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Facebook and Networked Interactivity

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Robert Patton

Committee in charge:

Professor Bruce Bimber, Co-Chair

Professor Ronald E. Rice, Co-Chair

Professor Andrew J. Flanagin

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ABSTRACT

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This study examined the communication behaviors of student users of the popular online social networking site (SNS) Facebook. Specifically the research analyzed the relationships between three categories of antecedent user characteristics: academic achievement, background demographics, and new media use behaviors against the forms of networked interactivity present in Facebook user profile communication: one-to-one, one-to-many, many-to-many and aggregated networked interactivity. Data analysis conducted on student Facebook profiles (N=348) suggests significant relationships between the constitutive forms of networked interactivity and independent variables of academic achievement, gender, user socio-economic background and specific media use behaviors such as instant-messaging and online game playing. Under analysis the most frequent relationships found are those between the antecedent variables and one-to-one interactivity. These results suggest that while SNS environments offer users multiple forms of communication to engage one another, direct one-to-one interactivity remains the dominant form of networked interactivity.

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Introduction

Online social networking has quickly become a communication phenomenon. The most basic characterization of online social networking is that it is a web-based activity facilitated by several web services (e.g. Facebook, MySpace, Friendster) providing users a common interface to articulate an online social network and communicate with other users sharing similar networks, interests, and activities. Social networking sites (SNS) such as MySpace and Facebook have seen the number of their registered users grow exponentially over the course of the last four years (ComScore Media Metrix, 2006; PEW, 2007a). Recent user estimates total 100 million for MySpace and 30 million users for Facebook (Abram, 2007; Cashmore, 2006). By all accounts social networking site use is one of the most popular forms of Internet media use among young adults today (Snider, 2006; PEW, 2007a).

Scholarly research on the communication between users within social networking sites is nascent. While academic interest in SNS is high, both descriptive and explanatory research examining the uses and effects of SNS to date only touches the surface of the communication taking place among users. Explaining the SNS phenomenon is likely to be an on-going challenge for researchers as long as SNS are viable environments where users interact. A group of scholars have initiated the investigation into SNS by employing a host of theoretical lenses to frame their research, from identity management and self-presentation (boyd, in press 1 & 2; 2006; 2004; boyd & Heer, 2006; Lenhart & Madden, 2007) to social capital (Ellison, Steinfield, & Lampe, 2006; Vanden Boogart, 2006) to privacy and self-disclosure (Gross & Acquisti, 2005; 2006; Lenhart & Madden, 2007; 2007a; Mazer, Murphy, &

Simonds, 2007; Stutzman, 2006b; 2006c; 2006d). These scholars are asking intriguing questions with several methodological approaches and the efforts of their studies have significantly moved our understanding of the SNS phenomenon forward.

The current work is an attempt to fill a fundamental gap in SNS and in particular Facebook research. One of the most unique characteristics of the Internet as a communication technology and by extension SNS is the several forms of communication that the network affords. SNS users can employ a range of interface features that facilitate interaction with one another either directly one-to-one, bounded interaction via a group or interaction with the network as a whole. Extant research has overlooked the importance of the SNS feature set as a mechanism for enabling multiple forms of communication. This research uses the theoretical perspective of interactivity (Rafaeli & Ariel, 2007) in computer-mediated communication (CMC) to understand how Facebook users employ the range of process related communication features to engage with one another. Consequently because SNS involve networks of users communicating within a network infrastructure the current work examines Facebook interactivity as a form of user-to-user *networked interactivity* (Rafaeli & Sudweeks, 1997).

What is Facebook?

Launched in February 2004 by Harvard undergraduate Mark Zuckerberg, the social networking website Facebook now has over 31 million active users across over 47,000 regional, work-related, collegiate and high school networks. Facebook is the sixth-most trafficked site in the United States and the number one photo-sharing site on the Internet (Facebook 1, 2007, online). According to the company,

Facebook is a social utility that helps people understand the world around them. The company develops technologies that facilitate the spread of information through social networks, allowing people to share information online the same way they do in the real world. People with a valid email address can register for Facebook and create a profile to share information with their friends in a trusted environment. Facebook is a part of many people's daily routine; half of the people on Facebook come back daily and, according to comScore, spend an average of 20 minutes per day sharing and gathering information. (Facebook 2, 2007, online).

Beyond the official company line, social networking sites like Facebook have been characterized in many ways. For instance, danah boyd [sic] defines social networking sites as, "a category of websites with profiles, semi-persistent public commentary on the profile, and a traversable publicly articulated social network displayed in relation to the profile" (boyd, 2006a, online). The U.S. Congress has also provided a definition of online social networking in legislation. Specifically, H.R. 5319 defines commercial social networking sites as, "commercially operated Internet website[s] that – (i) allows users to create web pages or profiles that provide information about themselves and are available to other users; and (ii) offers a mechanism for communication with other users, such as a forum, chat room, email, or instant messenger" (Fitzpatrick, 2006, online).

In a recent television interview Mark Zuckerberg, CEO of Facebook suggests that Facebook "is building a website helping people communicate in a completely different way" (Zuckerberg, 2007). Throughout the interview Zuckerberg reiterates,

at least six times, that Facebook is a new tool to help individuals connect and most importantly communicate with friends. Given the communication message instilled by the company it is incumbent upon communication scholars to closely examine the fundamental mechanisms that enable Facebook communication. This research is the first attempt to put emphasis on the importance of interactivity as the central mechanism through which users connect and communicate with friends and other users.

Interactivity

The conceptual definition of interactivity has long been debated among Communication scholars, (McMillan, 2002; Rafaeli & Ariel, 2007). Despite this Rafaeli and Sudweeks (1997) find that interactivity plays a key role in creating the attraction of networks and in generating their growth patterns. Further Richards (2006) notes, “interactivity and the properties of interactivity are both important but only in the context of the positioning of the user in relation to the generation of content” (p. 546). Because interactivity has not been used to examine SNS communication, both Rafaeli and Sudweeks’ and Richards’ comments above are fundamental to this research because they underscore the idea that interactivity is a generative mechanism for the growth of networks and content creation, two essential communication activities embedded within SNS use.

Rafaeli and Ariel (2007) write that interactivity has been explicated using three distinct literature-based definitions. The first is “interactivity as a process-related variable, the second is “interactivity as an invariable medium characteristic” and third, “interactivity as a perception-related variable” (p. 74).

This study focuses on process-related interactivity embedded within the SNS of Facebook. Rafaeli and Ariel (2007) note that process-related studies treat interactivity as a variable that, “focuses on the ways that two (or more) participants transfer information between each other (e.g., Rafaeli 1985; Rogers 1995; Rafaeli & Sudweeks 1997; Stewart & Pavlou 2002)” (p. 74). In the case of SNS and in particular Facebook process-related variables are present and displayed in the public profiles of users. Process-related interactivity appears in several instances throughout Facebook, such as the user “wall,” a space within the user profile where other users can post comments and or carry on a “wall-to-wall” public conversation with another user. This type of process-related interactivity resembles Rafaeli’s (1988) early and often cited definition of interactivity as:

an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions (p. 111).

Proposition #1: The communication that is facilitated by Facebook can be examined as a form of process-related user-to-user networked interactivity.

In empirical studies interactivity has been used to explore both website features (Sundar, Kalyanaraman & Brown, 2003; Amichai-Hamburger, Fine, & Goldstein, 2004; Coyle & Thorson, 2001; Warnick, Xenos, Endres & Gastil, 2005; McMillan & Hwang, 2002; Teo, Oh, Liu, & Wei, 2003) as well as user-to-user interaction fostered by different the Internet technologies (Cho & Leckenby, 1999; Maddux, Johnson & Willis, 1997; Rafaeli & Sudweeks 1997). Given these two distinct methods of investigating interactivity Facebook interactivity can be examined

using a definition derived by Kioussis (2002) in his detailed construct explication of interactivity. Kioussis builds on Rafaeli's (1988) definition by conceptualizing interactivity as the degree to which a communication technology,

can create a mediated environment in which participants can communicate one-to-one, one-to-many, and many-to-many, both synchronously and asynchronously, and participate in reciprocal message exchanges (third-order dependency). (p. 372).

Proposition #2: Facebook networked interactivity is comprised of three communication forms: one-to-one, one-to-many and many-to-many allowing users to participate in reciprocal message exchanges.

In line with the above proposition Rafaeli and Ariel (2007) note that when investigating online interactivity, "websites tend to be a mixture of both static information and dynamic applications, one should be careful to examine or simulate the communication processes that use websites in a fashion that expresses the entire range of expressive and communicative potential" (p. 76) which emphasizes the importance of degrees and or forms interactive communication can represent via the network interface. Interactivity provides a distinctive explanatory framework to better understand the uses of SNS. In general SNS present not simply a new technology to investigate interactive criteria, but also one of the first web-based instantiations of a technology designed specifically to support multiple degrees of user controlled interactivity all contained within one interface. Rafaeli and Sudweeks (1997) introduce *networked interactivity* but unfortunately fail to provide a conceptual and or operational definition. They do however suggest that the term may

in part be a function of how interactivity facilitates participatory communication online “explaining how groups, especially CMC groups, stick together” (Rafaeli & Sudweeks, 1997, online).

Understanding Networked Interactivity in Facebook Terms

Employing the basic tenets of Rafaeli and Sudweeks’ interactivity work this research conceptualizes networked interactivity into Facebook terms. As proposition #2 indicates networked interactivity is the aggregate of the three forms of interactive communication – one-to-one, one-to-many and many-to-many – a user engages in as he or she participates within the Facebook network.

