Social Media Connections and Active Learning in a Large-Enrollment Evolutionary Biology Class

Nora Lazerus
Nora.Lazerus@Colorado.EDU
Social Media Connections and Active Learning in a Large-Enrollment Evolutionary Biology Class

By
Nora Lazerus
Ecology and Evolutionary Biology (EBIO), University of Colorado Boulder

Defense Date: April 5, 2019

Thesis Advisor:
Dr. Andrew Martin, Ecology and Evolutionary Biology

Defense Committee:
Dr. Andrew Martin, EBIO
Dr. Barbara Demmig-Adams, EBIO & Honors Council Representative
Dr. Beth Osnes, Theater and Dance & Environmental Studies
ABSTRACT

While lecture-style classrooms do not adequately prepare students for the realities of careers in the sciences, classroom structured for active learning help students establish critical thinking skills and analytical abilities, problem solving skills, and the capacity to successfully collaborate in a group. Active learning (as the opposite of passive, lecture-style learning) better prepares and educates students for the demands of real-world science. A better understanding of the relationship between students’ social media connectedness, their grades, and with whom and how they are associating in class may improve the implementation of active learning and student comprehension. While the relationship between education and social media remains poorly studied, a potential for positive and negative aspects of social media in educational settings has been suggested. Social media have been suggested to aid in student engagement, learning, communication and participation as well as extend and/or enrich the online classroom. Data were collected using an online survey distributed by the professor via Qualtrics. Many students were found to have been connected socially before the start of the class. In addition, 21% of students sampled became connected on social media as a result of this class. No relationship was found between either how connected students were to the person they sat next to in class and or students’ final exam scores. Some students who started as strangers ended up connecting to the person they sat next to at a level equal to that of students who knew each other before the start of the class. Since social media, by nature, offer additional channels for communication among students, increased social media connectedness is likely to influence classroom dynamics. Further research should address social media connectedness within active-learning classrooms and its influence on classroom dynamics since this study has is showing that students are, in fact, connecting. Further research could also investigate the impact of instruction style on social
media connections by comparing lecture-style with active-learning classrooms.

**INTRODUCTION**

A more thorough understanding of teaching science is pivotal to ensure a highly qualified and prepared workforce, with the technical and critical-thinking skills expected of graduates in the sciences (Handelsman et al. 2007). Traditional lecture-style courses do not adequately prepare students to think critically and collaborate in group dynamics, or prepare scientists to do science (Handelsman et al. 2007). Lecture-style classes rely on memorization of facts rather than practicing problem-solving skills, and do not place emphasis on regular student self-assessment of learning advances, which has been found to improve student learning (Handelsman et al. 2007). Furthermore, a principal goal of higher education institutions is to engage students and stimulate a lasting educational experience (Handelsman et al. 2007). This engagement has shown to improve student learning (Chi 2014). Lecture-style classes often do not engage students in their learning in a way that aligns with this broad goal of student engagement (Smith & Cardaciotto 2011). Lecture based classrooms have not only been shown to stimulate students less (Smith & Cardaciotto 2011), but also increase their likelihood to fail (Freeman et al. 2014).

Students currently enrolled in universities and future college attendees are different from students from students of past generations. Current students are more technologically inclined, connected to each other, and are referred to as the “digital native” or millennial student (Prensky 2001). Digital native students are purportedly better adapted for learning from graphics rather than text, have an increased literacy for visuals and propensity for multitasking and technology as well as a lower tolerance for lecture-style classes (Rohel et al. 2013). However, there is debate not only of the concept of a digital native student who benefits strongly from technology and is
particularly good at multitasking, but also whether this idea should be considered in classroom design (Kirschner & De Bruyckere 2017, Brumberger 2011). It is, however, clear that technology use has increased both on a personal and global level. Whether or not current and future students have altered mental processing and multitasking abilities as a result of growing up surrounded by technology in a digital age, there is no doubt that university students are using technology that is connecting them in ways that were not possible years ago.

