

The Influence of Teaching Methodology on Student Social Interaction

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ABSTRACT

In this paper, we explore the effects of various teaching methodologies on the social interactions reported by university students in the School of Public Affairs at the University of Colorado Denver. Specifically, we will answer the question: *How do different teaching methodologies affect the formation of network ties among students in a university classroom?* We implement a novel research design, in which we operationalize the impact of alternative teaching methodologies on social interactions, specifically the number and quality of dyadic relationships between students in university classrooms. We find that online classes tend to have fewer, but more frequent interactions among students, more diversity among interactions, and greater likelihood that students perceive other students as influential to their learning. In primarily lecture classes, students reported fewer connections, but similar to online students' interactions, the interactions were frequent and influential. We conclude that teaching in an online environment has its own strengths in terms of student relationships; that working in groups offers fewer positive relational outcomes than expected; that the experience of the lecturer has a surprising influence on relationships among students; and that student types affect relationships in fairly predictable ways.

It will come as no surprise that students in a classroom tend to form relationships that may affect their experiences, including their learning and understanding of classroom material. However, less is understood about factors affecting these relationships. Some research points to the importance of teaching methodology in connection to outcomes. For example, using technology in a classroom can create new literacy environments (Moayeri, 2010), and teaching methodology can affect the levels of student participation in the coursework and, in turn, their learning outcomes (Nunn, 1996). There is less research describing the influence of various teaching methodologies on the social interactions of students in a university classroom, or how these social interactions influence outcomes. In this paper, we explore the effects of various teaching methodologies on the social interactions reported by university students in the

School of Public Affairs at the University of Colorado Denver. Specifically, we will answer the question: *How do different teaching methodologies affect the formation of network ties among students in a university classroom?* We implement a novel research design in which we operationalize the outcomes of alternative teaching methodologies as social interactions, specifically the number and quality of dyadic relationships between students in university classrooms. (To be consistent with the literature, we include both in-person and online classes in the term *classroom*.)

THE IMPORTANCE OF SOCIAL INTERACTION TO CLASSROOM OUTCOMES

This question of how teaching methodology affects social interaction is an important one, given the debate in the literature and the media on how student interactions affect outcomes. While some students thrive in environments where independent work is the method, some studies suggest that team-based or group work activities in a classroom lead to better outcomes. Specifically, Hiltz and Wellman (1997) found that “despite the lack of physical space, an ALN’s (asynchronous learning network) virtual facilities allow students to exchange emotional support, information, and a sense of belonging” (p. 44). Social interactions can range from simple exchanges of greeting to working collaboratively on assignments or forming friendship ties outside the classroom setting. The range and quality of these interactions may all have impacts on outcomes. In this study we look at classroom methods, such as how students are assigned to work together, to determine whether the course format, tenure of the instructor, and grade accountability are related to the way that students form social connections in a classroom.

ALTERNATIVE METHODS TO TEACHING IN THE CLASSROOM

It is becoming more common for instructors to explore various mediums, methods, and settings in which to conduct class. Alternative structures to the traditional classroom configurations are being considered (e.g., the increased use of hybrid or online class settings, also known as “high-tech classrooms,” Gutierrez-Folz, 2010). The rise of online courses and access to social media such as Facebook and YouTube present a new menu of options for lecturers; but with it, speculation that students will not get the required and/or expected social interaction to succeed (Steinfeld, Ellison, & Lampe, 2008; Valenzuela, 2009). However, others found that these alternative methods of teaching have a positive effect:

Despite earlier fears to the contrary by those who worry about the possible dehumanizing effects of computers, online communities provide emotional support and sociability as well as information and instrumental aid related to shared tasks. Online virtual classrooms combine the characteristics of online communities and computer-supported workgroups. New software tools and systems

for coordinating interaction may alleviate some of the problems of interacting online, like information overload and normless behavior. (Hiltz and Wellman, 1997, p. 44)

While it is often assumed that a face-to-face environment is *the* best way to create synergy and in turn intellectual creativity and increased knowledge exchange, there are many methodologies for teaching face-to-face, and some are better than others. Alternative choices such as group activity and online discussion groups have opened the door to new kinds of social interaction.

Teaching techniques and class structure chosen by instructors can influence student learning. An important factor in teaching effectiveness relates to the experience of the instructor with the course material. Experience of an instructor can affect how well a course is organized and activities are facilitated. Such factors can account for up to 40% of variation in student achievement (Strong, 2007). The importance of using group discussion and cooperative learning methods in classes (as opposed to lecture only) is well known (Orlich, Harder, Callahan, & Brown, 2010; Rotenberg, 2005) and the benefits of online instruction are evident, but ways to maximize them are still being discovered (De Laat, Lally, Lipponen, & Simmons, 2007; Kelly, Ponto, & Rovai, 2007). Online learning enables the development of competencies in collaboration, critical thinking, personal knowledge, and identity development (Ala-Mutkam, 2009). However, the potential implications these techniques have on student relationships is less well known. This is an important factor, because social networks of students in academic settings have been shown to influence such outcomes as academic performance, development, and persistence (Rizzuto, LeDoux, & Hatala, 2009; Sparrowe, Liden, Wayne, & Kraimer, 2001), as well as health outcomes (Valente et al., 2007, 2009).