One-to-One Interactivity. One-to-one interactivity resembles interpersonal CMC involving an act where one individual communicates directly with another. If we accept Facebook CEO Mark Zuckerberg’s premise that Facebook is a tool for connecting and communicating with friends it only makes sense that one-to-one Facebook communication is a fundamental component of the interface infrastructure. One-to-one interactivity involves the most investment on part of the user given that any one-to-one interaction includes third-order dependency. One-to-one communication involves relationship maintenance which is a common theme in the offline social networks literature (e.g. Granovetter, 1973) and has been studied widely by communication scholars investigating interpersonal effects of CMC (e.g. Rabby & Walther, 2002). Common channels of one-to-one Internet communication include email and instant messaging. In Facebook individuals communicate one-to-one using several interface features.

- The “poke” – a means of telling another user you have viewed their profile

- An internal message – email sent through the Facebook interface
- Accepting an invitation to join a friend’s network (both locally and externally)
- Writing on a user’s “wall” – a space in the user profile to leave comments
- Photo “tagging” – linking a user’s profile to an uploaded photo

Figure 1 illustrates one-to-one (1-1) computer mediated-communication where two individuals use an SNS interface to communicate directly with one another.

Figure 1 One-to-One Interactivity

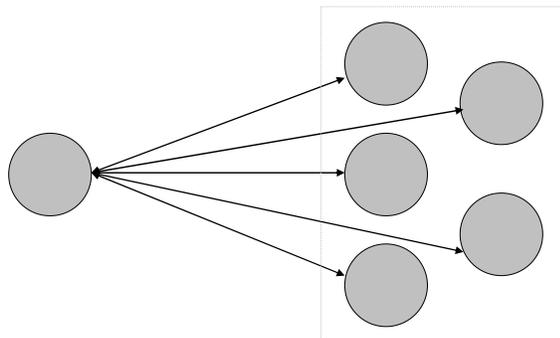


One-to-Many Interactivity. One-to-many interactivity within Facebook is group level interaction where one user communicates directly, using the broadcast features of the technology, to interact with a bounded segment of the larger network. This form of interactivity requires less investment than 1-1 interactivity on the user end in part because the transactional costs of communicating with one’s group of friends or a segment of the network, such as a large Facebook group, are eliminated by the affordances of the technology. Users have several methods to communicate one-to-many within Facebook.

- Joining and or creating a Facebook group
- Creating a note and sending it to more than one “friend”
- Creating an event that is broadcast to a group of “friends”
- Daily “mini-feed” broadcasts that appear on “friends” home pages

Figure 2 illustrates one-to-many (1-M) computer mediated-communication where an individual uses the SNS interface to communicate to multiple users in a broadcast format with the option of feedback on the receiver end. 1-M interactivity is bounded by the group or sub-network.

Figure 2 One-to-Many Interactivity



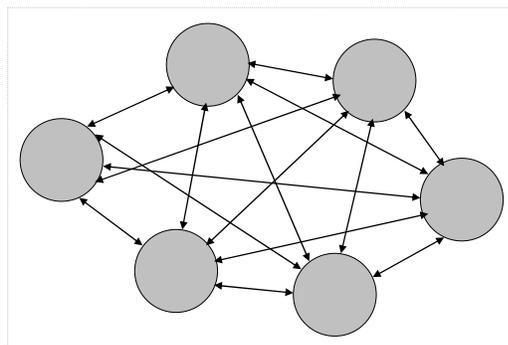
Many-to-Many Interactivity. The third form of Facebook networked interactivity is *many-to-many*. Many-to-many interactivity is a form of structural communication created between the interaction of user generated information and the automatic hypertext linking of that information by the Facebook interface. Unlike one-to-one and one-to-many interactivity where the communication is bounded to another individual and or a group, many-to-many interactivity takes place between the user and the entire network. This form of interactivity is a default when participating in contemporary SNS environments. This form of interactivity requires the least amount of investment and or communication maintenance on the part of the user but provides the potential for developing one-to-one and one-to-many interactivity by structurally articulating commonalities between users. Facebook makes possible more many-to-many communication through its interface feature set

than any of the other forms of interactivity. Many-to-many interactivity is facilitated in the following fields.

- Favorite music bands
- Favorite T.V. shows
- Favorite movies
- Favorite books
- Activities
- Interests

Figure 3 illustrates many-to-many (M-M) computer mediated-communication where the SNS interface acts to generate a communication link between users with similar information, bounded not by the individual or group but by content.

Figure 3 Many-to-Many Interactivity



Note: Appendix D. provides an inventory of all the interactive features within a Facebook profile and codes each of the features to one of the three forms of networked interactivity: one-to-one, one-to-many and many-to-many. The profile feature-set in Appendix D. was compiled prior to the May 24, 2007 release of *Facebook Platform*. Facebook Platform provides the user the flexibility to embed externally developed applications with interactive features into their user profile.

Extant SNS research assembles itself around four broad areas of investigation. The first is loosely categorized as identity sharing, performance or production; the second is issues of privacy and self-disclosure; the third is general patterns of network behavior and network activity; and finally the development of social capital and online community. What follows is a review of Facebook specific and more general SNS research and the findings as they are grouped within these four categories.

In her ethnographic work studying Friendster (in press 1; 2006; 2004), and MySpace (in press 2) danah boyd explores how users in SNS environments experiment with identity production by using the technology to articulate their social relationships. While concluding that “none of this is real” in her early work with Friendster (in press 1), she poses several interesting questions in her work with Heer (2006) on the nature of Friendster communication conceiving user profiles as conversations where context is created through the collective interplay of identity performance. More recently, boyd’s MySpace work (in press 2) continues to develop the idea that the properties of SNS technology – “persistence, searchability, replicability, and invisible audiences” (p. 22) – help create a powerful norm among today’s youth as they negotiate the construction of their social identities. Further, Lenhart and Madden (2007a) use a similar perspective on identity to frame their findings. They suggest that psychologists have long noted the teenage years as a tumultuous period of identity formation. They note that “adolescents are intensely focused on social life and consequently have been eager and early adopters of Internet applications that help them engage with their peers” (p. 1). In a national

representative sample of random telephone interviews and focus groups run by the PEW's Internet and American life Project, Lenhart and Madden (2007) report that teens actively manage personally identifying information by performing a balancing act between sharing information with a close network of friends and using the sites to make new friends.

Stutzman's descriptive SNS research (2006b, 2006c, 2006d) is unique in that he has collected real Facebook profile data in order to comment generally on the broad disclosure of information by undergraduate users. His data illustrates the wealth of information Facebook users commonly disclose in their profiles, information such as: real name, gender, birth date, sexual orientation, relationship status, address information, and political views. In related Facebook self-disclosure research, Mazer, Murphy, and Simonds (2007) use an experimental design to find positive effects of teacher self-disclosure on: Facebook on student motivation, affective learning, and classroom climate.

Other scholars have focused more specifically on privacy in the SNS environment. Most recently, Lenhart and Madden (2007) show in their representative telephone survey that for the majority of young adults, "decisions about privacy and disclosure depend on the nature of the encounter and their own personal circumstances" (p. iv). In two separate works Gross and Acquisti (2005, 2006) investigate the role of privacy among Facebook users. Through survey analysis and data mining of Facebook profiles, they examine privacy concerns among users and attitudes and awareness of the nature of the visibility of their personal information. Gross and Acquisti (2006) find that the majority of Facebook users trust the network,

are generally aware of the visibility of their information, and document “significant dichotomies between specific privacy concerns and actual information revelation behavior” (p. 15).

A third area of Facebook-specific research focuses on the structure of network interaction engaged in by users. This research comes closest to the interactivity perspective employed here. Stutzman (2006b) for example compares two incoming freshman classes 2005 and 2006, and finds that while Facebook adoption rates among the two samples remained stable there are noticeable differences in patterns of behavior between the two groups. Most notably is the number of unique external or “out-networks” that users are connected to; specifically, freshmen in 2006 participated in five times as many unique networks as did freshmen in 2005. In addition, researchers at Hewlett-Packard (Golder, Wilkinson & Huberman, 2006) have examined an extensive archive of 284 million one-to-one messages and 79.6 million “pokes” sent by 4.2 million Facebook users. Their findings illustrate several temporal messaging patterns by users such as daily and weekly regularities and seasonal variations in Facebook use. An interesting finding Golder et al. note is that, “most messages are sent to friends. However, most friend pairs do not exchange messages, suggesting it’s easier to have lots of friends than lots of message partners” (p. 13) meaning that the majority of messages sent one-to-one internally via Facebook are only sent to a small group of friends within a user’s total local and or external network of friends. While not exclusively focused on Facebook a recent presentation to the Annual Meeting of the American Sociological Association by Paul DiPerna (2006) purposes a "connector website model" to examine SNS websites (e.g.

Facebook, MySpace, Friendster, LinkedIn) as social organizations and social systems. In this broad comparison analysis Di Perna illustrates that as social systems, connector websites experience exponential change over time. Di Perna explains that, the connector website provides a relatively simple means of interaction for users who seek to offer or obtain goods, services, or information; It is an intermediary offering peer-to-peer web applications that collectively make up an infrastructure for social exchange, networking, and diffusion processes; Over time, user-to-user interactions gradually generate a majority portion of the website content and the regulation of which is governed jointly between the host organization and the online community of users; depending on the surrounding social and economic conditions, as well as site design and development, the connector website should excel in facilitating the discovery and coordination of context-based communications and transactions (p. 5).

The final area of Facebook specific research examines the use of the network in the development of social capital and online community (Ellison, Steinfield, & Lampe, 2006; 2007; Vanden Boogart, 2006). This research is theoretically grounded and derives potency from a breadth of social capital and computer-mediated communication research. Ellison et al. examine Facebook usage intensity against satisfaction with college life across three types of social capital: bridging, bonding and high school (maintained). They find that Facebook plays a significant role in reducing barriers to participation in college life for low self-esteem students. “We found that low self-esteem students who do use Facebook more intensely are just as likely to have bridging social capital as their high self-esteem peers” (p. 31). Ellison

et al. also make a significant theoretical finding that Facebook users, “are using the online channel less to meet new people than to intensify and solidify relationships that started offline” (p. 32). Vanden Boogart’s (2006) Master’s thesis examines the social impacts Facebook use has on the physical world communities of residence halls at four major college campuses. In general Vanden Boogart finds that students who use Facebook more frequently feel more connected to the college campus than students who use Facebook less. In a more recent study Ellison, Steinfield, and Lampe (2007) following Vanden Boogart find a strong association between use of Facebook and bridging, bonding, and maintained social capital, with the strongest relationship being to bridging social capital defined as loose connections between individuals who may provide useful information or new perspectives.

