lead to a higher level of communication among group members, and therefore enhances the perceived task performance on a project basis. Apart from these, social media usage was not found directly and significantly

influence the perceived task performance. These results provide educators with new insights on the usefulness of social media in pedagogy, as well as the way of allocating students into different project groups based on the closeness of the relationships in the social network.

Notes

1. Digital natives: a generation born during or after the introduction of digital technologies (during 1980s or after), who grew up with access to computers and the Internet and are therefore inherently technology-savvy (Oblinger & Oblinger, 2005; Prensky, 2001)
2. Disruptive pedagogy: a process whereby technology integration creates "change in teaching approaches because (they) encourage new ways of teaching and learning". (Hedberg & Freebody, 2007, p. 8)
3. Student-centered learning: the method of teaching that shift the focus of instruction from the teacher to the student. It requires students to be active, responsible participants in their own learning and with their own pace of learning (Eli, 2013). Social media is becoming one of the tools or facilitators of student-centered learning (Kirk, 2015).
4. Prosumer: under the context of Pedagogy 2.0, students are both producers and consumers (prosumers) of knowledge, ideas and artifacts. Through social media, they not only create and construct knowledge, but also apply and share the knowledge in the virtual learning community. (Mcloughlin & Lee, 2008)
5. Social constructivism: maintains that human development is socially situated and knowledge is constructed through interaction with others (McKinley, 2015). Also see section 3 for further details.
6. Project-based learning: a student-centered pedagogy that involves a dynamic classroom approach in which students acquire a deeper knowledge through active exploration of real-world challenges and problems (Markham, 2011).
7. Asynchronicity: an action and its reaction in communication can take place at different times/places (Güler, 2015).

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Figures：

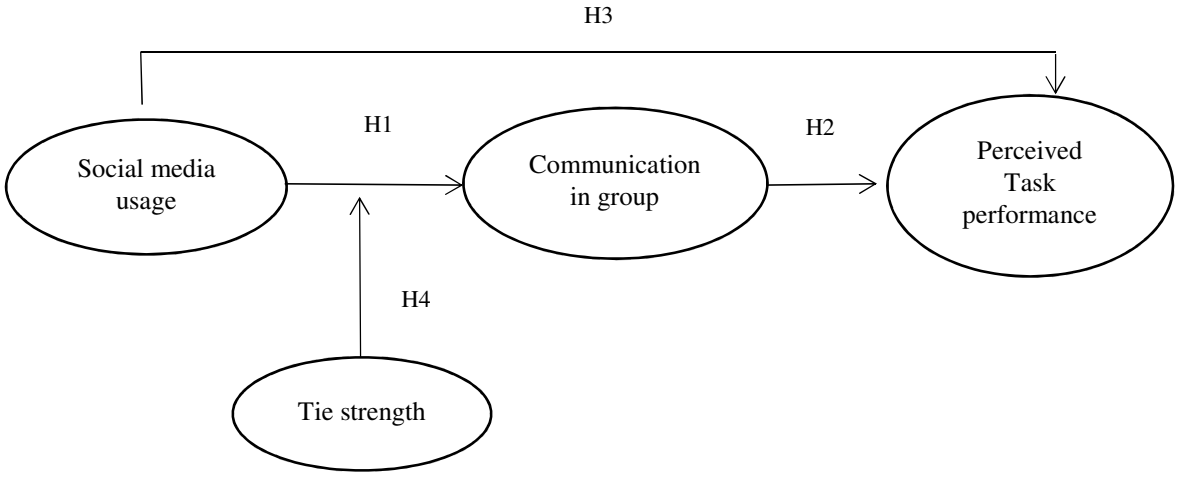
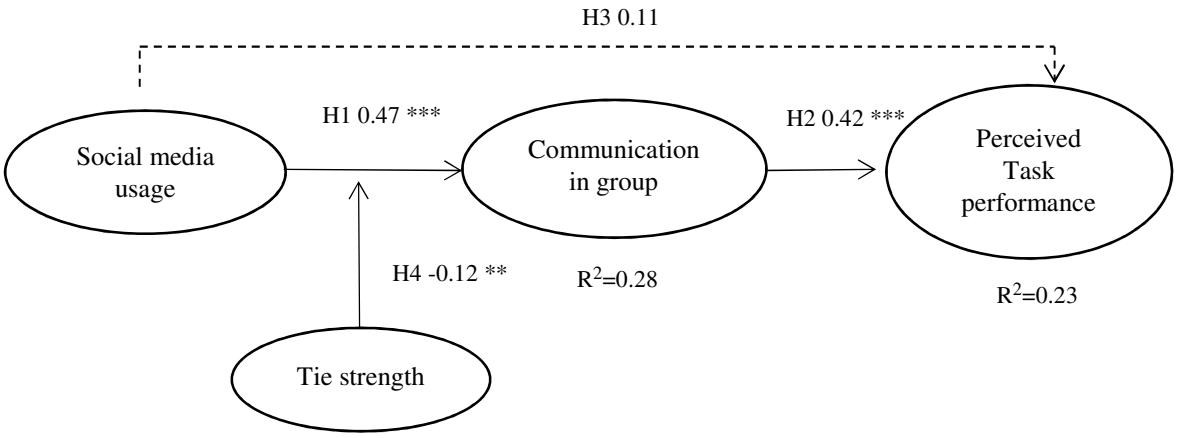