SOCIAL EXCHANGE FRAMEWORK

To further understand how students create and maintain interactions in relation to teaching methodologies, we employ a social exchange framework. This framework has its roots in exchange theory (Homans, 1958, 1961, 1964), which explains the likelihood of dyadic (two-partner) relationships based on the supply and demand of resources that each member of the dyad has to offer. Social exchange theory views the exchange relationship between two actors as “actions contingent on rewarding reactions from others” (Blau, 1977, p. 91). In Homans’s own words:

Social behavior is an exchange of goods, material goods, but also non-material ones, such as the symbols of approval or prestige...persons that give much to others try to get much from them, and persons that get much from others are under pressure to give much to them. (1958, p. 606)

We break down social exchange theory in this context to explore how various types of teaching methodologies explain the formation of network ties among students in a university classroom. We consider this social activity at the dyadic level to predict which students will form relationships with other nodes in different settings. Generally, these types of explanations fall into two categories: *opportunity-based* antecedents and *benefit-based* antecedents. The former considers the likelihood that two actors will connect to each other as a result of factors such as membership in groups and/or likelihood of social interaction facilitated by such agents as the classroom instructor (Festinger, Schacter, & Back, 1950). In contrast, the benefit-based antecedent posits that individuals will form network ties because of the expected benefit the connection brings to that individual (such as availability of resources or presumption that the network tie will positively influence an outcome; McPherson, Smith-Lovin, & Brashears, 2001) and/or similarity between individuals (connecting with those that face similar constraints as you might increase ease of communication and social exchange; Blau, 1977; Borgatti, Mehra, Brass, & Labianca, 2009).

Opportunity-Based Antecedents

Individuals develop relationships for many reasons, including to fill emotional needs (Fowler & Christakis, 2008) and to gain access to resources (Uzzi, 1997). In a university classroom, we are interested in how the setting and teaching methodology (opportunity-based antecedents) influence the likelihood that students will form network connections. Specifically, we are interested in how factors such as the course setting (online vs. in person), the assignment of group activities, the style of teaching (primarily lecture vs. other), the experience of the instructor, and the type of students enrolled in the class (our independent variables) affect the formation of ties among students, including the number of ties they report, the frequency of interaction, the diversity of those connections, and the types of connections (our dependent variables). Finally, we are interested in how these different teaching methodologies affect the students' perception of influence that other students have over their learning, grades, and satisfaction with their program (dependent variables).

SOCIAL INTERACTIONS IN CLASSROOMS

This study examines what impact certain teaching methodologies have on social interactions. Specifically, the independent variables include the following:

1. Teaching methodologies operationalized as classroom setting (online vs. in-person classes, primarily seminar vs. lecture)
2. Type of student (undergraduate vs. graduate)
3. Group assignments (whether or not groups were assigned in class)
4. Experience of instructor (number of times an instructor taught the course)

We use the formation of network ties in university classrooms as our dependent variables. We employed four measures:

1. Number of connections
2. Frequency of interaction with their network
3. Diversity of connections
4. Type of connections between dyads (partners) among university student interactions

We have already discussed the literature related to our independent variables. In the following sections, we provide the theoretical and analytic explanations for each of these dependent variables.

Number of Connections and Frequency of Interactions

A healthy social life is often described as being filled with many relationships; that is, the more the better. People with few connections are often described as “hermits,” “antisocial,” and “loners.” This assumption, that more personal relationships over a lifetime results in greater outcomes such as increased social capital (Putnam, 2001), is the status quo. In fact, greater density of social interactions is believed to be associated with increased network effectiveness by facilitating communication and cooperation (Marsden, 1990).

However, some have challenged this assumption, suggesting that fewer connections to others can increase a person’s structural advantage if redundancy is reduced but connectivity to subgroups remains (Burt, 1995, 2004). Important to this line of thinking is how outcomes are measured: in one argument (the more is better argument), a greater number of ties provides greater social support, greater access to diverse resources, and a variety of experiences (Granovetter, 1973). The other argument suggests considering how reducing the number of connections to engage only in high-quality, nonredundant relationships gives a person a structural advantage (Burt 1995). Recent studies (McPherson, Smith-Lovin, & Brashears, 2006) have found that Americans indicated they had fewer relationships with people they discuss important matters with than they had on average 9 years ago. In the 2004 General Social Survey study, when asked to list the people that they would discuss important matters with, the mean network size of a respondent was 2.08; in 1985, the average was 2.94. The modal respondent in 2004 now reports having no confidants, whereas in 1985 the modal respondent indicated three confidants. Although this finding may be surprising—indicating that people are isolating themselves, becoming “hermits, loners, and more antisocial”—there are alternative explanations. The authors of the study explain that perhaps to stay in touch, people may be using new technologies that allow a network to “spread out across geographic space and might even enhance contacts outside home” (McPherson et. al., 2006, p. 373).

In this research, we explore the relationship between teaching methodologies and the density of networks by using density as the number of ties respondents identified out of all students enrolled in their class. We are also interested in the

frequency of interactions within networks. Since this study involved students from classes of varying size, a network ratio was created: the number of student ties identified divided by the number of ties possible in that class. In the relational questions, students were asked how often they interacted with each network member. These variables are used to develop the first two hypotheses:

- H1:** Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *number* of network connections.
- H2:** Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *frequency* of network connections.

Diversity of Network Ties

In addition to the number of relationships formed between individuals, the diversity of those relationships is said to influence outcomes. While it is natural to be attracted to those with similar characteristics and backgrounds (known in network theory as “homophily”), some authors speculate that diversifying our networks can bring increased benefits (Granovetter, 1973). Homophily is a network theory that explains connections by linking similar characteristics of the network members (McPherson et al., 2001). Hannan and Freeman (1977) refer to this situation as “competitive isomorphism” that arises from similarity of resource niches and environmental demands that often facilitate joint operations (Chung, Singh, & Lee, 2000). In studies on the interaction of students in classroom settings, homophily has been found to affect such outcomes as smoking (those who smoke are connected to others who smoke; Valente, Chou, & Pentz, 2007) and obesity (obese students are connected to other obese students; Bahr, Browning, Wyatt, & Hill, 2009).