Research into the idea of designing classrooms to better utilize technology and prepare students for real-world science has caused shifts from emphasizing traditional lecture-style classes to active-learning classrooms with increased use of technology (Gikas & Grant 2013, Handelsman et al. 2007). While there is no hard-and-fast definition of active learning, it can be broadly defined as the opposite of passive, lecture-style learning. Active learning as a classroom structure relies on student interaction in group-learning settings and mandates group work, student-centered learning involving review of lecture material and readings outside of the classroom, and a large amount of critical thinking. Critical thinking can be defined as any thinking that is skillful, involves and requires interpretation and analysis of observations, and uses figures and other information to draw conclusions, make assumptions and formulate questions (Fisher 2011). Critical thinking, and by extension, active learning is not about finding the correct answer but rather about engagement and processing.

Active learning as a classroom structure has been shown to improve student performance on exams, particularly in courses in Science Technology Engineering and Mathematics (STEM) courses (Freeman et al. 2014). Student-centered, rather than teacher-centered classrooms, not only benefit STEM students but can improve any class in which lecturing is the most used method of instruction (Rohel et al. 2013). Furthermore, flipped classrooms, or any classroom
style in which the focus is not on listening to a teacher for the entire time, can be more accessible to a wider range of students than traditional lecture-style learning (Bergmann & Sams 2012). Such increased accessibility is due to variation in types and styles of assignments and potential multimedia possibilities (Bergmann & Sams 2012). Going along with accessibility, active learning classrooms have been found to reduce the achievement gap in introductory level biology classrooms (Haak et al. 2011). Active learning allows for contact hours to be spent on deeper understanding, skill development, and problem solving (Bergmann & Sams 2012), while homework assignments outside of class generally consist of review of materials before and/or after class.

There is little debate in the academic pedagogical community that active learning benefits students, especially in STEM classrooms (Bergman & Sams 2012, Freeman et al. 2014, Haak et al. 2011, Handelsman et al 2007, Lee & McLoughlin 2007, Roehl et al. 2013). Since active-learning classrooms aim to alter and improve the educational environment, the factors that influence active learning classrooms must be understood. Active-learning classrooms require an emphasis on relationships, student accountability, and connections among students (Crouch & Mazur 2001). Group work and collaboration are a dominant form of assignments given in active learning curricula, and was also the case for the classroom in which my study was conducted.

Previous studies have investigated the nature and characteristics of student relationships in active-learning classrooms and factors that impact these relationships. Buchenroth-Martin et al. (2017) investigated the effects of sex, GPA, attendance, and other factors, on community network relationships within an active-learning classroom and described how students are likely to interact in an active-learning classroom. These authors found that the student community in an active-learning classroom is complex, and that some students (termed settlers) prefer to sit in the
same place and work with the same people every day, while other students (termed wanderers) prefer to switch groups and partners regularly. Students who moved between groups more regularly connected with all of the students in the classroom and contributed to forming a larger, more connected student network. My study addresses factors that may influence how students are connected and how social media impact student relationships.

Since many people are connected on social media, it is considered important to better understand the relationship between social media and educational opportunities (Rodriguez 2011). Furthermore, although there is agreement in the literature that active learning is beneficial, a few studies indicate that active learning that is not properly implemented does not substantially improve student learning (Andrews et al. 2011). The latter study acknowledges the potential for large educational gains from implementation of active learning, but posits that active learning implemented by a typical biology professor without a deeper understanding of active-learning classrooms will not necessarily improve learning. Active-learning environments that greatly improve student learning are typically implemented by biology professors who have expertise in both scientific education research as well as biological research (Andrews et al. 2011). A nuanced understanding of active-learning environments and their implementation is important to be able to produce and assess potential gains. A better understanding of the relationship between students’ social media connectedness, their grades, and with whom and how they are associating with in class should improve the understanding and implementation of active learning.

