

# Technical Report

## Fall 2012

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**CASL-TR-11-12**

Complex Adaptive Systems Laboratory

University of Central Florida, November, 2012

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SONET-MATH: Social Networks for Mathematics  
Pilot Program Report- Summer 2012

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# **SONET-MATH: Social Networks for Mathematics**

## **Pilot Program Report**

### **Summer 2012**

#### **Goal**

- Evaluating the effectiveness of social networking technologies to enhance STEM education for Calculus II students

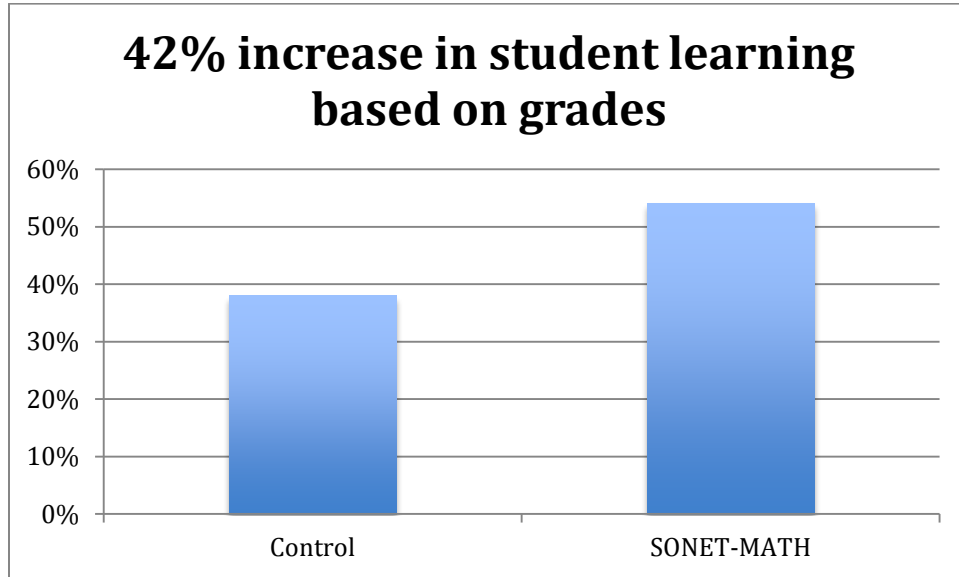
#### **Expected Outcomes**

- Performance increase of students taking Calculus II using the social networking educational platform versus students not using the platform
- Emergence of social phenomena in support of STEM educational goals