Even though the natural tendency is to forge ties with those most like us, research suggests there is value in working with many diverse partners (Granovetter, 1973). Granovetter’s (1973) study introduced the “strength of weak ties” theory, which asserts there are benefits to increasing the number of weak ties in our “networks” and defines *weak ties* as connections to others who are most unlike us. It is common to surround ourselves with strong ties that include people very similar to us—we share beliefs, access to similar resources, and enjoy similar activities. Through weak ties, we begin to diversify our networks and create avenues for accessing a variety of resources that can include tangible items or knowledge. By fostering more weak ties, we can expand the number of partners we work with and thereby reap the benefits of a more diversified network.

In this research, we explore the relationship between teaching methodologies and diversity of network ties by using diversity as a single score based on three variables that identify similarity or difference between dyads. *Dyads* are defined as “a relationship between the respondent and another student.” Dyad

members were compared in terms of gender, perception of academic success, and perception of constraints, and a “similarity” score was developed for each dyad. For example, if student respondents (a) identified a classmate who was a different gender, (b) described the classmate with a different perception of academic success than the perception of their own academic success, and (c) did not agree that the classmate faced similar constraints and challenges as they did to finish their degrees (such as family and work obligations), then that student dyad would have the lowest possible similarity score. This leads us to our next hypothesis:

H3: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *diversity* of network connections.

Type of Network Ties

So far, we have discussed relationships in a university classroom as characterized by the number and diversity of the network ties that a student forms with other students. Also examined in this research is the *type* of network ties that students form. There are many ways to define the type of tie. (For example, we could define it by the level, type of resources exchanged, the quality of that tie in terms of a positive vs. negative exchange, the “multiplexity” of the tie defined by the number of different types of relationships—e.g., friendship vs. kinship vs. working relationships, among others.) In this research, we use the type of tie as the amount of influence that network ties have on a student’s satisfaction with the program, grades, and learning. The literature shows that the level of influence that others have on students can greatly influence outcomes for success.

Student learning can be facilitated or impeded by social interaction. The salience of social networks and their contribution to environmental contextual influence on human behavior have long been recognized in social research (Marsden, 1987). Student outcomes are found to be affected by instructor-related factors, such as teaching methods, mentorship, quality of teacher, and the type and organization of curriculum (Berliner, 1984; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). Social relationships can have positive and negative impacts on student motivation to be successful in academic work (Urdu & Schoenfelder, 2006). Student college achievement is also mediated by interpersonal relationships (Kuh & Love, 2000; Kuh et al., 2006). Student determination, satisfaction, and ultimately what students obtain from college are all influenced by their relationships with faculty, staff, and peers as well as their families and friends (Astin, 1977, 1993; Kuh, Gonyea, & Williams, 2005; Kuh et al., 1991; Pascarella & Terenzini, 2005; Terenzini & Pascarella, 1991a, 1991b; Tinto 1975, 1987, 1993). Involvement by students in classroom settings is also critical to successful learning (Astin, 1984); however, achieving this involvement is not common, and the list of reasons why students do not become involved is extensive (Weaver & Qi, 2005). Collaborative learning groups (Gokhale, 1995;

Kapucu, Yuldashev, Demiroz, & Arslan, 2010; Kuh et al., 2006; Rau & Heyl, 1990) have been successful and are becoming more of a research focus for analyzing student learning and achievement.

In the social exchange framework, influence is the property of a relationship and not a particular actor, because it “resides implicitly in the other’s dependency” (Emerson, 1962, p. 32). In this research, we are interested in how various teaching methodologies affect whether students form relationships with those who positively or negatively influence them. The possibility of influence imbalances, however, may threaten the likelihood of graduate student interaction.

This line of thought leads us to the following hypothesis:

H4: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *type* of network ties.

This research will contribute to a more general understanding of how teaching methodology might enable students to form network ties with other students that will have a positive influence on outcomes such as grades, learning, and overall satisfaction.

Methods

Sample. A survey of students at the School of Public Affairs (SPA) at the University of Colorado Denver was conducted at the end of the spring 2010 semester to obtain information about student characteristics, the interactions among students in these classrooms, and feedback about classmates they identified in their courses. SPA is located at the University of Colorado Denver; 585 students enrolled in spring 2010—418 are graduate students (373 master’s and 45 PhDs), and 167 are undergraduates. The university is a public, coeducational institution located on two campuses in the Denver Metro area; it has a student body of over 15,000. The SPA programs consist of an undergraduate concentration in criminal justice, master’s programs of public administration and criminal justice, and a doctoral degree in public affairs.

Data collection. During the spring 2010 semester, a total of 445 students from 19 classes were invited via e-mail to participate in the survey. These students included graduate and undergraduate students representing all SPA programs. Surveys were administered via students’ school-sponsored e-mails, and three subsequent reminders were sent to those who had not responded. This approach is consistent with the Dillman Survey Methodology (Dillman, Smyth, & Christian, 2009), which outlines the methods for conducting a survey through e-mail. Human subjects’ protection approval was received from the university’s Internal Review Board before administering the survey.

A total of 145 students ($N = 145$) participated, for a response rate of 33%. Fifty-five percent of the respondents were female, which is representative of females in the program (59%). These 145 respondents generated a total of 1,136 dyadic relationships (a dyad, as mentioned earlier, is the relationship between a respondent and another student). These dyads were the focus of this research. We analyzed these 1,136 dyads as our sample population ($N = 1,136$).

Instrument. Respondent characteristics and variables were measured using an 18-question social network survey, designed using PARTNER (Program to Analyze, Record, and Track Networks to Enhance Relationships, www.partnertool.net; Varda, Usanov, Chandra, & Stern, 2008). The survey covered different aspects of student experiences and relationships within their classroom. It contained 11 questions regarding tenure in the program, satisfaction with the program, employment information (job title and percentage of time working), motivation for getting a degree, and the extent to which respondents considered themselves to be academically successful. Additionally, they answered eight questions (explained later) regarding their relationships with other students in their classes. This survey was designed using three methods for question development: validated measures that exist in the PARTNER survey, references to the literature, and revisions made from two pilot tests of the survey in previous SPA classes. Gender and lists of student names were collected from existing course records.