The term social media encompasses a large number of websites and applications related to collaboration and community (Tess 2013). My study uses this definition of social media and specifies sites such as Facebook, Instagram, Snapchat, Twitter, etc. While the relationship
between education and social media remains poorly studied (Friesen & Lowe 2012), a potential for both positive and negative impacts of social media in educational settings have been suggested (Friesen & Lowe 2012). Social media have been suggested to aid in student engagement, learning, communication and participation as well as extend and/or enrich the online classroom (Rodriguez 2011). University students have indicated that utilizing social media in an academic environment provides learners with a multitude of outlets to discuss and understand course content (Gikas & Grant 2013). Since each student learns differently, social media may aid in educating a more diverse group of students, effectively adding variation to learning ventures. Additionally, since social media are a constant factor in students’ lives, students may be able to engage more consistently with course content (Gikas & Grant 2013).

Social media are also thought to foster learner-centered educational environments (Lee & McLoughlin 2007, Greenhow 2011) since social media allows for open communication, collaboration, and interactions. Students are able to engage more thoroughly and thoughtfully when connected over social media since they can discuss ideas, progress, and other aspects of the material outside of class in an authentic way. This pedagogical relationship is one that active learning classrooms aim to establish as well. In my study, personal contact information, such as phone number and email address, beyond social media are considered connecting factors similar to social media.

**Study Questions**

My study addresses three questions:

1) How often do students within an active learning classroom connect to their peers through social media as a consequence of interactions during class?

2) How does social media connectedness of students in a class change over time?
3) Is there an association between student connectedness through social media and performance in class?

METHODS:

Class structure

This study took place on campus at the University of Colorado, Boulder in a relatively large enrollment (n=123) evolutionary biology classroom. Most of the students enrolled in the course were Ecology and Evolutionary Biology (EBIO) majors since the class is a requirement for the completion of the EBIO major or minor. Most of the students were at least in their second year and the majority of students in the class were in their third or fourth year.

An important aspect of successful active learning classrooms is the physical layout and structure of the classroom. A number of round tables with multiple screens have been shown to best utilize space to maximize educational impact in the context of an active learning setting (Park & Choi 2014). The classroom in which this study took place fits the above description well. 12 tables with an average of 10 chairs around each table faced six screens which were positioned on the two long sides of the room (see Images 1 & 2). My study took place in the same classroom as that of the study conducted by Buchenroth-Martin et al. (2017).

Students were free to sit at whichever table they wanted every day. No assigned roles were given for any group activity or project. Visuals, graphics, videos and questions prompting engagement were projected onto the screens, and guidance was given by the professor and undergraduate learning assistants (LAs) as to how to work through and solve assigned problems (Buchenroth-Martin et al. 2017). LAs had received pedagogical training on how to best prompt student discussion and were encouraged to engage with students without revealing what could be
considered correct answers. While in active-learning classrooms questions are often asked, there are no absolute correct answers to these questions. Guiding questions are written such as to stimulate discussion, collaboration and a deeper understanding of course material and science processing skills.

Assignments given as homework included mostly readings, followed by quizzes on the readings or instructions to illustrate methodology of scientific studies or evolutionary phenomena. Homework assigned outside of the classroom was intended to prepare students for discussion and activities within the classroom. A majority of the classwork assigned in class was to be completed in small groups of three to four people. An example of an in-class assignment might be annotating a graph, discussing hypotheses, going over illustrations assigned as homework, or coming up with evidence-based claims constructed from data or graphics given.

This class required enrollment in an ancillary laboratory section composed of students from both lecture sections. There were six laboratory sections with about 20 people in each. Lab sections were taught by two graduate-level students. All lab sections used the same instructional material.

**Data Collection**

Data on social media relationships were self-reported on a volunteer basis. A survey (see questions below) created on Qualtrics (a private web-based site used for surveys) was posted on the online announcement board for the two sections of the class on Canvas by the professor. Canvas is a web-based learning management application utilized by all students and staff at the university. Additionally, an announcement was made in class for both sections and time was given in class to fill out the survey. It was stated that survey results would be anonymous to the
instructor and that participation was voluntary. The online survey was open for approximately two weeks near the end of the fall semester from 10-26 November. At this time in the semester, student groups had likely been well established, making this an appropriate time in the semester for a survey about connections.