Figure 1. Research model



Notes: The solid line means the path coefficient is significant; dotted line means not significant.
** p<0.05; *** p<0.01

Figure 2. Results of PLS analysis

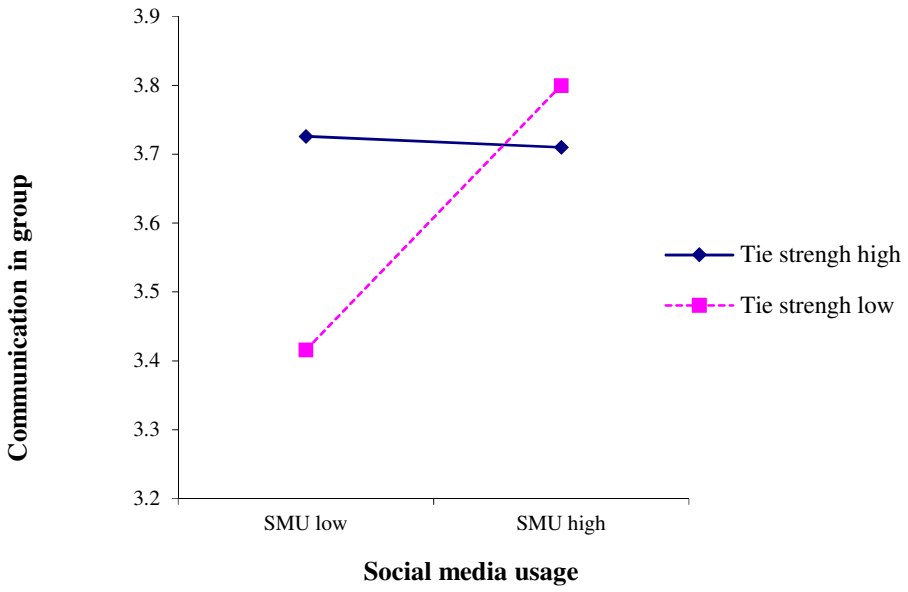


Figure 3. The two-way interaction effect of tie strength

Tables

Constructs	Measures	Source
Social media usage -The frequency for people to perform social interaction and information exchange on the social networking sites (Hughes et al., 2012).	Please indicate your frequency to perform the following tasks. 1) I use social media to find and spread information 2) I use social media to keep in touch with friends 3) I use social media to keep abreast of current events 4) I use social media to socialize with people	Hughes, Rowe, Batey, & Lee (2012)
Communication in group - A group member's evaluation of the level of group discussion effectiveness and development (Burgoon, Bonito, Ramirez, Kam, Dunbar & Fischer, 2002)	When working on the group project through Facebook group, from my own perspective, 1) The overall quality of the group communication is good. 2) The outcome of the group communication is satisfactory. 3) The forms of expression in communication have a high variety. 4) The detailed messages in communication are very vivid. 5) The group communication is appropriate. 6) The group communication is suited to the topic. 7) It is easy to communicate openly to all members of this group. 8) When people communicate to each other in this group, there is a great deal of understanding. 9) The information I received is generally accurate. 10) The accuracy of information passed among group members does not need to be improved.	Lowry, Roberts, Romano, Cheney & Hightower (2006)
Tie strength - A (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie. (Granovetter, 1973)	In the Facebook group, 1) I have a strong relationship with most of my group members. 2) I feel comfortable about asking most of my group members to loan me HKD $100 or more. 3) If I were looking for a job, most of my group members are helpful. 4) I would be upset if most of my group members unfriend me on Facebook. 5) If I left Facebook for another	Gilbert and Karahalio (2009)

	social networking site, I would bring most of my group members along.	
Perceived task performance - The effectiveness of completing the group project as perceived by the group members. (Henttonen, Janhonen, & Johanson, 2013)	Please evaluate your group's performance. 1) I think our group presentation performance is excellent. 2) I think our group presentation performance deserves an A. 3) I don't think our group presentation needs to be improved.	Self-created