In addition, we asked instructors to answer a set of survey questions to tell us more about how their classes were structured and conducted, and to share their own experiences in using different teaching methodologies. All faculty members completed these surveys, for a 100% response rate. Both surveys are included in an Appendices A and B at the end of this paper.

Social Interactions in Classrooms

Variables related to social interactions in the class, number and frequency of connections, diversity of network ties, and type of network ties were evaluated. Some questions asked students to identify their perception of their own academic success, and other questions asked students to specify their relationships with each classmate they identified as “knowing” within their course. Specifically, students were asked to select others in their course that they had a relationship with and then were asked eight questions about each of the students they selected. Here is one of the relationship questions:

During a typical semester, how frequently do you interact with this person (by “interact,” we mean you exchange greetings (at a minimum), have conversations in class, or hang out with in social environments outside of class, for example)?

Once students selected “others,” they were asked a battery of questions about each dyadic relationship. These questions included the frequency of their interaction and how each student met. Influence was assessed by asking at what level those persons influenced their grades, learning, and overall satisfaction with the program. Additionally, they were asked whether the persons selected faced similar constraints and challenges in completing their degrees. Finally, a question asked whether these students worked in a group together. A 4-point Likert Scale of responses of “Not at all,” “A small amount,” “A fair amount,” and “A great deal” was listed for most of these questions (frequency and how they met had different responses categories). Those without this scale were given a dichotomous choice (e.g., yes or no).

To determine the number of network connections, a ratio score was calculated based on how many students were actually selected by the respondents divided by the total number of students in their class (a “density” score for each respondent: “number of selections/total possible number of selections”). Diversity of connections was determined by creating a score based on (a) the student respondents and their dyad counterpart’s gender, (b) whether the students perceived their own academic success as similar to what they perceived their counterpart’s to be, and (c) to what extent they believe their counterpart experiences similar constraints. These responses were used to create a similarity index score. Finally, the type of network ties was determined by the amount of influence that network ties have on a student’s satisfaction with the program, grades, and learning. A perceived influence index was created by adding the three scores given for the dyad member and used in the analysis.

Setting and Teaching Methodology

Student surveys were organized by class, so all student respondents could be associated with teacher and course characteristics. Faculty members of the participating courses responded to questions regarding class structure, including whether group assignments were given, if the class was taught online or in person, and the number of times they had taught the course. Here is an example question asked of instructors: “Do you assign group projects in your class?” to which instructors selected from the answers yes or no. This information was used to determine the setting and teaching methodology variables. Information provided from each course was coded appropriately, so that the corresponding course and instructor information was assigned to the appropriate student respondent.

Descriptive Results

Course characteristics. Sixteen of the courses were taught in person, and three were taught online. Of the in-person classes, 10 met once a week and 6 met twice. Twelve of the courses were primarily seminars, and 12 of the courses were taught primarily in a lecture format. Eight of the classes included assigned group

projects as part of the course structure. The average number of times faculty members taught the course was 7 ($S = 6.11$); the range was from 1 to 20 times.

Respondent characteristics. The survey respondents represent mainly MPA students; fewer respondents were from the other SPA programs (see Table 1 for percentage of respondents by type). This percentage is reflective of the overall student enrollments for all four SPA programs.

Table 1.
Percentage of Respondents by Student Type (N = 145)

Student Type	Percentage of Respondents
BACJ	10.3
MCJ	6.2
MPA	68.3
PhD	15.2
Total:	100

Note. BACJ = Bachelor of Criminal Justice; MCJ = Masters of Criminal Justice; MPA = Masters of Public Administration; PhD = Doctorate of Philosophy (in Public Affairs).

Of the students who responded to the survey ($N = 145$), the class sizes ranged from 9 to 51 students ($M = 25.26$). A large portion of students worked as paid employees outside of their role as a student. At the time of the survey, most students worked at least part-time (68.1%), and 26.4% worked full-time. Twenty percent of students were in their first semester of the program; 34.7% in their second; 8.3% in their third; and 19.4% in their fourth or fifth.

Students were asked to rate to what extent they consider themselves academically successful. Almost half (49.7%) reported the highest possible rating (a great deal believed they were academically successful). Forty-five percent reported having a fair amount of academic success, and less than 5% of students rated themselves as having a small amount or no academic success. Most students were satisfied with their experience at SPA (37.5%); only 4.2% were not satisfied, 18.8% were somewhat satisfied, 34% were very satisfied, and 5.6% were completely satisfied. Students were asked to choose which aspects of the program contributed to their satisfaction. They were then asked to pick one of their choices as contributing the most to their satisfaction. The most common student response was that their instructors had the greatest influence on their satisfaction (38.7%). That response was followed by other students (20.4%) and variety of course offerings (19.7%). See Table 2 for further details.

Table 2.
Contributors to Student Satisfaction

	Contributed a Great Deal to Satisfaction (%)	Contributed to Satisfaction (%)
Instructors	38.7	68.1
Other Students	20.4	62.1
Variety of Course Offerings	19.7	44.1
School Resources (library, computer, labs)	6.3	44.8
Community Connections	4.2	27.6
Mentorship from Faculty	7	18.6
SPA Staff	3.5	34.5

Students also identified reasons for getting their degree at SPA. Among these options, the most important reason was to get a job (40.8%); 33.1% said they were attending to further their education, 9.2% to learn more about the policy process, 6.3% to get a promotion, 3.5% to learn specific skills, 2.8% to be a more engaged citizen, 2.8% to learn about public or nonprofit management, and 1.4% to make community connections. See Table 3 for further details.