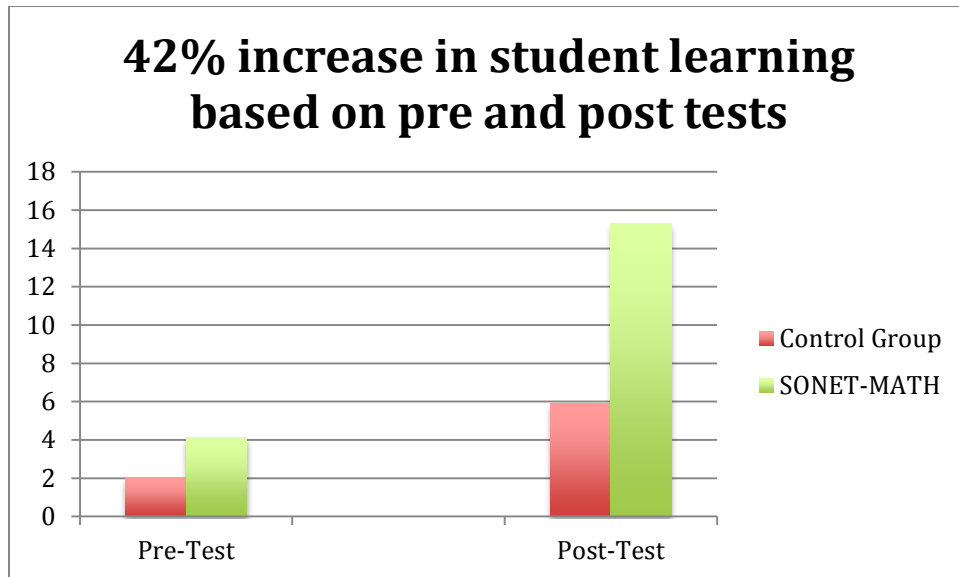
#### **Rationale**

- We plan to adapt STEM education to better reach the current generation of undergraduates: digital natives
- Digital natives use extensively digital media and social networking (McArthur Foundation's Digital Youth Project and Participatory Culture reports; Educause's Undergraduate Students and Information Technology report).
- Focus group: very successful UCF STEM students consider social media critical for their success
- Social networking educational platform
  1. Enable student's social learning providing them with a basic social network platform
  2. Encourage students behaviors that, we hypothesize, are supportive of STEM education via learning and teaching strategies
  3. Analyze the kind of social behavior emerges as a result

## Results



**Figure 1.** 42% increase in learning by SONET-MATH pilot students as compared to a control group of students as measured by their grades: 54% of students in the SONET-MATH group earn grades A or B while only 38% of students got these grades in the control group.



**Figure 2.** Increase in learning by SONET-MATH pilot students as compared to a control group of students as measured by pre and post-testing grades. SONET MATH students in average increase their grades from 4.1 to 15.3 (270% increase) while control group students increase their grades from 2.0 to 5.9 (189% increase) points from the pre-test to the post-test. This is an increase of 42% in learning gains.

## Social media tools used

The students in the SONET-MATH Calculus with Analytic Geometry II (MAC 2312) course in the Summer 2012 used a customized beta version of Discuzz. Discuzz (<http://discuzz.com/>) is a social media system with focus on communication and collaboration recommended to UCF by Microsoft higher education representatives. The following are a list of social media tools available to the students of the pilot via the Discuzz system:

- Facebook-like:
  - Social networking: all students received a Discuzz account. Their basic profile information was loaded in the system and available to other students in the class.
  - Facebook-style “wall”: a space similar to a personal blog used by the students to post their comments.
  - A “like” functionality to express their support for other student’s postings or comments. The number of likes determines the popularity of a comment.
- Workspaces: students were able to create custom collaborative spaces where they can invite any other user, share postings and media, and upload documents. The instructor created one collaborative space for the entire class and one per each study group in the class. Students were able to create any number of additional collaborative spaces and invite any student in the class to collaborate
- Dropbox-like document sharing: students can upload any documents like homework, solutions, etc. to a workspace.

## Social learning strategies implemented

1. Social Learning:
  - a. Promote constant contact with peers and instructors via social network and other means
  - b. Create small study groups: 5-3 students per group of their own choosing with the following group activities:
    - i. Required to meet at least 30 minutes a week face-to-face
    - ii. Encourage to keep in contract contact with social networking
    - iii. Tutoring and Collaborative lab was made available to all pilot students. This lab is a physical collaborative space manned by teaching assistants. Students were encouraged to expend time on this lab with their study groups
    - iv. Required to expend at least 3 hours a week in the tutoring lab if grades felled below 80%
    - v. Required to go over their test with a tutor in the lab if grades felled below 70%
2. Participatory Learning
  - a. Students were encouraged to post helpful links and resources to workspaces

- b. To encourage groups to participate actively, every week the instructor will give gift cards to the group that most actively participated that week
3. Collaborative Learning:
  - a. Weekly assignments designed to promote student collaboration
  - b. To encourage collaboration a space was created for students to nominate fellow students that were particularly help full to them