Extant SNS findings reinforce the breadth of theoretical potential for research into social networking site communication. However, extant work omits crucial analysis into how SNS users utilize communication features provided by the technology to interact with one another.

Correlates to Social Networking Site Use and Hypotheses

Because this research is interested in the application of user-to-user interactivity one of the first steps towards inter-relating the concepts to the population sample is to establish some general correlates to Facebook use. Establishing the correlates in turn help with the construction of individual level hypotheses. Three general correlates to Facebook use are considered. This first is the relationship between Facebook use and being a student. The focus of this study is a sample of student users of Facebook. In doing so a central variable of interest is academic

achievement and its relationship with Facebook interactivity. The second significant correlate to understanding user-to-user interactivity is antecedent demographic background variables. User sex, ethnicity/race, and socio-economic background are therefore used because of their application in Internet research over the past two decades. Examining these three demographic correlates is especially important because little has been written on how they specifically influence SNS communication. Finally, a range of Internet and new media uses is examined as a correlate to Facebook interactivity including networked courseware use. The current generation of U.S. university students has grown-up immersed in a culture where Internet and new media communication is ubiquitous and therefore a natural correlate to examine Facebook interactivity is general new media usage and the usage of comparable networked courseware tools that appear in the classroom.

Academic Achievement

Education scholars believe that student involvement in higher education is central to a positive academic experience and overall performance (Astin, 1999). Astin proposes a theory of student involvement in higher education in which he explains the construct of involvement as “the amount of physical and psychological energy that the student devotes to the academic experience” (p. 297). Thus, a highly involved and therefore successful student devotes considerable energy to actively and frequently interacting with other students, student organizations, and faculty members (Astin, 1999). With diffusion in the U.S. college market at 85% (Facebook 1, 2007) Facebook has become a fundamental media artifact in the college experience and an essential tool for students to maintain their involvement in academic life. An

extension of this reasoning suggests that academic success is predicated on an individual's one-to-one and one-to-many communication with others who support academic activities and or facilitate a connection to academic life.

H1. Student academic achievement will be positively associated with Facebook networked interactivity.

H1a. Student academic achievement will be positively associated with one-to-one Facebook interactivity.

H1b. Student academic achievement will be positively associated with one-to-many Facebook interactivity.

H1c. Student academic achievement will be negatively associated with many-to-many Facebook interactivity.

Demographics

Sex

Recent self-report research conducted on Internet use shows that young females (ages 15-17) are the predominate creators of online content (PEW, 2005a), in particular in social networking sites (PEW, 2007). This provides ample reason to suspect that female Facebook users will be highly engaged with each form of Facebook related networked interactivity. There are other reasons beyond extant SNS research to believe female students will engage in higher overall levels of networked interactivity. O'Brien (1999) notes that because gender is a central feature of our offline interpersonal interaction gender in online communication seamlessly reproduces itself. Boneva and Kraut (2002) explore one-to-one communication via email and they note that scholars have shown that women and men value

relationships differently and have different styles in sustaining them which results in differences in the way men and women use the Internet for interpersonal communication (p. 374). Further Boneva and Kraut continue to suggest that women in general,

tend to engage in intimate conversation with their good friends, whereas men tend to spend time in common activities with theirs (Caldwell & Peplau, 1982; Davidson & Duberman, 1982; Duck & Wright, 1993; Spence & Buckner, 1995; Twenge, 1997; Walker, 1994; Wright & Scanlon, 1991). It has also been suggested that women are more likely to communicate in order to avoid isolation and gain community, whereas men tend to communicate to gain and keep social position (Tannen, 1992) (p. 374).

Additional illustrative evidence for potential differences in male and female Facebook networked interactivity is alluded to by Henry Jenkins (2006) in *Convergence Culture* when he writes that gossip has long played an instrumental role in the development and maintenance of social ties between women (p. 84). Jenkins cites Deborah Jones (1980) who notes that women have historically used gossip to connect with each other to broaden their personal experience and social relationships. While the current research does not investigate the nature of Facebook interactivity as gossip it does suggest that 1-1, and 1-M Facebook interactivity assumes similar characteristics to gossip such as idle and informal talk.

H2. Female students will engage in more networked interactivity than male students.

H2a. Female students will engage in more one-to-one Facebook interactivity than male students.

H2b. Female students will engage in more one-to-many Facebook interactivity than female students.

H2c. Female students will engage in more many-to-many Facebook interactivity than male students.

Ethnicity/Race

Research on the *digital divide* suggests that racial and ethnic background contributes to differences in Internet usage behaviors (PEW, 2000, 2001a, 2001b). Servon (2002) notes that early Internet research finds that people of color were disproportionately part of the digital divide. But Hargittai (2002, 2006) explains these findings were largely based on an understanding of the digital divide in binary terms or between the haves and have-nots of Internet access. Hargittai (2006) argues for a new approach to exploring the digital divide that investigates how individuals use the Internet rather than simply if they have access to it or not. Examining uses rather than access Cotton and Jelenewicz (2006) find that, “once college students begin using the Internet for various activities, digital divide aspects related to race and Internet experience play minimal roles in the amount of time students spend doing each activity” (p. 501). In general these findings tend to suggest the possibility of no significant differences in SNS use between white and non-white students. However, this research argues, that race continues to matter online (Burkhalter, 1999) in particular in multimedia SNS environments because of homophily. Homophily in social networks is explained by McPherson, Smith-Lovin, and Cook (2001) as the principle that communication between similar people occurs at a higher rate than among dissimilar people. Homophily therefore provides reason to believe that minority students in general will build smaller “primary” network connections while at the same time belong to more “external” Facebook networks, each in their own right forms of one-to-one Facebook interactivity. While on the other hand network homophily also suggests that white majority student users are more likely to develop

more “primary” network connections and belong to more “external” networks that have more connections and thus engage in more overall one-to-one communication than minority students. Further, because race plays a role both offline and online on the college campus the principles of social identity theory (Tajfel & Turner, 1979) and self-categorization theory (Turner, 1987) provide useful insight towards hypothesizing why individuals’ employ the forms of networked interactivity differently. “Self-categorization theory focuses on the basic social cognitive processes, primarily social categorization, that cause people to identify with groups, construe themselves and others in group terms, and manifest group behaviors” (Hogg & Reid, 2006, p. 9). This perspective is instructive toward understanding why minority students are likely to exhibit heightened group communication behaviors as members of minority campus populations. And as a result it follows that minority students are more likely to engage in more group process related communication while interacting in Facebook.

H3. The white student majority will engage in more networked interactivity than non-white student minority.

H3a. White students will engage in more one-to-one Facebook interactivity than non-white students.

H3b. Non-white students will engage in more one-to-many Facebook interactivity than white students.

H3c. White students will engage in more many-to-many Facebook interactivity than non-white students.

Note: Non-white students in the above hypotheses are defined as students who indicated to the University Office of the Registrar an ethnicity code of African-American, Asian, Hispanic, or Other.

Socio-Economic Background

A recent discussion online among Internet researchers regarding class and SNS use (AOIR, 2007; boyd, 2007) raised the latent influence of socio-economic background on SNS communication. The discussion underscored the difficulty of defining “class” in the U.S. in particular as a correlate of income. Scholars who study political socialization and behavior have long understood that the most important determinant of SES is not income but rather educational attainment (Verba, Schlozman, & Burns, 2004). These scholars have shown that individuals whose parents are advantaged in terms of SES are much more likely to have the skills and resources to be active members in social networks of participation. Students coming from higher SES backgrounds as measured by parent educational attainment are more likely to be exposed to greater one-to-one and one-to-many civic-oriented and political discussions and as a result of absorbing that activity will be more likely to engage in similar communication behaviors.

H4. Student socio-economic background will be positively associated with Facebook networked interactivity.

H4a. Student socio-economic background will be positively associated with one-to-one Facebook interactivity.

H4b. Student socio-economic background will be positively associated with one-to-many Facebook interactivity.

H4c. Student socio-economic background will be positively associated with many-to-many Facebook interactivity.

Internet New Media Use

Today's undergraduates are unique when it comes to Internet and new media experience, use, and skill. Their ability to create and consume online content is unprecedented (PEW, 2005b). Youth and technology research continues to reveal that the current generation of 8-18 year olds is more dependent than any other prior generation on the Internet and related communication technologies to carry out the activities of their day-to-day lives (Kaiser, 2005; McMillan & Morrison, 2006; PEW, 2005; Tapscott, 1998). Research specifically on undergraduate use of instant messaging clearly indicates undergraduates' propensity to satisfy several daily communication needs using a mix of one-to-one contemporary technologies (Flanagin, 2005). This same research shows that it is not uncommon for today's undergraduate to use instant messaging to carry on several simultaneous one-to-many and or one-to-many conversations at once. This generational cohort's experience and frequency of new communication technology use alone provide sufficient reason to believe that students who demonstrate overall higher levels of new media use will likely engage in a higher level of Facebook networked interactivity and its three forms.

H5. Student Internet and new media use will be positively associated with Facebook networked interactivity.

H5a. Student Internet and new media use will be positively associated with one-to-one Facebook interactivity.

H5b. Student Internet and new media use will be positively associated with one-to-many Facebook interactivity.

H5c. Student Internet and new media use will be positively associated with many-to-many Facebook interactivity.