Survey Questions

Q1: The following survey is intended to quantify your social media relationships to better understand networks developed in class. Your participation is completely voluntary. If you do complete the survey, you will be asked questions about your social media use and connections to people. All of the personal information will be kept anonymous and will not be available to the professor.

Q2: What is your name?
   write in: ________

Q3: Which section are you in?
   1:00-1:50
   2:00-2:50

Q4: Choose your section in lab/recitation
   Tues 10-12
Tues 12-2
Wed 10-12
Wed 12-2
Thurs 9:30-11:30
Thurs 11:30-1:30

Q5: Who do you sit by?
   - Someone I knew before this class
   - Someone I met in this lecture
   - Someone I met in lab
   - A different person each day

Q6: Do you have the email address of the person you sit by?
   - Yes
   - No

Q7: Do you have the phone number of the person you sit by?
   - Yes
   - No

Q8: If you have his or her phone number, did you have it before the start of this class?
   - Yes
   - No

Q9: Do you follow the person you sit next to on any social media? (Facebook, Instagram, Snapchat, etc.)
   - Yes
   - No

Q10: If yes to Q9, which platform do you follow them on? Select all that apply.
    - Facebook
    - Instagram
    - Snapchat
    - Twitter
    - Other

Q11: If you choose other, please specify which social media platform(s) you use? If there is more than one, please separate each one with a comma.

Q12: Did you follow them on social media before the start of this class?
   - Yes
   - No

Q13: Do you sit at the same table every day?
   - Never
   - Sometimes
   - Always

Data analysis
Gains in student connectedness were estimated from the survey data by comparing the number of students connected by phone and social media before class and at the time of the survey (near the end of class).

Final-exam grades were entered into a csv data file by the instructor, at which point names were deleted to make student data anonymous to the researcher. Student privacy and anonymity was ensured throughout the entirety of the study. The other data as collected from the survey were also entered into this csv file and analyzed in the R studio program. R studio was used to run analysis of variance tests, models, and create visualizations of the data.

**Sum connectedness index**

In this study, an index termed sum connectedness was used score how connected on social media a student respondent was to the person the student sat next to in class. This index was calculated by assigning a value between zero and three based on the answers to questions six, seven, and nine from the survey.

A sum connectedness score of zero indicated that a student did not have the email address or phone number of the person the student sat next to and did not follow that neighbor in class on social media. A sum connectedness score of one indicates that a student was connected to the person the student sat next to in class in one of the ways mentioned above. A two indicated that a student was connected to the person the student sat next to in two ways, and a three indicated that a student was connected to the person the student sat next to in all three ways.

**RESULTS**
Of the total student enrollment in the class of 123, 57 responses were received, which is a response rate of 46%. Out of these 57 students, a majority (33 out of 57 total student responses) of students sat by someone they first met in lecture. Other students sat by someone they knew before the start of this class (17 out of 57 responses). A few students sat by someone they met in the required ancillary lab section (6 out of 57 responses), and one student reported that sitting by a different person each day. Figure 1 visualizes these data.

Next to whom a student sat in class, as self-reported on question five of the survey, significantly influenced how connected (s)he was as per the sum connectedness score ($F_{3,53}, P < 0.001$). Knowing the person sitting next to you in class before lecture resulted in a sum connectedness score that was 1.5 times higher than sitting next to a person whom you had only met in lecture or lab.

![Who Do You Sit By in Class?](image)

**Figure 1: Bar plot visualizing the results to question five (Q5) which asks who do you sit by in class?** Detail of student responses are as follows: A different person each day: 1, Someone I knew before this class: 17, Someone I met in lab: 6, Someone I met in lecture: 33. Total student response of 57.