## **Experimental Design (Lori Pyle)**

### Experimental Group

Grades were based on four tests (75%), quizzes (5%), online homework (10%), weekly assignments (5%) of challenging problems, and participation (5%). Students were required to spend 3 hours a week in the EXCEL Lab (a tutoring lab) before receiving their first test grade. They were then required to spend 3 hours a week in the lab if their first test grade was under an 80% and had no lab hour requirement if their first test grade was 80% or higher. The same guidelines were then used to determine lab hours after the second and third tests were returned. If a student earned less than a 70% on a test, they were required to rework problems in which they lost points and then go over the test corrections with the instructor or a TA (three TAs were helping the instructor and running the EXCEL Lab). Students chose study groups of 3-5 classmates at the beginning of the semester. They were required to meet with their groups for 30 minutes each week. Compliance with lab hours, test corrections (during weeks in which tests were returned), and meeting with their study groups determined their participation grade each week. Students used Discuzz throughout the semester. The instructor posted the weekly assignments on it as well as some supplemental materials and handouts. Students posted helpful links and resources within the workspaces for their study groups and also used Discuzz to communicate with each other, the teaching assistants, and the instructor outside of class. The links and resources within the workspaces for the study groups could be referenced by students at any time they needed extra help. Additionally, Discuzz was used to discuss movies, art, and music related to mathematics. To encourage collaboration through positive reinforcement a workspace called "Best of the Best" was created for students to nominate classmates who had been particularly helpful toward another classmate. All postings within Discuzz had a "like" button that students could click on to express their satisfaction with the information.

The weekly assignments were meant to encourage student collaboration. Two challenging problems were assigned at the beginning of each week. Students were encouraged, but not required to work together. Each student was required to submit his or her own unique write-up of the solutions. Students were also given the opportunity to work in their study groups on ungraded practice problems during class.

### Control Group

The control group consisted of the other four sections of Calculus with Analytic Geometry II (MAC 2312) offered during the summer 2012 semester. In three of the four sections the course grade was based on four tests and regular quizzes. The fourth section based the course grade on weekly homework assignments that were turned in to be graded as well as four tests. No lab hours or test corrections were required. Each section was taught by two different instructors (one taught the first 6 weeks of the course and the other taught the remaining six weeks). No assistants were supporting the instructors of record. No social media was used for class communication and student study group formation was not facilitated by the instructors.

### Assessments

Student success was measured through course grades and performance on a pre-test and post-test assessment. 54% of students in the experimental group earned a course grade of “A” or “B” compared with 38% of students in the control group who earned an “A” or “B.” The pre-test consisted of 6 problems covering topics from throughout Calculus II (list topics here) and was used to measure the amount of Calculus II knowledge students had upon beginning the course. This assessment was given during the first week of class. The post-test consisted of the same six questions contained on the pre-test and was given during the last week of class. The increase in student performance between the tests was measured for each student in the control group and the experimental group. Two teaching assistants graded each test according to a rubric and scores for each problem on each test from each grader were compared.

### Experimental Group Instructor’s Classroom Experience

Some students in the course were students from the EXCEL Program and knew each other from having taken previous classes together. Students formed their study groups during the first week of class and quickly became very social toward each other. During class they would regularly encourage each other and they collaborated well during group work exercises in class. Having the support of peers seemed to motivate students and created a learning environment in which student participation flowed easily during class discussions.

## **Student Perceptions Research (Amanda Koontz)**

### **Learning Styles of the Digital Generation**

This study contributed to our understanding of the learning styles of the “digital generation.” More specifically, we learned of the learning styles of students in Calculus 2 courses.

## ***Student Perceptions***

### ***INDEPENDENCE***

#### *Independence: Grades*

First, while previous research suggests the inherently social nature of the digital generation (see proposal), we found that students still feel strongly responsible for their own education and success in courses.

**Table 1. Question: I felt I was solely responsible for my grade in this class**

**(1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
1	61	27.5	40.7	40.7
2	70	31.5	46.7	87.3
Valid 3	11	5.0	7.3	94.7
4	6	2.7	4.0	98.7
5	2	.9	1.3	100.0
Total	150	67.6	100.0	
Missing System	72	32.4		
Total	222	100.0		

As can be seen in Table 1 (above), 59% of all participants (experimental and control groups) stated they either strongly agreed or agreed that they were solely responsible for their grades in the summer course.