Table 3.
Motivations for Getting Degree

	Most Motivating Factor (%)	Contributed to Motivation (%)
To get a job	40.8	59.3
To get a promotion at work	6.3	19.3
To be a more engaged citizen	2.8	33.8
To learn specific skills	3.5	53.8
To further my education	33.1	84.1
To learn about public and/or nonprofit management	9.2	42.8
To learn about the policy process	2.8	49.7
To meet other students	0	20.7
To make community connections	1.4	39.3

The students who responded reported a total of 1,136 student dyads ($N = 1,136$). Descriptive statistics were calculated to provide an aggregated perspective of these dyads. These included similarity scores for each dyad (how similar the dyads are on a number of variables), frequency of interaction between dyads, and the level of influence between dyads. Table 4 provides descriptive statistics about all these dyad-level dependent variables.

Table 4.
Student Dyad Scores

	<i>N</i>	Min	Max	Mean	<i>SD</i>
Similarity Score	1,093	0.25	3.00	1.61	0.74
How frequently do you interact?	1,135	1*	5	2.98	1.20
How influential is this person in terms of your LEARNING?	1,136	1**	4	2.04	0.96
How influential is this person in terms of your GRADES?	1,133	1	4	1.60	0.92
How influential is this person in terms of your OVERALL SATISFACTION?	1,135	1	4	2.13	1.03
Mentorship from Faculty			7	18.6	
SPA Staff			3.5	34.5	

* 1 is never, 2 is “occasionally exchange greetings,” 3 is “at least one conversation,” 4 is “regularly talk,” 5 is “regularly talk and hang out.”

** 1 is “not at all,” 2 is “a small amount,” 3 is “a fair amount,” and 4 is “a great deal.”

Finally, student characteristics of those who took the online course were compared with those who took in-person classes. Chi-square tests were run for categorical variables and independent samples, and t-tests were used to compare them on interval-level variables. The online classes consisted only of MPA students. Otherwise, no significant differences were found between the two groups in terms of gender, reasons for obtaining their degree, level of employment, semesters in the program, or number of times the instructor had taught the course.

Results of Inferential Analyses

H1: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *number* of network connections.

To address the first hypothesis, the student respondents’ ($N = 145$) network sizes were analyzed using linear regression. The students “out-degree” ratio (network density based on the number of students they selected) scores were regressed onto Online vs. In Person, Group Projects, Number of Times Taught, Primary Lecture vs. Not. The model was significant ($p < .001$), and almost half the variation in network density (46%) was accounted for by dyads being in online classes (fewer connections), the higher number of times the instructor had

taught the course (fewer connections), and if the course was taught primarily in lecture format (fewer connections). The technique of assigning groups in class did not appear to influence network density. See Table 5 for details.

Table 5.
Predictors of Network Density (Out Ratio)

Variable	<i>B</i>	SE (<i>B</i>)	β	<i>T</i>	Sig. (<i>p</i>)
Online	-0.527	0.058	-0.750	-9.03	.000
Assign Group Projects	-0.038	0.043	-0.067	-0.871	.386
Number of Times Taught	-0.009	0.003	-0.191	-2.894	.004
Primarily Lecture	-0.408	0.056	-0.699	-7.300	.000
<i>R</i> ² (Adjusted)	0.461	—	—	—	—
<i>F</i>	31.77	—	—	—	.000

To investigate differences among students, grouped by type (undergraduate, MCJ, MPA, and PhD) in terms of network density ($N = 145$), analysis of variance was used to examine out-degree ratio (number of relationships divided by number of total possible in the class) differences among the four different types of students typically taking the classes. A significant difference ($F = 23.46, p < .001$) was found among the four groups; Undergraduate ($M = .23$), MCJ ($M = .31$), MPA ($M = .32$), PhD ($M = .75$). As seen in the mean scores, undergraduate students had the lowest network density and PhD students had the highest network density.

H2: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the frequency of network connections

Hypothesis 2 relates to the frequency of interaction between dyad members. The student frequency of interaction with dyad member scores ($N = 1,136$) was regressed onto Online vs. In-Person, Group Projects, Number of Times Taught, Primarily Lecture vs. Not. This model was significant, but less than 2% of the variation in the frequency of interaction was predicted. Higher frequency of interaction was related to being in an online class ($p < .001$) and being in a class that was primarily lecture ($p = .049$). The other variables were not significant. See Table 6 for details.

Table 6.
Predictors of Frequency of Interaction with Network Member

Variable	<i>B</i>	SE (<i>B</i>)	β	<i>T</i>	Sig. (<i>p</i>)
Online	0.614	0.130	0.171	4.739	.000
Assign Group Projects	-0.108	0.098	-0.045	-1.103	.270
Number of Times Taught	-0.002	0.006	-0.010	-0.329	.742
Primarily Lecture	0.234	0.119	0.091	1.971	.000
<i>R</i> ² (Adjusted)	0.017	—	—	—	—
<i>F</i>	5.96	—	—	—	.000

Analysis of variance was used to investigate frequency of interaction among dyad members ($N = 1,136$) and the independent variable identifying the four student types. A significant difference ($F = 6.12, p < .001$) was found among the four groups; Undergraduate ($M = 2.86$), MCJ ($M = 2.33$), MPA ($M = 3.02$), PhD ($M = 3.05$). Means scores reveal that PhD students had the highest frequency of interaction and MCJ students had the lowest frequency of interaction.

H3: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *diversity* of network connections.

To address Hypothesis 3, student similarity scores (representing the dependent variable “diversity”) were regressed onto the four independent variables. This model was significant, but only 3% of the variation in similarity was predicted. Being in an online class was associated with higher diversity, and the higher “number of times a course was taught by an instructor” was associated with more diversity. Courses that were primarily lecture and group assignment were not significantly related to diversity. See Table 7 for details.