Table 1 shows the counts of pre and post class connectivity. Of the 57 students surveyed, 16 were not connected to a peer in the class and were not connected after the class. Overall, 30
out of 57 did not change their connectivity. However, the connectivity for 25 students increased and decreased for two students. This data is visualized in Figure 2, which shows the number of students and their change in connectivity. The majority of students had no change in connectivity, but many students did have some change in connectivity.

<table>
<thead>
<tr>
<th>Post-class connectivity</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-class connectivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Counts of individuals based on their pre- and post-class connectivity.

A summary of which social media platforms students were connected on can be found in Table 2. This table serves as a good descriptor of the data even though no analysis was
conducted with this data. Twelve of the 57 total student respondents were connected on social media as a result of this class. This value was determined by using the sum function in R studio to find the difference between students who answered yes to question nine (whether or not you follow the person you sit next to on social media) and students who answered yes to question twelve (whether or not you followed them on social media before the start of the class).

The change in percent connectivity for students who were not connected before the class and students who were connected as a result of the class is 21%. More simply, 21% of the students who were sampled were connected as a result of this class. In addition to this 21%, many students were connected prior to this class.

<table>
<thead>
<tr>
<th>Social Media Platform</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>13</td>
</tr>
<tr>
<td>Instagram</td>
<td>18</td>
</tr>
<tr>
<td>Snapchat</td>
<td>14</td>
</tr>
<tr>
<td>Twitter</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Table summarizing the results to question number 10 on the survey. Details on which social media platform students follow the person they sit next to.

There was no relationship found between a student’s sum connectedness score and his or her final exam score. This was evidenced by using a liner model analysis ($DF = 54$, $P = 0.53$). This relationship is illustrated in Figure 3.

Change in sum connectedness in relationship to final score was also analyzed using the sum connectedness score (the accumulation of questions six, seven and nine) with questions eight and twelve. The change in sum connectedness score is on a scale of negative one to two. Change in connectedness score included a data point of negative one because of a reporting error.
rather than a student losing connections in this class. Change in connectedness score only goes to
two rather than three because of difficulties determining whether or not a student had the email
address of the student (s)he sat next to in class before the start of class. This difficulty arose
because class email rosters and the connected university email system complicated this
determination.

It was determined that there is no relationship between change in connectedness and final
exam score. This is evidenced with a linear model analysis (\(DF = 54, P = 0.67\)) and is visualized
in Figure 4. The change in connectivity for each student is visualized in Figure 2. The negative
values in Figure 2 are likely as a result of survey response error rather than students losing
connections within this class.

![Final Exam and Sum Connectedness](image)

*Figure 3: Final exam scores of students compared to student connectedness score. The change in connectivity is shown for each student.*
DISCUSSION

It had been predicted that higher sum connectedness scores would positively correlate with higher exam scores, but such an effect was not found. It was also predicted that students who sat next to a different person each day would have noticeably lower sum connectedness scores, but since there was only one student response who stated that (s)he sat next to a different person each day, no claim could be made on this matter.

It is possible that attaching a graded component to the volunteer self-reported survey might increase student participation. However, this is unlikely since Buchenroth-Martin et al. (2017) reported ~50% participation on similar self-reported surveys in the past. That said, it has been determined that acceptable response rates on surveys in the academic community range from 36% (+/-13) to 60% (+/-20) so the response rate of 46% achieved in this study is valid for the conclusions made in this study (Baruch 1999).

Although many students were connected before taking this class, students who did not know each other before this class and met either in lab or in lecture had sum connectedness
scores as high as those of students who had known each other before this class. These results indicate that students are forming social connections within this classroom that are comparable to those formed outside of class. Students who first meeting in the classroom were connecting socially on a level similar to that of students who had met previously outside the classroom. Future studies could build on my study to further test that social media connectedness is a factor in active-learning classrooms.