Table 1. Measures

	Category	Frequency	Total (%)
Gender	Female	82	61%
	Male	53	39%
Age	19 – 20	30	22%
	21 – 22	80	59%
	23 – 24	17	13%
	25 – 26	6	4%
	> 26	2	2%
Year of Study	1	0	0%
	2	15	11%
	3	60	44%
	4	52	39%
	>= 5	8	6%
Major	Accounting & Finance	8	6%
	Double Degree	35	26%
	Management & Marketing	80	59%
	Others	12	9%
WGPA*	0 – 0.9	0	0%
	1.0 – 1.9	0	0%
	2.0 – 2.9	50	37%
	3.0 – 3.9	69	51%
	4.0 – 4.5	16	12%
Work Experience (Year)	< 1	70	52%
	1 – 2	40	29%
	2 – 3	12	9%
	3 – 4	8	6%
	> 4	5	4%

Note: * WGPA=Weighted Grade Point Average

Table 2. Profile information of the respondents

Constructs	No. of items	Composite reliability	Square root of AVE
Social media usage	4	0.817	0.73
Communication in group	8	0.927	0.79
Tie strength	5	0.810	0.68
Perceived Task performance	2	0.898	0.90

Table 3. Composite reliability

	Social media usage	Communication in group	Tie strength	Perceived Task performance
Social media usage	**0.73**			
Communication in group	0.43	**0.79**		
Tie strength	-0.09	0.24	**0.68**	
Perceived Task performance	0.29	0.47	0.27	**0.90**

Notes: Diagonal elements are the square roots of the AVEs

Table 4. Construct correlations and the squared roots of AVEs

	Social media usage	Communication in group	Tie strength	Perceived Task performance
SMU_1	**0.666**	0.200	0.006	0.124
SMU_2	**0.896**	0.462	-0.095	0.332
SMU_3	**0.696**	0.242	-0.068	0.162
SMU_4	**0.631**	0.239	-0.080	0.131
COMM_1	0.374	**0.822**	0.198	0.389
COMM _2	0.325	**0.875**	0.288	0.466
COMM _3	0.336	**0.816**	0.118	0.422
COMM _4	0.288	**0.828**	0.151	0.347
COMM _5	0.437	**0.848**	0.147	0.357
COMM _6	0.385	**0.744**	0.184	0.358
COMM _8	0.193	**0.633**	0.224	0.325
COMM _9	0.315	**0.682**	0.178	0.251
TS_1	-0.075	0.224	**0.751**	0.155
TS_2	-0.191	0.021	**0.497**	0.162
TS_3	-0.127	0.173	**0.741**	0.196
TS_4	-0.032	0.136	**0.675**	0.237
TS_5	0.014	0.140	**0.711**	0.207
PTP_1	0.333	0.449	0.219	**0.922**

PTP_2	0.175	0.396	0.270	**0.883**

Notes: SMU=Social Media Usage; COMM= Communication; TS=Tie Strength; PTP=Perceived Task Performance

Table 5. Loading and cross loadings of the indicators.

Paths	**Path coefficient**	**T-statistics**	**Significant?**
H1: Social media usage → Communication in group	0.47	6.06	Yes (0.01 level)
H2: Communication in group → Perceived Task performance	0.42	4.68	Yes (0.01 level)
H3: Social media usage → Perceived Task performance	0.11	1.30	No
H4: Interaction effect → Communication in group	-0.12	2.20	Yes (0.05 level)

Table 6. Path coefficients

	Mediating variable	**Dependent variable**	
	Communication in group	Perceived Task performance	
Independent variables		Model 1	Model 2
Independent variables			
Social media usage	0.475***	0.310***	0.108
Mediating variable			
Communication in group			0.424***
R^2	0.147	0.096	0.230

Note: ***p < 0.01

Table 7. Results of the mediating effect of communication in group