Networked Courseware Use

With the extensive development of new media and communication technologies in their early lives today's undergraduates have experienced unparalleled exposure to technology in the classroom. The majority of undergraduate students have grown-up in an educational environment where technology aids have been experimented with and deployed as a universal remedy for the challenges of the instructional and learning processes (Mayer, Almeroth, Bimber, Chun, Knight, & Campbell, 2006). Research has found that asynchronous learning networks or the "cornucopia" of online media infused into classrooms has mixed results when it comes to learning benefits (Rice, Hiltz, & Spencer, 2005, p. 217). Rice et al. note however, that research indicates online classroom tools are especially well-suited for promoting collaborative and cooperative learning and in turn group communication. In addition the affordances of online classroom tools eliminate one-to-one communication barriers persistent in the face-to-face classroom environment that make it easier for students to interact and provide class content directly with each other (Quinn, Mehan, Levin, & Black, 1983 as cited by Rice et al., p. 218).

H6. Student use of courseware technology will be positively correlated to Facebook networked interactivity.

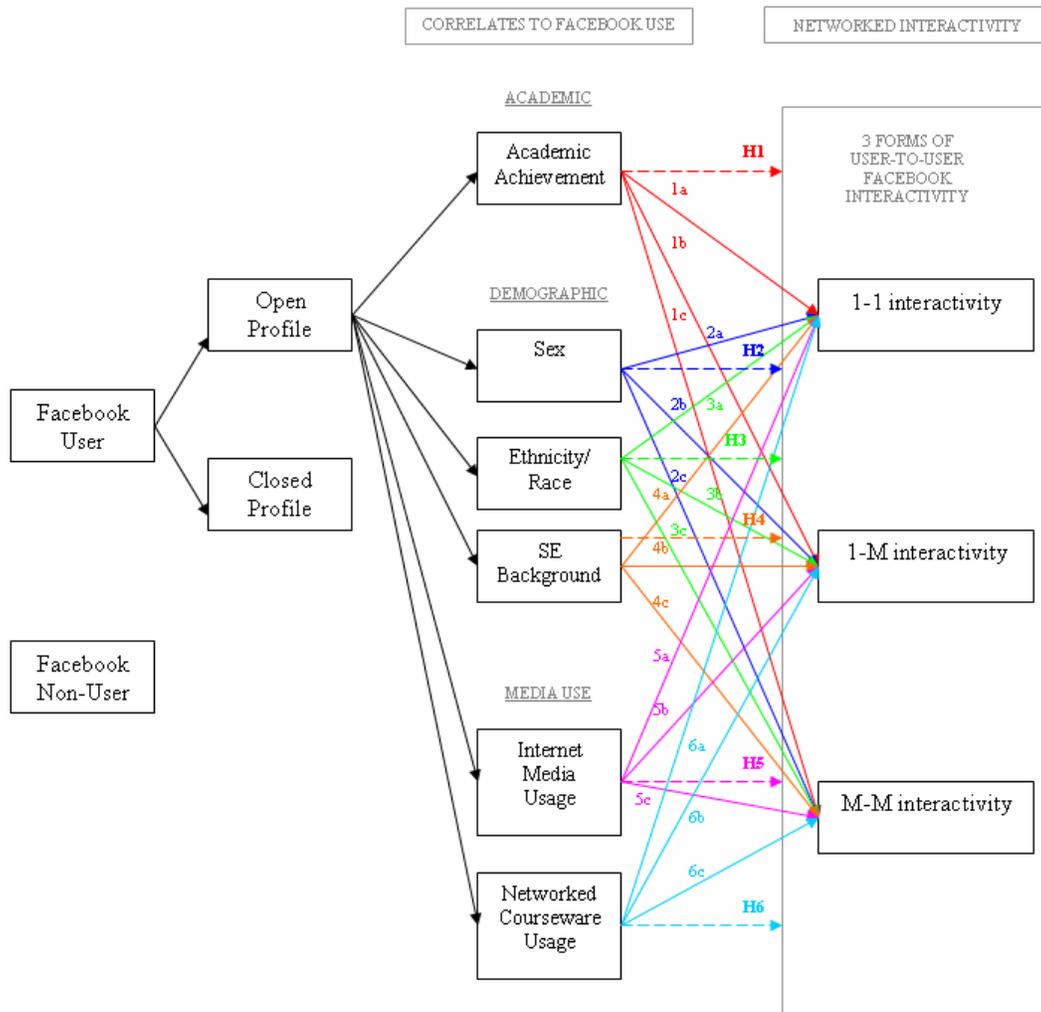
H6a. Student use of courseware technology will be positively associated with one-to-one Facebook interactivity.

H6b. Student use of courseware technology will be positively associated with one-to-many Facebook interactivity.

H6c. Student use of courseware technology will be positively associated with many-to-many Facebook interactivity.

Model

Figure 4 Proposed Facebook Networked Interactivity Model



Method

Participants

The participants providing data for this research were 348 undergraduates at the University of California Santa Barbara who participated in a separate experimental study funded by the Andrew W. Mellon Foundation titled *Assessing the Pedagogic Implications of Technology in the Classroom* (APITC). The APITC sample data was collected from undergraduates in 16 real-time classes at UC Santa Barbara between fall 2003 and spring 2007. The classes were chosen to produce a variation in size, grade-level, and subject matter. They included a small writing class, lower-division history classes, and upper-division classes in computer science and psychology. The APITC study has amassed several thousand data points from several sources about students in these classes: self-report survey data administered in class at the beginning and end of the academic term; official Office of the Registrar data about students' family background, standardized test scores, and GPA; and *Moodle* courseware usage data for the courses under investigation. From the APITC study population, a sample of 348 was drawn of participants randomly assigned to a technology condition including students who used *Moodle* courseware. Data from these participants is uniquely important because *Moodle* is a networked classroom technology with many of the same interactive principles and interface features as contemporary SNS but is designed for the classroom.

Data

Data are examined from 348 APITC randomly assigned *Moodle* condition participants. The current research used three APTIC data sources in conjunction with researcher-collected Facebook profile data about those same 348 APTIC participants.

Self-Report Data. The APITC project database contains self-report survey data from participants measuring student uses of Internet and other new media technologies. The self-report survey data was collected via pre-questionnaires distributed to all students at the beginning of each course involved in the APITC study. Information such as hours per week a student uses a computer, to the amount per day a student spends instant messaging were collected via self-report surveys. See *Appendix A* for a complete list of APTIC self-report pre-questionnaire data used in this research.

Official Registrar Data. The APITC project data also contains official university Registrar information from participants. Official Registrar data includes measures of socio-economic status, ethnic and other background demographics, and academic achievement measures including Standard Aptitude Test (SAT) scores and cumulative grade point averages (GPA). See *Appendix B* for a complete list of APITC Office of the Registrar data used in this research.

Networked Courseware Usage Data. APITC information also includes student usage data of *Moodle* courseware. This is server log data that includes all student activities using *Moodle* courseware over a 10 week long quarter course. Server log data includes information such as frequency of student logins, the number of resources a student accesses, as well as all activities a student engages in while

logged onto the system. For a list of the APITC networked courseware data used in this research see *Appendix C*.

Facebook Data. Facebook profile data was collected about the 348 APITC Moodle technology condition participants. Table 1 provides a cross-section of the data collected from the Facebook profiles and APITC data sources. 268 of the 348 APITC participants had Facebook profiles that could be validated using APITC data to cross-reference participant identity. 67 of the 268 participant Facebook profiles were closed and could not be used in networked interactivity analysis. Facebook profile data was therefore collected in its entirety for 201 APITC participants. Because the APITC study has collected data over a span of four years (2003-2007) the current research's sample of 201 Facebook profiles contains both currently enrolled students and alumni. The Facebook data used in this research also contains data from students who are likely to have adopted Facebook earlier and later in their college careers given that Facebook was released in 2004. Each of these adoption factors is potentially confounding when measuring the dimensions of user interactivity. In addition, time plays a significant role in networked interactivity. The longer one has been online communicating within an SNS the greater the possibility for increased frequency of interactive communication. To measure the time a user has been interactive, the date of the first Facebook "Wall" post and subtract that date from the date the profile data was collected. For a complete list of the Facebook data used in this research see *Appendix D*.

Table 1 *Sample Summary Statistics (N=348)*

	Mean or % (n)
Facebook Profile Status:	
Facebook Profile (yes)	77% (268)
Facebook Profile (no)	23% (80)
Open Facebook Profile	58% (201)
Closed Facebook Profile	19% (67)
Academic Achievement:	
Cumulative GPA	3.13 (261)
Cumulative SAT	1179 (265)
Sex:	
Male	45% (158)
Female	55% (190)
Race/Ethnicity:	
White	55% (177)
Non-White	39% (128)
Decline	6% (20)
Social Economic Background:	
Education Level Father ¹	5.24 (273)
Education Level Mother ¹	5.05 (275)
Parent Income Level ²	3.92 (214)
Internet Media Usage:	
Computer hours per week ³	25 hours (286)
Courseware page views per quarter ⁴	73 (159)

Notes: ¹ represents parent education level; 1 = no high school, 2 = some high school, 3 = high school graduate, 4 = some college, 5 = two year college graduate, 6 = four year college graduate, 7 = post-grad study. ² represents parent income; 1 = under \$20,000, 2 = \$20,000-\$34,999, 3 = \$35,000-\$49,999, 4 = \$50,000-\$74,999, 5 = \$75,000 or more. ³ represents the measure converted from an ordinal scale using mid-point of response category (e.g. 10-20 hours = 15 hours) min = 30 minutes, max = 168 hours. ⁴ represents the measure from total courseware page views over a ten week academic quarter, min = 5, max = 267.