Table 7.
Predictors of Similarity Score

Variable	<i>B</i>	SE (<i>B</i>)	β	<i>T</i>	Sig. (<i>p</i>)
Online	-0.233	0.080	-0.106	-2.913	.004
Assign Group Projects	0.014	0.061	0.009	0.222	.824
Number of Times Taught	-0.020	0.004	-0.167	-5.408	.000
Primarily Lecture	0.013	0.073	0.008	0.171	.864
<i>R</i> ² (Adjusted)	0.03	—	—	—	—
<i>F</i>	10.5	—	—	—	.000

The independent variables of student type and diversity among student networks were investigated using analysis of variance to better understand differences among groups of students. Significant differences were found among the student group types ($F = 11.18, p < .001$); Undergraduate ($M = 1.98$), MCJ ($M = 1.61$), MPA ($M = 1.54$), PhD ($M = 1.63$). Undergraduates on average were more similar to the classmates they selected, and MPA students were the least similar to the classmates they selected.

H4: Classroom setting, type of student, group assignments, and experience of instructor will be significantly associated with the *type* of network ties.

Hypothesis 4 was addressed by examining the student respondents' dyads ($N = 1,136$) network relationships in regard to Perceived Influence Index (index of influence on satisfaction, learning, and grades, as a proxy for the "type" of tie) using linear regression. Dyads in online classes had higher influence scores ($p < .001$); those who were in classes that contained group projects had lower influence scores ($p = .002$); and those in classes where faculty members used primarily lectures were significantly associated with more influence between dyads ($p < .001$). This model significantly predicted only 4% variation in the amount of influence that dyad members had on student respondents. See Table 8 for results.

Table 8.
Predictors of Scale of Influence

Variable	<i>B</i>	SE (<i>B</i>)	β	<i>T</i>	Sig. (<i>p</i>)
Online	1.624	0.251	0.231	6.474	.000
Assign Group Projects	-0.592	0.192	-0.124	-3.086	.002
Number of Times Taught	-0.004	0.012	-0.011	-0.373	.709
Primarily Lecture	1.247	0.231	0.249	5.395	.000
R^2 (Adjusted)	0.04	—	—	—	—
<i>F</i>	11.81	—	—	—	—

The relationship between the dependent variable, perceived influence, and the independent variable, student type, was examined using Analysis of Variance. Significant differences ($F = 11.22, p < .001$) were found among the four different student types in terms of how much perceived influence dyad members had over students. MPA students ($M = 6.01$) perceived the highest amount of influence from classmates, PhD students perceived the next highest ($M = 5.51$), followed by Undergraduates ($M = 5.40$), and MCJ students ($M = 4.33$) perceived the least amount of influence.

Table 9 is a summary of the findings from this analysis. The dependent variables are listed as the rows (corresponding to the hypotheses), and the

independent variables are listed in the columns. This table provides an overall look at which teaching methodologies and classroom settings were found to significantly increase network connections, frequency of interactions, diversity of relationships, and influence of relationships. In summary, although students in online classes reported fewer numbers of connections, these relationships tend to be more frequent, diverse, and have greater influence between dyads. Similarly, while those in classes that were primarily lecture reported fewer numbers of connections, these were also more frequent and more influential. Group assignments have a negative effect on influence, and experience of instructor was significantly related to fewer numbers of connections and greater diversity.

Table 9.
Directionality of Relationships between Independent and Dependent Variables

	Online Setting	Primarily Lecture	Group Assignments	More Experience of Instructor
No. of Connections (H1)	↓	↓	NS	↓
Frequency (H2)	↑	↑	NS	NS
Diversity (H3)	↑	NS	NS	↑
Influence (H4)	↑	↑	↓	NS

Note. NS = not significant.

DISCUSSION

The purpose of this study was to explore how social interactions, specifically the formation of network ties reported by university students, are influenced by various teaching methodologies. We were interested in how the setting and teaching methodology (opportunity-based antecedents) such as the course setting, the assignment of group activities, the style of teaching, the experience of the instructor, and the type of students enrolled in the class affect the formation of ties among students. Additionally, we explored how these different teaching methodologies affect the students' perception of combined influence over their learning, grades, and satisfaction with their program. The four hypotheses were tested, and some significant relationships were found. While the connection between teaching style and student interaction is well established in the field of teaching research, this paper makes some unique contributions specifically in regard to the connectivity among students in terms of social interactions in online versus face-to-face classrooms. These findings may provide new insight into the ways in which classroom setting is a factor for how classrooms are managed and how students are taught, and assessed. They can also inform

opportunities for leveraging new advances in technology to improve student social interaction.

Network connections were related to teaching methodology (e.g., classroom and instructor variables). Almost half of the variance in student network size (network density) was predicted by whether students were in online or in-person classes, the experience of the instructor, and whether courses were taught using primarily lecture. Three findings stood out as interesting. First, students in online classes had lower network density, which is not surprising given the constraints of developing relationships in an online environment, particularly in larger classes. Second, more experienced faculty members were associated with lower student network density. This leads us to question whether students tend to make more ties in classes with less experienced faculty to make up for this “experience gap.” Lastly, students who attended classes that were not primarily lecture had larger networks. If students have more opportunity for interactions (instructors command less of the attention), do larger student networks develop? These results have implications for how certain characteristics of classroom settings and instructors may negatively influence student outcomes. In this case, online classes, instructors with longer tenures, and lecture-only classes can potentially lead to smaller networks and, in turn, to less interaction among students.

Although students in online classes had lower network density (fewer connections), they reported higher frequency of interactions between respondents and their dyad members. This finding makes sense when considering less in-class demand on their time and a greater need to interact one-on-one with their networks. Particularly if student networks are smaller, it is logical that their frequency of interactions could be higher (more time to spend with classmates if there are only a few). This point leads us to believe that claims about online courses leading to less interaction among students, often cited as a negative aspect of online course environments, are likely more assumption than certainty. We do not know whether these more frequent interactions are the result of more online class requirements to participate in discussion boards and chat sessions. However, in this research we find that online environments led to a higher frequency of interactions among student networks, suggesting that there may be something qualitatively important about not just the number of students who interact, but the quality of those interactions. Future research should address this finding by exploring how online relationships qualitatively differ from relationships developed in in-classroom settings.