It has been shown that student-student interactions and peer relationships affect the classroom dynamic, particularly in a classroom that utilizes technology such as this one (Sher 2009). Since there were significant links between student social media connectedness and who a student sat by in class, future studies should investigate this relationship further to test if strong student social media connections formed in an active -earning classroom help create an improved educational environment and contribute to a sense of student belonging. This sense of student belonging and engagement is an important factor for the rates of student completion of degree program (O'Keeffe 2013). Furthermore, the fact that students are meeting as strangers in a classroom setting and then reaching levels of social media connectivity on par with those of students who had previously known each other is noteworthy because of the potential for enhanced group dynamics, increased numbers of safe spaces for students, more peer accountability for attendance and ownership of a student’s education and possibly as a result, increased student happiness and overall student belonging which is important for engagement by STEM students (Wilson et al. 2015).

Lab sections offer an opportunity for students to meet peers who are potentially different from the students they might sit by or work with in class. Additionally, lab sections offer an environment similar to that of an active-learning classroom since there are assignments that
involve critical thinking and small group collaboration and communication. Future research might investigate similarities and differences between active-learning classrooms and laboratory classes to assess how these two classroom types influence and affect each other. It is predicted that laboratory sections will not offer the same exact benefits of active-learning classrooms since labs are taught by graduate students typically not trained in active-learning-based instruction (Andrews et al. 2011). However, some students were sitting in lecture next to a person (s)he met in lab, which indicates these factors are interacting.

The finding that there was no relationship between final exam score and either of the sum connectedness indices begs the question of whether or not the final exam was able to accurately act as a proxy for student learning in the classroom. Almost all of the classwork assigned as well as larger projects required and recommended group collaboration. The final was the only assignment where group collaboration was not permitted. It was explicitly stated that the final examination would require personal preparation and would be built around data sets, visuals, and graphics that had already been reviewed in class or as homework. The final was structured to test critical-thinking skills and science process skills such as making observations, formulating hypotheses and interpreting data (Padilla 1990) on an individual level that should have been refined throughout the activities and assignments of the semester. For these reasons, the final exam had been assumed to be an appropriate test to address the study questions.

The scope of my study was limited by the fact that there was no control in the form of a traditional lecture-style classroom. Since there was no comparison between an active-learning classroom and a traditional lecture-style classroom of the same enrollment size, classroom structure, subject material and general student demographic, it cannot be excluded that the additional student connections were formed due to the instructional style of the class. Since all of
evolutionary biology classes at the University of Colorado Boulder are taught in an active-learning style, such a comparison was not possible for this study.

Further research should investigate student social media connections by taking two classes of similar characteristics, one of which uses lecture style and the other active-learning style to assess if increased student connectedness is a result of active learning that, in turn, leads to enhanced social media connections due greater collaboration and comradeship demanded by active-learning assignments. The documentation of classroom dynamics and the student survey developed for my study could be used for such a follow-up study.

There are many avenues for future research that would enhance our understanding of the relationship between social media, student online social connectivity, and active learning classrooms. One could compare the social media connections of students coming into the classroom not only with that of students leaving the classroom, but also at various points throughout the semester.

CONCLUSION
Social media connections are being made within a relatively large-enrollment active learning evolutionary biology classroom. These connections between students who met in class or in the ancillary lecture are of similar nature to those being formed organically outside the classroom. Social media by nature offers alternative channels of online communication between students both outside and within the classroom. Increased social media connectedness likely influences student sense of belonging and classroom engagement which in turn could improve overall student education. Even though this study did not find correlation between student sum connectedness and final exam score, the results of this study offer insight into the potential for social media as an influential factor in university level STEM classes. A better overall
understanding of the factors that influence active learning classrooms, such as social media connections may help higher education systems prepare students for the real world challenges of a career in science.

ACKNOWLEDGEMENTS

Thank you to Andrew Martin for acting as my advisor to this project and for assisting me with data collection within his classroom, to all of the students who helped by participating in this study, to Barbara Demmig-Adams for all of her assistance in the process, to Wynne Moss for help with statistics, to my classmates for constructive feedback and to my friends and family for their support during this process.

REFERENCES