Independent Variables

Academic Achievement. Student cumulative grade point average (GPA) and the Standard Aptitude Test (SAT) scores are used as independent measures in the examination of Facebook networked interactivity and its three constitutive forms. As indicated the population of interest in this study is students and therefore measures of academic achievement are likely to be significant indicators of behaviors within the education environment where Facebook interactivity occurs.

Sex. Student sex is also used as an independent measure to examine the three forms of Facebook interactivity. The independent measure of participant sex is taken from the official Office of Registrar data.

Ethnicity/Race. A student user's racial ethnicity as reported to the Office of the Registrar at the time of the student's entrance into the university is also used as an independent measure to examine user-to-user interactivity.

Internet New Media Usage. New media usage is clearly an important variable to examine when investigating the more specific nature of how individuals interact within SNS. Usage in this research is operationalized via self-report measures provided by the student sample population. These self-report measures include items such as the number of hours per week a student uses a computer and how much time they spend emailing and instant messaging per day. Other Internet specific activities are also used, such as time per day spent online playing games, listening to music, general web browsing, and the amount of time spent online for academic purposes.

Networked Courseware Usage. A unique independent variable in this study is how students use courseware technology that provides many of the same interactive

components as SNS technologies. For the purposes of this study networked courseware usage interactivity is measured by a subset of actions taken within the *Moodle* networked courseware environment over the period of a 10-week quarter long course. Networked courseware usage is specifically measured using three items: total number of *Moodle* logins per quarter, total number of *Moodle* page views per quarter, and the total number of server log activities recorded by the user over the course of the quarter.

Dependent Variables

Rafaeli and Sudweeks (1997) conceptualize networked interactivity as the engagement of people on networks in participatory communication. This research expands their pre-SNS conceptualization to suggest that networked interactivity includes the sum of three component forms of communication engaged in by users over their membership as active participants in a social networking site (SNS). The current research argues that users are afforded both synchronous and asynchronous forms of one-to-one, one-to-many and many-to-many forms of communication within Facebook. This research is therefore interested in understanding the differences in how student users employ the three forms of SNS interactivity. Interactive communication data collected from 201 Facebook profiles was categorized into three forms of interactivity: one-to-one (1-1), one-to-many (1-M) and many-to-many (M-M).

One-to-One Interactivity. One-to-one interactivity (1-1) is defined as computer mediated-communication where two individuals use the SNS interface to communicate directly with one another. In the communication discipline this type of

interactivity most resembles a dyadic bi-directional interpersonal interaction. There are many measures of 1-1 interactivity in Facebook this research includes only 1-1 interactivity measures that are visible in the Facebook profile. A 1-1 interactivity measure is computed as the sum of the standardized scores for each of the following Facebook interactions: the total number of wall posts, the total number of wall-to-wall third order dependent conversation partners, the total number of local network friends, total number of external network friends, the total number of external networks a user belongs to, the total number of photos of a user uploaded and “tagged” by another user, and the total number of gifts received by a user.

One-to-Many Interactivity. One-to-many (1-M) interactivity is defined as CMC where an individual uses the SNS interface to communicate to multiple others at once. This type of interactivity most closely resembles a broadcast method of communication where one source uses a channel to communicate with an audience. A unique feature of SNS CMC is that unlike traditional broadcast models (e.g. Television) the flow of communication in 1-M networked interactivity is bi-directional. One-to-many interactivity in Facebook is measured by taking the mean of the standard scores of the following nine items: the total number of photos a user uploads, the total number of photo albums a user creates, the total number of photos in all photo albums, the total number of “groups” a user belongs to, the total number of “events” posted by a user, the total number of “notes” shared with multiple users, the total number of posted items (“posted items” are a specific action allowing a user to incorporate external web information to share with other Facebook users), the total number of profile “stories” listed on the user “mini news feed” at time of data

collection, and the total number of “courses” a user lists. The 1-M interactivity score for each participant was derived by computing the mean of the constituent item z-scores of the nine 1-M measurements.

Many-to-Many Interactivity. Many-to-many (M-M) interactivity is operationalized by a subset of fields within Facebook where hypertexts links are automatically generated when a user adds profile information. M-M interactivity occurs when a hypertext link is generated connecting all network users who input similar information. M-M interactivity constructs a series of smaller networks of commonality from the larger network population. M-M interactivity is unique in that it is unbounded.

There are two distinct types of M-M interactivity fields within Facebook. The first type of M-M interactivity field is the result of a user/interface selection process. There are twenty-one profile fields where a user can choose from x number of options in a pull-down menu, only one is ultimately linked. For example, a user can choose among one of eight options in the “political views” field, where if the user selects “liberal,” liberal will be the information that appears in the user field and by doing so links that user to all other liberal users. This is different from the second type of M-M interactivity field where the user inputs the information that is automatically hyperlinked by the system. For example, the “Favorite TV shows” field allows a user to input as many television programs as they want. Each instance of a TV program is then linked to other users who have included the same TV show in their profile thereby creating a sub-network of user interested in that TV program.

Seven measures from both types of M-M interactivity field were collected to construct an overall measure for M-M interactivity. To create a student's M-M interactivity score the mean of the standardized scores for the following M-M interactive fields was computed: total number of activities, total number of interests, total number of favorite music entries, total number of favorite TV shows, total number of favorite movies, total number of favorite books, and the sum of the standardized scores for five selection process M-M items (political views, religious views, high school, major, and hometown).

In all, standardized scores of twenty three interactive Facebook items were used to compute three Facebook interactivity measures: seven 1-1, nine 1-M and seven M-M. The final 1-1 measure was computed by combining seven 1-1 z-score items and dividing the sum by seven. The final 1-M measure was computed by combining nine 1-M z-score items and dividing the sum by nine. The final M-M measure was computed by combining seven M-M z-score items and dividing the sum by seven. Principal component factor analysis run on the seven 1-1 items was used to confirm the interactivity scale, Table 2. The seven 1-1 measures loaded together into one dimension using varimax rotation explaining 64% of the variance. A reliability analysis run on the 1-1 interactivity component yielded an alpha value of $\alpha .90$. Nine items were used to construct a one dimensional 1-M interactivity scale, Table 3. The nine 1-M measures extracted into one dimension explains 38% of the variance. A reliability analysis run on the 1-M component yielded an acceptable alpha value of $\alpha .74$. Seven items were used to verify sufficient factor loadings to construct the M-M interactivity scale, Table 4. The seven M-M measures loaded on one dimension

using varimax rotation explaining 42% of the variance. A reliability analysis run on the M-M interactivity component yielded an acceptable alpha value of $\alpha .76$.

Networked Interactivity. SNS CMC is unique in that it allows users a range of methods to communicate with each other, three specific forms of SNS interactivity are conceived as one-to-one, one-to-many, and many-to-many. Rafaeli and Sudweeks (1997) introduce the construct of networked interactivity several years prior to the first generation of social networking sites. They use the concept to suggest a mechanism for the formation and coalescence of CMC groups. A social network is a group and it follows that the sum of the interactive communication that takes place within that social network can be understood as networked interactivity. A key component in explicating networked interactivity is time and in particular the length of time an individual has been participating within a social network. Time provides individuals with the opportunity to take advantage of the interactive opportunities afforded by a SNS.

The final aggregated measure of networked interactivity (NI) was operationalized from the computed 1-1, 1-M, and M-M measures. Network Interactivity scores for each participant were computed by summing \bar{x}_{1-1} (one-to-one); \bar{x}_{1-M} (one-to-many); and \bar{x}_{M-M} (many-to-many) and dividing the sum by the amount of time (T) in days a user has engaged in interactive communication within Facebook.

Measures

Table 2 *One-to-One Facebook Interactivity Component*

One-to-One (1-1) Interactivity Factor Analysis 7 items, Valid N=188	Factor Loadings
Local network friends	.87
External network friends	.85
External networks	.84
Wall messages total	.85
Wall-to-wall conversation partners	.85
Photos tagged by others	.69
Gifts given to a user	.58
Eigenvalue	4.45
% of Variance	63.7
Mean	-.0002
Standard Deviation	.78
Cronbach's Alpha	.90

Table 3 *One-to-Many Facebook Interactivity Component*

One-to-Many (1-M) Interactivity Factor Analysis 9 items, Valid N=196	Factor Loadings
Photos uploaded by a user	.87
Albums created by a user	.89
Album pictures total	.91
Groups joined by a user	.51
Events attending	.36
Profile notes	.68
Posted items	.18
MiniFeed	.42
Courses listed	.01
Eigenvalue	3.42
% of Variance	38.01
Mean	-.01
Standard Deviation	.54
Cronbach's Alpha	.74

Table 4 *Many-to-Many Facebook Interactivity Component*

Many-to-Many (M-M) Interactivity Factor Analysis 7 items, Valid N=201	Factor Loadings
Activities	.52
Interests	.53
Favorite music	.67

Favorite TV	.73
Favorite movies	.79
Favorite books	.66
Political, religious, high school, major, hometown	.58
Eigenvalue	2.93
% of Variance	41.87
Mean	-.0003
Standard Deviation	.64
Cronbach's Alpha	.76

Table 5 *Aggregated Networked Interactivity*

Networked Interactivity (NI) \bar{x} (1-1) + \bar{x} (1-M) + \bar{x} (M-M) / Time, Valid N=183	
Mean	-.0002
Standard Deviation	.004

Table 6 *Intercorrelations between Forms of Interactivity*

		1-1	1-M	M-M	NI
One-to-One (1-1)	Pearson coefficient		.56**	.25**	.59**
One-to-Many (1-M)	Pearson coefficient	.56**		.41**	.61**
Many-to-Many (M-M)	Pearson coefficient	.25**	.41**		.52**
Networked Interactivity (NI)	Pearson coefficient	.59**	.61**	.52**	

**Correlation is significant at the 0.01 level (1-tailed).

Results

Hypothesis Testing

Bivariate correlations using one-tailed tests of significance and independent-samples t-tests were conducted to examine research hypotheses H1a-c through H6a-c.