Based on these results, it appears that teaching methodology had a significant but minimally predictive (3% of the variation) relationship with diversity of student network connections. Those aspects that had significant relationships with diversity were online versus in-person classes and the number of times lecturers had taught the courses. Student dyad relationships among students in

online classes resulted in students choosing people less similar to them. Although causal links cannot be confirmed in our findings, it does raise the question about whether face-to-face interactions induce a tendency in students to choose people more like themselves for their networks. We expect that when students can visually assess their classmates, they may tend to pick classmates they think are most like them (which corresponds to the homophily argument that “birds of a feather flock together”). When the option for visually assessing a teammate is removed, there appears to be less homophily among students (yet another argument that online classes result in negative interactions—when in fact, in this research we see that diversity is improved among online interactions). Another interesting finding is that the more times an instructor taught the course, the higher the diversity. Does the instructor’s experience have some influence on students’ openness to associating with diverse classmates?

In examining the influence of one dyad member on another, although little predictive value (4% of the variation) existed for our independent variables, it was interesting to find that perceived influence was significantly higher, leading us to conclude that interactions with other students tend to be perceived as more influential in the online class dynamic. Another interesting finding is that dyads in classes that did not have assigned groups found their dyad members to have a higher amount of influence on their experiences. Could this mean that natural network connections (those made out of student choice to interact vs. mandated to work with others) made in the classroom are more influential? Lastly, dyad connections found in classes with primarily lectures appeared to have higher influence. This finding may indicate that more frequent interactions are not related to influence. Finally, requiring group assignments in classrooms was associated only with influence between dyads.

For all dependent variables, significant differences were found among the different student types. PhD students had considerably higher network density and frequency of interaction; undergraduate students had the lowest in both cases. This finding makes sense, because PhD and graduate-level student cohorts tend to have more classes together. Undergraduate students overwhelmingly chose networks more similar to themselves, while MPA students chose those least similar. Finally, when we examined perceived influence on the combined learning, grades, and overall satisfaction index, MPA students found their classmates to be more influential than did the other three student types. Undergraduate and PhD students had similar perceptions when it came to dyad influence, while MCJ students found dyad members to have the least influence on them than of all four groups. It is interesting that differences were found among groups in regard to perceived influence. This finding led us to question if there a relationship between the cultures of each of program that pertains to peer influence in classes. Or perhaps maturity plays a role in this outcome?

Limitations

This study has several limitations. The sample was taken from one school, and although the sampling frame included all courses offered during one semester, its cross-sectional nature introduces sampling bias for one semester in which only a certain number of faculty members were teaching a certain number of courses. It is also important to know that the network and student data could be considered nested, and thus there is a possibility of violations to the assumption of independence. This means that there is a chance that error estimates could have been over- or underestimated. Next, we are not able to account for the fact that students self-select into either online or in-classroom courses (some courses are offered in only one format, but not all). Students' relationships may differ based on their preference for online versus in-class formats. This is an area in need of future research. Finally, this survey was conducted online only for students and therefore could have introduced a bias toward students who are more familiar with online survey methods and are more willing to respond than those who have a lower comfort level with online surveys.

CONCLUSION

This study highlights the importance of teaching methodology on how students create network ties, an important factor in student outcomes. By examining how techniques and class structure may influence student networks, we acknowledge the salience of student relationships to learning outcomes. The approach is novel, and the results yielded interesting findings, although some of the relationships discovered in this study need to be examined further before being confirmed. The rise of online courses and access to social media have presented new opportunities for lecturers, but their effect on social interaction must be considered to assess the qualitative differences in relationships created in this online environment. Although it may be true that a face-to-face environment is the best way to create synergy, intellectual creativity, and increased knowledge exchange, alternative choices such as group activity and online discussion groups have opened the door to new kinds of social interaction (Umphrey, Wickersham, & Sherblom, 2008). However, as social media become more familiar to students, we may expect to see the difference between students' network ties in online versus face-to-face classes fade over time. For one thing, students in face-to-face classes likely augment their face-to-face interactions with interaction using social media. For another, they are likely skillful with and willing to use social media, though whether that will still be different in the two types of classes (and lecture method vs. other teaching methods) will be interesting to observe in the long run. Time-series analyses may be one technique to assess these differences. We would hypothesize that students will continue to seek out learning environments that incorporate varying levels of social media, whether enrolling in online or face-to-face classes.

The most interesting conclusion may be how student interactions relate to the classroom setting. Specifically, online classes tend to have students with

fewer but more frequent interactions, more diversity among interactions, and more likelihood that students perceive other students as influential. These conclusions invite a follow-up discussion on ways in which online courses can be qualitatively different from in-person courses. By gathering data on person-to-person ties and exploring the explicit interactions, perceptions, and opinions about these relationships, we have found some interesting results. Some instinctively assume that online classes will result in fewer relationships and relationships characterized by decreased quality (Picciano, 2002), but we found something different. Some research says that diversity can increase social learning in a classroom—a quality that was more frequent in our data in the online setting. This quality could be an important benefit of teaching online, or of incorporating forms of social media in all classroom settings. Further, interactions among students in the online setting appear to include characteristics of strong (e.g., measured by more frequent interactions) and meaningful (e.g., measured as a stronger influence on each other in terms of learning, grades, and satisfaction) relationships.