The complete results are presented in Table 7. Bivariate correlations yielded significant findings across the independent variable groupings of academic achievement, socio-economic background and Internet new media use items. No significant relationships were found between the independent variable of *Moodle* networked courseware usage and the dependent variables of 1-1, 1-M and M-M Facebook interactivity. Independent samples t-tests yielded mixed results for sex and race/ethnicity and the constitutive forms of networked interactivity.

The determination to support a hypothesis was based on an arbitrary standard. The *support standard* was applied when the majority of independent variables with multiple measures were found to have significant findings correlated in the same direction as hypothetical claims.

Academic Achievement Hypotheses

With specific regard to the academic achievement hypotheses data analysis yielded mixed results. Each hypothesis about academic achievement was comprised of six measures. The measures were not combined into a single scale because they represent different dimensions of achievement and test each individually.

No significant overall association appeared between the aggregate variable of networked interactivity and measures of academic performance, providing no support for H1.

Bivariate correlations run on H1a variables yielded significant associations in both positive and negative directions for individual components of academic performance. The results for H1a show that different measures of academic achievement align differently with the interactivity scales. For 1-1 interactivity

students who do better academically have more 1-1 interactive communication when examining student cumulative grade point average (GPA) ($r = .15, p < .05$).

However, analysis also shows that 1-1 interactive communication *decreases* for students who have higher cumulative standard aptitude test (SAT) scores ($r = -.15, p < .05$).

H1b is unsupported because the direction of statistical findings was opposite to what was predicted. Analysis to test H1b found negative significant relationships between 1-M interactivity and student cumulative SAT scores ($r = -.14, p < .05$) and two measures of math aptitude: SAT math score ($r = -.14, p < .05$) and SAT II math achievement score ($r = -.19, p < .01$).

Similar correlation analysis run on the final academic achievement hypothesis, H1c, found a positive relationship between M-M interactivity and students who score well on the SAT writing exam ($r = .13, p < .05$). H1c is not supported because the predicted significance is in the opposite direction.

Demographics Hypotheses

Tests between demographic measures and Facebook interactivity also found significant relationships. Support for H2a-c and H3a-c was determined based on the results of Independent samples t-tests between items of sex and ethnicity/race (classified as white and non-white). The Bonferroni correction was used to adjust for the multiple Independent samples t-tests used to analyze demographic hypotheses H2a-c and H3a-c. Similar to H1a-c, support for H2a-c through H4a-c was determined based on whether the majority of demographic t-tests and socio-economic background correlations were significant and in the same direction as hypothetical claims.

Sex. Analysis results strongly support demographic sex hypotheses H2a-b. Independent samples t-tests found that female students engage in significantly more 1-1 interactivity $t(186) = -2.68$ $p < .013$ $M = .14$ $SD = .870$, more 1-M interactivity $t(194) = -3.28$ $p < .013$ $M = .10$ $SD = .617$, and more aggregated networked interactivity $t(181) = -2.72$ $p < .013$ $M = .0004$ $SD = .003$ than their male counterparts. The sex hypotheses results remain significant given the Bonferroni correction was used to adjust for the multiple Independent samples t-tests.

Ethnicity/Race. Results from analyses run on race and all forms of networked interactivity show no significant differences. The race/ethnicity results do not support predictions made by H3a-c.

Socio-Economic Background. Similar to H1a-c, H4a-c analyses on socio-economic background was comprised of multiple measures. Three measures were used to assess the associations between socio-economic background and the forms of

networked interactivity. H4 was supported using the above mentioned standard since parent income was the only significant relationship found in relation to the aggregate of networked interactivity ($r = .22, p < .05$).

Two significant relationships in the direction predicted were found between 1-1 interactivity and parent income ($r = .24, p < .05$) and mother's education level ($r = .15, p < .05$), thus providing support for H4a.

H4b and H4c were not supported because of the absence of significant relationships.

Media Use Hypotheses

Internet Media Usage. The third group of hypotheses predicted relationships between media use behaviors and the forms of networked interactivity, no support for the hypothetical claims was found. Similar to the academic achievement and socio-economic background hypotheses the media use hypotheses test multiple measures of media use specifically ten items are tested, and the same standard of support was applied to find support for hypotheses H5a-c through H6a-c.

Analysis of H5 found three significant correlations between the aggregate of network interactivity and Internet new media uses, however, each of the three significant relationships were in the opposite direction of what was predicted. Students who spend more time online browsing, surfing, shopping online, bill paying, trip planning, reading news or blogs are engaged in less networked interactivity ($r = -.17, p < .05$). Strong negative relationships were found between student's aggregated networked interactivity and the amount of time students spend playing online games

both alone ($r = -.34, p < .01$) and in multi-player games ($r = -.22, p < .01$). Results do not support H5 claims.

Correlations run to test H5a found two negative and one positive significant relationships between 1-1 interactivity and Internet new media use. Strong negative relationships again were found between 1-1 interactivity and the amount of time students spend playing online games both alone ($r = -.22, p < .01$) and in multi-player games ($r = -.21, p < .01$). A weaker significant relationship was found in the predicted direction between 1-1 interactivity and the amount of time students spend online instant messaging ($r = .14, p < .05$). Applying the support standard, H5a was not supported.

H5b tests found that 1-M interactivity was also negatively correlated with online game playing both alone ($r = -.20, p < .01$) and in multi-player games ($r = -.15, p < .05$). Results also found that 1-M interactivity was negatively related to the amount of time students use a computer each week ($r = -.14, p < .05$). Results do not support H5b claims.

Correlation analyses run to test H5c found no significant relationships at all between M-M interactivity and the ten Internet media usage variables.

Networked Courseware Usage. Finally, media use hypotheses H6a-c claimed positive relationships between Moodle networked courseware use and the constitutive forms of Facebook interactivity. The correlation results yielded no significant findings providing no support for H6a-c.

Table 7 Hypothesis Results

ACADEMIC ACHIEVEMENT				
<i>Academic Achievement</i>	H1: Student academic achievement will be positively associated with Facebook networked interactivity	H1a: Student academic achievement will be positively associated with one-to-one (1-1) Facebook interactivity	H1b: Student academic achievement will be positively associated with one-to-many (1-M) Facebook interactivity	H1c: Student academic achievement will be negatively associated with many-to-many (M-M) Facebook interactivity
GPA Cumulative	.11	.15*	.07	.02
SAT Cumulative	-.04	-.15*	-.14*	.03
SAT II Math	-.05	-.12	-.19**	-.01
SAT II Writing	.10	-.07	.03	.13*
SAT Math	-.05	-.13	-.14*	-.03
SAT Verbal	-.02	-.12	-.11	.07
DEMOGRAPHICS				
<i>Sex</i> ¹	H2: Female students will engage in more networked interactivity than male students	H2a: Female students will engage in more one-to-one Facebook interactivity than male students	H2b: Female students will engage in more one-to-many Facebook interactivity than male students	H2c: Female students will engage in more many-to-many Facebook interactivity than male students
Male	t(181) = -2.72* M = -.0009 SD = .004	t(186) = -2.68* M = -.16 SD = .633	t(194) = -3.28* M = -.14 SD = .409	t(199) = -1.33 n.s. M = -.06 SD = .642
Female	M = .0004 SD = .003	M = .14 SD = .870	M = .10 SD = .617	M = .06 SD = .640
<i>Race/Ethnicity</i> ¹	H3: White students will engage in more networked interactivity than non-white students	H3a: White students will engage in more one-to-one Facebook interactivity than non-white students	H3b: Non-white students will engage in more one-to-many Facebook interactivity than white students	H3c: White students will engage in more many-to-many Facebook interactivity than non-white students
White	t(181) = 1.43 n.s. M = .0001 SD = .002	t(186) = .767 n.s. M = .04 SD = .864	t(194) = 1.10 n.s. M = .02 SD = .600	t(199) = .324 n.s. M = .01 SD = .665
Non-White	M = -.0006 SD = .005	M = -.05 SD = .660	M = -.06 SD = .450	M = -.02 SD = .614
<i>Socio-Economic Background</i> ²	H4: Student socio-economic background will be positively associated with Facebook networked interactivity	H4a: Student socio-economic background will be positively associated with one-to-one Facebook interactivity	H4b: Student socio-economic background will be positively associated with one-to-many Facebook interactivity	H4c: Student socio-economic background will be positively associated with many-to-many Facebook interactivity
Education Level of Father	-.02	-.002	-.10	.05

Education Level of Mother	-01	.15*	-010	.03
Parent Income	.22*	.24*	.08	.14

MEDIA USE

<i>Internet New Media Use</i>	H5: Student Internet and new media use will be positively associated with Facebook networked interactivity	H5a: Student Internet and new media use will be positively associated with one-to-one Facebook interactivity	H5b: Student Internet and new media use will be positively associated with one-to-many Facebook interactivity	H5c: Student Internet and new media use will be positively associated with many-to-many Facebook interactivity
Hours per week do you normally use a computer?	-012	-012	-.14*	-001
Hours per day gathering information for a class, studying, or using a computer for academic purposes	-005	-005	-003	-003
Hours per day emailing	.02	.05	-006	-005
Hours per day playing games in a group (multi-player)	-.22**	-.21**	-.15*	-001
Hours per day playing games alone (single-player)	-.34**	-.22**	-.20**	-007
Hours per day instant messaging.	.01	.14*	-001	-008
Hours per day creating or modifying your own webpage(s)	.02	-001	-001	-001
Hours per day listening to music, accessing music	-006	-004	.08	-002
Hours per day other new technology use hours	.02	.20	.0002	.11
Hours per day browsing, surfing, shopping online, bill paying, trip planning, reading news or blogs.	-.17*	-014	-009	.06
<i>Networked Courseware Use</i>	H6: Student use of courseware technology will be positively associated with Facebook	H6a: Student use of courseware technology will be positively associated with one-to-one Facebook	H6b: Student use of courseware technology will be positively associated with one-to-many	H6c: Student use of courseware technology will be positively associated with many-to-many

	networked interactivity	interactivity	Facebook interactivity	Facebook interactivity
Courseware logins per 10 week quarter	.00006	.05	-.05	-.02
Courseware page views per 10 week quarter	-.003	-.01	-.03	.02
Courseware total logged actions per 10 week quarter	-.03	-.02	-.08	-.04

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed).