The most surprising findings from this research were the particular strengths we found in teaching in an online environment. We also found less strength in terms of positive relational outcomes for students working in groups, surprising results in terms of the relationship between tenure of the lecturer and positive relational outcomes, and some expected findings based on student type. We conclude that teaching methodology does appear to have some effect on how students interact in a classroom. However, no one teaching methodology appears to be the best way. Rather, a combination of teaching methodologies that integrate new advances in social media, including online discussion setting (e.g., Blackboard, eCollege, and even more commercial forums like Facebook and Ning) both in face-to-face and online classrooms, may be most beneficial to improve student interactions. Future strategies for professors and lecturers aiming to improve student interactions in their classrooms may include a combination of face-to-face meetings with online tools, as a method to stimulate the diverse type of learners that come through today's classrooms. As schools of public affairs increase their online course offerings, appealing to new generations of learners and a broader (sometimes geographically) student body, it will be essential for professors and lecturers to become familiar with these social media tools for teaching. We presume that students will begin to look for alternatives that fit their learning styles; choices could include hybrid or even fully online coursework. This research indicates potential benefits of this type of inclusion of social media tools, in some cases (e.g., diversity and positive peer influence), for students.

Future work on this topic might include testing some of these findings with new hypotheses and a larger sample size in a time-series design. A study of this sort might complement this work and continue to provide new insight into the impact of teaching methodology on student social relations and, ultimately, on student outcomes.

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APPENDIX A
Student Survey Questionnaire

1	No	Please select your name from the list.																	
2	No	Please describe what percent time you work at a job outside of school and what kind of position you hold (for example, 50% time working as a supervisor at the EPA or 100% time working as a mom). Or if you don't have an outside job, list "full-time student."																	
3	Yes	How many semesters (including this semester) have you taken courses in a SPA program (in semesters—for example, "3" meaning 3 total semesters)?																	
4	No	What aspects of your SPA program are you particularly satisfied with (pick as many as apply)?	Instructors (faculty, adjuncts, lecturers)	Variety of course offerings	Community connections	School resources (library, computer labs)	Mentorship from faculty	SPA staff	Other students	I'm not satisfied with any aspect of the program									
5	No	Of the aspects of the program you selected, which describes the most influential in terms of your satisfaction with the program?	Instructors (faculty, adjuncts, lecturers)	Variety of course offerings	Community connections	School Resources (library, computer labs)	Mentorship from faculty	SPA staff	Other students	I'm not satisfied with any aspect of the program									
6	Yes	Please indicate your motivation for getting your degree at SPA (choose as many as apply).	To get a job	To get a promotion at work	To be a more engaged citizen	To serve the public's interest	To learn specific skills	To further my education	To learn about public/nonpublic management	To learn about the policy process	To meet other students	To make community connections							
7	No	Of the responses you chose, which is the most important reason you are getting a degree at SPA?	To get a job	To get a promotion at work	To be a more engaged citizen	To serve the public's interest	To learn specific skills	To further my education	To learn about public/nonpublic management	To learn about the policy process	To meet other students	To make community connections							

APPENDIX A

Student Survey Questionnaire (continued)

8	No	How satisfied are you with your SPA program so far?	Not satisfied	Somewhat satisfied	Satisfied	Very satisfied	Completely satisfied
9	Yes	To what extent do you consider yourself academically successful?	Not at all/Not sure	A small amount	A fair amount	A great deal	
10	No	Please select from this list those people in your class that you know by name.					
18	Yes	When did you meet this person?	I knew this person outside of SPA	I met this person at SPA outside of a class	I met this person at SPA in a class		
12	Yes	During a typical semester, how frequently do you interact with this person (by "interact," we mean you exchange greetings (at a minimum), have conversations in class, or hang out with in social environments outside of class, for example)?	We have never talked	We occasionally exchange greetings	We have had at least one conversation	We regularly talk	We regularly talk and we even hang out together outside of class
13	No	How influential is this person in terms of your LEARNING? *Learning: The person has made a difference in how well you understood a topic.	Not at all/Not sure	A small amount	A fair amount	A great deal	
14	No	How influential is this person in terms of your GRADES? *Grades: The person has made a difference in the grade you received in a class (regardless of whether it was a good or bad influence).	Not at all/Not sure	A small amount	A fair amount	A great deal	
15	No	How influential is this person in terms of your OVERALL SATISFACTION WITH YOUR SPA EXPERIENCE? *Overall SPA Experience: The person has made a difference in how satisfied you are with your experience, in general.	Not at all/Not sure	A small amount	A fair amount	A great deal	
16	No	To what extent do you consider this person ACADEMICALLY SUCCESSFUL?	Not at all/Not sure	A small amount	A fair amount	A great deal	
17	No	To what extent does this person FACE SIMILAR CONSTRAINTS AND CHALLENGES? *Similar Constraints and Challenges may include family obligations, job obligations, etc.	Not at all/Not sure	A small amount	A fair amount	A great deal	
11	No	Have you worked in a group with this person?	Yes	No			

APPENDIX B

Instructor Questionnaire

INSTRUCTOR _____ COURSE _____ DATE _____

1. Is this class online or in person? ONLINE IN PERSON
2. Do you assign group projects in your class? YES NO
If yes, please answer the following:
 - a. How many groups have you assigned to your students this semester? _____
 - b. Do you let students pick their group members? YES NO
Please explain.
 - c. Do the group members change each time you put them in groups, or are they always in the group with the same group members? YES NO
Please explain.
 - d. Do you assign grades based on group assignments? YES NO
Please explain.
3. Is your class a core class or elective? CORE ELECTIVE
4. Is your class mainly attended by undergraduate, MPA, or PHD students?
UNDERGRADUATE MPA PHD
5. Is your class mainly a seminar or lecture class? SEMINAR LECTURE
Please explain.
6. How many times have you taught this course? _____
7. Do you encourage class discussions in your class? YES NO
Please explain.
8. How many times a week do you meet? 1 2 3 4 5 ONLINE
9. How long is each class? _____ HOUR(S) ONLINE
10. Are your students part of a cohort? If yes, which cohort?
AMPA PHD OTHER: _____