¹ For Sex and Ethnicity/Race variables, Independent Samples t-tests were used to test hypotheses H2a-c and H3a-c. The Bonferroni correction was used to adjust for four multiple Independent samples t-tests used to test Sex and Ethnicity/Race against the forms of Facebook Interactivity in H2a-c and H3a-c. * = .05/4 = .0125.

² Analysis on parent income; 1 = under \$20,000, 2 = \$20,000-\$34,999, 3 = \$35,000-\$49,999, 4 = \$50,000-\$74,999, 5 = \$75,000 or more

Discussion

The current study investigates the relationships between academic achievement, demographic antecedents, and media use independent variables and the dependent variables of networked interactivity and three component dimensions of one-to-one, one-to-many, and many-to-many interactivity on students within the SNS environment of Facebook. Unlike extant studies conducted on Facebook this research is unique in that it examined four explicit forms of communication student users engage in within Facebook. More generally the goal of this research was to illustrate that all forms of SNS communication are not equivalent. What makes SNS environments like Facebook distinctive is that the technology affords multiple unique forms of interactive communication between users, and that these forms of interactivity can be differentially predicted based on individual level variables in this case that are unique to student users.

Three groupings of directional hypotheses were asserted to make claims about networked interactivity. The results of this research illustrate an interesting mix of

both predicted positive correlations and T-tests summarized in Table 8 and negative non-predicted correlations summarized in Table 9. In total, eight hypotheses under analysis yielded significant correlations in the direction predicted and five hypotheses yielded significant negative correlations not predicted but important for the specific relationships they highlight between the forms of Facebook networked interactivity and the independent measures.

Table 8 *Summary of Significant Positive Correlations and T-Tests*

<i>Academic Achievement</i>		
H1a	Student academic achievement will be positively associated with one-to-one (1-1) Facebook interactivity GPA Cumulative	Pearson coefficient .15*
H1c	Student academic achievement will be negatively associated with many-to-many (M-M) Facebook interactivity SAT II Writing Achievement Test Score	Pearson coefficient .13*
<i>Sex¹</i>		
H2	Female students will engage in more networked interactivity than male students	T-Test results t(181) = -2.72 p < .013 M = -.0009 SD = .004 M = .0004 SD = .003
H2a	Female students will engage in more one-to-one Facebook interactivity than male students	T-Test results t(186) = -2.68 p < .013 M = -.16 SD = .633 M = .14 SD = .870
H2b	Female students will engage in more one-to-many Facebook interactivity than female students	T-Test results t(194) = -3.28 p < .013 M = -.14 SD = .409 M = .10 SD = .617
<i>Socio-Economic Background</i>		
H4	Student socio-economic background will be positively associated with Facebook networked interactivity Parent Income	Pearson coefficient .22*
H4a	Student socio-economic background will be positively associated with one-to-one Facebook interactivity Registrar Education Level of Mother Parent Income	Pearson coefficient .15* .24*
<i>Internet New Media Use</i>		
H5a	Student Internet and new media use will be positively associated with one-to-one Facebook interactivity Hours per day instant messaging.	Pearson coefficient .14*

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed).

¹ For Sex and Ethnicity/Race variables, Independent Samples t-tests were used to test hypotheses H2a-c and H3a-c. The Bonferroni correction was used to adjust for four multiple Independent samples t-tests used to test Sex and Ethnicity/Race against the forms of Facebook Interactivity in H2a-c and H3a-c. * = .05/4 = .0125.

Positive Correlations

Academic Achievement. Positive relationships were found supporting claims about 1-1 and M-M interactivity and academic achievement, specifically GPA and

the writing component of the standardized aptitude test. The GPA and 1-1 interactivity finding supports the idea that SNS use likely provides a vehicle for students to invest physical and psychological energy (Astin, 1999) necessary to reinforce their involvement in the broader academic environment. Further the finding between M-M and higher writing achievement is interesting in that it may suggest that students who are better writers in general like to write more about themselves in SNS environments given that six of the M-M factors are dynamic fill-in the blank profile fields.

Demographics. Five demographic hypotheses are supported in the direction predicted without mixed results. Prior research on SNS environments has found that women users are the predominant users of online social networks. Survey research finds that females reinforce pre-existing friendships in SNS (PEW, 2007a). The current research supports the PEW's findings as well as expands the understanding of the nature of how women and men engage in SNS environments. This research finds that, as predicted, women engage in significantly more aggregated network interactivity, and 1-1 direct communication (which helps to develop and maintain relationships), and more 1-M interactivity (which focuses on broadcasting and sharing of information to and with a bounded group of friends) than their male counterparts.

No significant relationships were found between interactivity and race, and while this is potentially a result of sample, it does provide support for Cotton and Jelenewicz's (2006) claims that differences in Internet usage attributable to digital divide are minimized among university students.

Socio-Economic Background. Additionally, the current research finds that, as predicted, measures of socio-economic background are also positively associated with Facebook interactivity. Specifically, aggregated networked interactivity and 1-1 interactivity are both positively related to a user's parental income. A further finding in relation to socio-economic background shows that students whose mothers have higher levels of education tend to engage in more 1-1 Facebook interactivity. Verba, Schlozman, and Burns (2004) suggest that parental education rather than income is a more explanatory measure for individual civic-engagement even though parental income is commonly used in political participation studies. In this case parental education may likely also be attributable to the forms of interactivity a student engages in while participating in a SNS. Communication scholars have long attempted to understand the acquisition of social skills (see: Weimann, 1977 & Brown and Levinson, 1978) which communication interaction is a main component and research clearly shows that family antecedent influences play a significant role. It is not surprising therefore that a mother's education is significantly related to the level of 1-1 interactivity engaged in by student SNS users.

Media Use. Only one new media use measure was found to have a significant positive relationship with Facebook interactivity. The amount of time a student spends instant messaging (IM) is correlated with the amount of 1-1 interactivity a student engages in within Facebook. This result makes intuitive sense since among students instant messaging in itself is a dominant form of new media one-to-one communication (Flanagin, 2005). The finding is likely explained by the fact that student use of Facebook and instant messaging is intertwined. 1-1 Facebook

interactivity such as third order dependency “wall” posts and building “friend” networks are consistent with instant messaging activities that involve short-hand real-time message exchanges and the building of friend-to-friend IM networks. These IM activities allow for communication between friends of friends and for the building of chatrooms for instant messages with all friends on that network, similar to the activities facilitated by 1-1 interactivity.

Table 9 *Summary of Negative Significant Correlations*

<i>Academic Achievement</i>	
Student academic achievement will be positively associated with one-to-one (1-1) Facebook interactivity	Pearson coefficient
SAT Cumulative	-.15*
Student academic achievement will be positively associated with one-to-many (1-M) Facebook interactivity	Pearson coefficient
SAT Cumulative	-.14*
SAT II Math Achievement Test Score	-.19**
SAT Math	-.14*
<i>Internet New Media Use</i>	
Student Internet and new media use will be positively associated with Facebook networked interactivity	Pearson coefficient
Hours per day playing games in a group (multi-player)	-.22**
Hours per day playing games alone (single-player)	-.34**
Hours per day browsing, surfing, shopping online, bill paying, trip planning, reading news or blogs.	-.17*
Student Internet and new media use will be positively associated with one-to-one Facebook interactivity	Pearson coefficient
Hours per day playing games in a group (multi-player)	-.21**
Hours per day playing games alone (single-player)	-.22**
Student Internet and new media use will be positively associated with one-to-many Facebook interactivity	Pearson coefficient
Hours per week do you normally use a computer?	-.14*
Hours per day playing games in a group (multi-player)	-.15*
Hours per day playing games alone (single-player)	-.20**

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed).

Negative Correlations

Academic Achievement. An interesting finding among the negative correlations is that those students who have higher math related academic skills tend to engage in less Facebook interactivity. Cross-tab analysis using the chi square statistic suggests that there is no significant difference between students majoring in a field that traditionally involves mathematics as part of its curriculum (i.e., computer science, chemistry, and economics) and students majoring in fields that are traditionally not associated with mathematics (i.e., history, political science and

literature) and their Facebook profile status (i.e., no profile, closed, or open) $\chi^2(4, N = 348) = 3.42, p > .05$.

Table 10 *Student Major Type by Facebook Profile Status*

PROFILE STATUS	TYPE OF MAJOR		
	Math Major	Non-Math Major	Undecided or Missing Data
No Facebook Profile	48	14	18
Closed Facebook Profile	37	17	13
Open Facebook Profile	129	32	40
Total N=348	214 (62%)	63 (18%)	71 (20%)

The frequencies illustrate that a majority of students with open Facebook profiles examined in this research have declared majors that require a higher level of math skill. This artifact of the sample is likely the reason why there is a math effect in the correlations between the forms of Facebook interactivity and academic achievement.

A second finding appears to be a pre-college effect with regards to academic achievement and Facebook interactivity. The mixed result that there is a negative significant relationship ($r = -.15, p < .05$) between cumulative SAT scores and 1-1 Facebook interactivity and a positive significant relationship ($r = .15, p < .05$) between cumulative college GPA and 1-1 Facebook interactivity suggests that direct interactive communication with friends and peers is likely to be more important to successful students once they are in college.

Media Use. Significant negative correlations were also found between media use measures and Facebook interactivity scales. The most compelling of these

negative media use relationships is that students who spend more time online playing both single and multi-player games score significantly lower on the three Facebook interactivity scales of 1-1, 1-M and aggregated networked interactivity. The findings with regards to 1-M interactivity are somewhat surprising in that 1-M interactivity is conceptually similar to multi-player gaming and therefore one would expect a significant positive relationship. One explanation for these findings is the time displacement explanation (Nie, Hillygus & Ebring, 2002). However, unlike Nie et al. – who treat interpersonal communication and sociability as a uniquely offline phenomenon – the current research finds that online sociability in the form of Facebook interactivity suffers from an increase in time spent via online entertainment represented by single and multi-player games.

Weak negative significant associations were also found between aggregated networked interactivity and the hours per day a student browses the Internet, shops online, pays bills, plans a trip and reads news or blogs ($r = -.17, p < .05$) and 1-M interactivity and the hours per week a student normally uses a computer ($r = -.14, p < .05$). Again the displacement explanation works to understand these negative relationships. The more time students spend with online activities external to Facebook such as external browsing and reading blogs the less time they are likely to have to engage in the more consuming activities involved with aggregated Facebook network interactivity, from developing friend networks, to uploading and assembling photos into albums, to filling-in and updating personal M-M favorites fields. The finding that the more students use the computer per week the less 1-M Facebook interactivity they engage in and vice versa is somewhat anomalous. On the one hand

this finding can be explained by the nature of 1-M interactivity in that it is a less time consuming to broadcast information to groups and friends and thus more interactivity is time saving. And on the other hand less 1-M interactivity is likely replaced with other more time consuming activities as students spend more time online.

Conclusion

Social networking sites have quickly become popular cultural and communication phenomena. A handful of SNS are among the most frequently visited and often used websites on the Internet. Not surprisingly commentators and scholars alike have come to understand the contemporary period of Internet history as Web 2.0 a term used to refer to the dominance of user generated content websites. Academic research on this popular form of computer-mediated communication is nascent and while extant research is intrinsically interesting and valuable to the broader study of social networking sites it lacks a detailed examination of the nature of communication taking place between SNS users. Instead extant research has chosen leapfrog fundamental communication questions to investigate second generation research concepts such as identity formation, social capital and privacy. The current research attempts to construct a mechanism to better understand SNS user communication using the concept of networked interactivity and its constitutive forms of one-to-one, one-to-many and many-to-many interactivity.

Implications. One of the important implications of this work is that it illustrates that given multiple forms of user-to-user interactivity available for engagement, users tend to choose direct one-to-one interaction more frequently and

therefore as the findings suggests more significant relationships are associated with Facebook users and one-to-one interactivity.

Limitations. As with most research this study could be improved upon in several ways. In particular there are three areas the findings bring to light. The first has to do with the sample population of Facebook profiles examined. An increased profile sample would facilitate a more thorough analysis of racial differences in user-to-user engagement in Facebook. This work finds no significant relationships between race and Facebook interactivity even though extant survey research (PEW, 2000, 2001a, 2001b) indicates that African-Americans, Asian-Americans and Hispanic-Americans respectively use the Internet differently and therefore by extension it would be expected to use SNS differently. However, this work was limited by using a white versus non-white dichotomy to examine racial differences and being a representative sample it contained small numbers of ethnic groups of interest (i.e. n=7 African-Americans).

Further this work is also limited by the media use measurements used by the APITC study. Though no fault of the APITC researchers some of the general new media measures tend to be conflated with Facebook practices. For example, many Facebook users choose to use the Facebook interface as an email client. So in reality there is a strong likelihood that email use is also Facebook use. The same argument can be made with regards to the question that asks participants how many hours per day they spend creating or modifying their own webpage. The APITC researchers did not conceive this question to include the SNS profile as one's own webpage. Similarly, the broad catch-all measurement of how many hours per day students

spend browsing, surfing, shopping online, bill paying, trip planning, reading news or blogs can be entangled with a user's daily activities within an SNS environment.

Finally, while this research is unique because it includes measurements of student use networked courseware technology, analysis finds that there are no significant relationships between networked courseware use and the constitutive forms of Facebook networked interactivity. Conceptually this is difficult to understand since the two activities so closely resemble each other. One explanation is that this research employed only three measures of networked courseware activity. The reason for this was that for each instance the *Moodle* courseware was used in a classroom the instructors had freedom to deploy the technology to serve their instructional needs and therefore a limited number of usage variables remain consistent across all *Moodle* deployments. Therefore only using the frequency of logins, page views and total actions limits this study's ability to make a true comparison with like forms of networked interactivity.

Future directions. Academic research on novel forms of communication technology like SNS is inherently disadvantaged. The reason for this is that SNS environments are moving targets. Market, organizational, and user driven forces make the technical infrastructure of Facebook and by extension user interaction persistently dynamic. The evolution of Facebook is a prominent example of the interplay between interface feature dynamics and user reaction. This research examines the interactivity facilitated by the feature set available to Facebook users prior to the release of *Facebook Platform* in May 2007. *Facebook Platform* is a means for anyone to develop software applications that can be embedded into the

Facebook environment for use by all users. Future research will benefit from an analysis into how users are populating their profiles with the over 5,000 recently developed Facebook applications as a means to engage in user-to-user interactivity.

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APPENDIX A – APITC Official Office of the Registrar Data (12 of 43 fields used)

VARIABLE	DESCRIPTION
MAJOR	Registered Major
SEX	Gender
ETHNIC	Codes for Student Ethnicity
CUM_GPA	Cumulative GPA
SAT_V	SAT Verbal Score
SAT_M	SAT Math Score
SAT_COMB	Combined SAT Score
ACH_1	SAT II Writing Achievement Test Score.
ACH_2	SAT II Math Achievement Test Score.
F_EDLVL	Fathers Education Level
M_EDLVL	Mothers Education Level
PARINC	Parent Income

APPENDIX B – APITC Pre-Questionnaire Self-Report Data (10 of 42 fields used)

VARIABLE	DESCRIPTION
COMP_HR_PER_WK	How many hours per week do you normally use a computer?
ACADEMIC	Gathering information for a class, studying, or using a computer for academic purposes per day.
EMAILHRS	Emailing per day.
IM_POSTHRS	Instant messaging, chatting in a chat room, posting to a bulletin board or blog per day.
GAMESALONEHR	Playing games alone (single-player) per day.
GAMESGROUHR	Playing games in a group (multi-player) per day.
MUSIC	Listening to music, accessing music per day.
WEBPAGE	Creating or modifying your own webpage(s) per day.
WEBBROWSING	Web browsing, surfing, shopping online, bill paying, trip planning, reading news or blogs per day.
OTHER_HR	Other hours per day.

APPENDIX C – APITC Moodle Courseware Data (3 of 88 log fields used)

VARIABLE NAME	DESCRIPTION
LOGINS	Courseware logins per 10 week quarter
PAGE_VIEWS	Courseware page views per 10 week quarter
TOTAL_LOG	Courseware total logged actions per 10 week quarter

APPENDIX D – Facebook Profile Data

Note: This profile feature-set was compiled prior to the May 24, 2007 release of *Facebook Platform*.

FACEBOOK PROFILE FEATURES	TYPE OF NETWORKED OF INTERACTIVITY
Basic (Profile Edit)	
Hometown, State, Country <i>Linked</i>	M-M
Political Views (1-8) <i>Linked</i>	M-M
Religious Views (Fill-in) <i>Linked</i>	M-M
Personal (Profile Edit)	
Activities (Fill-in) <i>Linked</i>	M-M
Interests (Fill-in) <i>Linked</i>	M-M
Favorite Music (Fill-in) <i>Linked</i>	M-M
Favorite TV Shows (Fill-in) <i>Linked</i>	M-M
Favorite Movies (Fill-in) <i>Linked</i>	M-M
Favorite Books (Fill-in) <i>Linked</i>	M-M
Education (Profile Edit)	
Major Concentration <i>Linked</i>	M-M
Major Second Concentration <i>Linked</i>	M-M
High School <i>Linked</i>	M-M
Courses (Profile Edit) (Multiple Entries Allowed)	
Subject <i>Linked</i>	M-M
Number <i>Linked</i>	M-M
Title <i>Linked</i>	M-M
Section <i>Linked</i>	M-M
Picture (Profile Edit)	
Profile (Yes or No)	M-M
Photos (Navigation Bar link)	
Photos uploaded by user.	1-M

Photos of user “tagged” by other users	1-1
Notes (Navigation Bar link)	
Other user comments	1-M
Other user(s) in note	1-M
Other user(s) notes about user	1-M
Groups (Navigation Bar link)	
Total number of groups joined	1-M
Total number of groups created and or a group officer/administrator	1-M
Total number of posts to group wall, discussion board, and photos	1-M
Events (Navigation Bar link)	
	1-M
Posted Items (Navigation Bar link)	
	1-M
User Friends & Networks (Profile)	
Total number of Local network “friends”	1-1
Total number of External network “friends”	1-1
Total number of external networks a user belongs to	1-1
Gifts (Profile)	
Total number of gifts received	1-1
Mini Feed Activity (Profile)	
Total number of modifications listed on “mini news feed” at time of data collection	1-M
Network Stories	1-M
Relationship Stories	1-M
Group Stories	1-M
Event Stories	1-M
Photo Stories	1-M
Edit Profile Stories	1-M

Note Stories	1-M
Posted Item Stories	1-M
Relationship Stories	1-M
Group Stories	1-M
Event Stories	1-M
Photo Stories	1-M
Edit Profile Stories	1-M
Note Stories	1-M
Posted Item Stories	1-M
Wall Stories	1-M
Friend Stories	1-M
Status Stories	1-M
Discussion Stories	1-M
Gift Stories	1-M
Marketplace Stories	1-M
Wall Activity (Profile)	
Number of “wall” posts on the user’s profile	1-1
Number of “wall-to-wall” posts with 3 or more instances	1-1