#### *Independence: Reaching Goals*

Relatedly, students' responses to the statement, "I have choices in how I reach the objectives of the course" revealed their opinions in relation to their independence in successfully completing the course. Fully 61.7% of students agreed (strongly agree and agree) that they have choices in how they complete the objectives of the course in the pre-survey, while 47.7% still agreed/strongly agreed with this statement at the end of the course (findings between pre- and post-surveys not significantly different). Approximately 20% of students in the pre-survey and 15% of students in the post-survey remained neutral.

**Table 2. Question, Pre-Survey: I have choices in how I reach the objectives of the course. (1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	27	12.2	13.4	13.4
2	110	49.5	54.5	67.8
3	45	20.3	22.3	90.1
4	18	8.1	8.9	99.0
5	2	.9	1.0	100.0
Total	202	91.0	100.0	
Missing System	20	9.0		
Total	222	100.0		

**Table 3. Question, Post-Survey: I have choices in how I reach the objectives of the course. (1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	28	12.6	18.4	18.4
2	78	35.1	51.3	69.7
3	33	14.9	21.7	91.4
4	10	4.5	6.6	98.0
5	3	1.4	2.0	100.0
Total	152	68.5	100.0	
Missing System	70	31.5		
Total	222	100.0		

However, in their written comments, students helped to clarify their perspectives. Pre-surveys from the experimental group revealed general perspectives on achieving course objectives, which appear to be driven by individualism. For example, one student stated “Every choice has a consequence; i.e. whether to finish all your work determines if you pass or fail” (E1). Another student stated “You



obviously have to do the assignments, but as far as studying, it is up to the student to take notes, go to SI, or tutoring” (E4). Another succinctly stated, “How much I study is a choice” (E5). Many more students wrote in a similar fashion, stating “It depends on my motivation” (E9) and another, “I feel that while objectives are given, it is up to the individual on how I accomplish them” (E12). Because this is the pre-survey, the students have as-of-yet to focus on particular course objectives. They do feel restrained by course assignments, such as stating, “To pass you have to do the work, it’s not really much of a choice” (E8) or “Yes, as students we are free to make choices to receive the A whether by completing homework or acing tests” (E13).

Thus, in a strong pattern for the experimental students before starting the course, they felt it is up to individuals to complete the work. They acknowledge the structure of the course, but do not place great emphasis on whether the structure allows them freedom in how to complete the course, but instead on their own motivation in completing the course.

A similar pattern remains at the end of the course, between the experimental and control groups (not significantly different).

**Table 4. Crosstabulation (Post-Survey): I have choices in how I reach the objectives of the course. Experimental (1) and Control (2)**

		Group		Total
		1.00	2.00	
1	Count	7	21	28
	% within Group	19.4%	18.1%	18.4%
2	Count	20	58	78
	% within Group	55.6%	50.0%	51.3%
REACH2 3	Count	7	26	33
	% within Group	19.4%	22.4%	21.7%
4	Count	2	8	10
	% within Group	5.6%	6.9%	6.6%
5	Count	0	3	3
	% within Group	0.0%	2.6%	2.0%
Total	Count	36	116	152
	% within Group	100.0%	100.0%	100.0%

While students’ reactions included information more specific to courses in their post-responses, the trends remained the same and helped to clarify those students

who marked “neutral.” For example, one student who marked neutral declared that “At the end, results are the only things that matter” (E14). Another “neutral” stated, “Most of the objectives I have really only have one or two ways that they can be achieved effectively” (C27). One of example of a student who disagreed stated, “There’s a set plan that most courses follow.” (E19).

One student who agreed said, “Objectives can be met in different ways, including putting all your effort in it or barely meeting the criteria” (E16). Once again, students focused on their own commitment to the course, rather than the structure of the course. This pattern remained in the control groups, such as “You can choose how much time you spend to reach your objectives” (C22). If students mentioned the structure, it still did not connect directly to how to complete the assignments, but the options for getting help and what they assigned work included. For instance, “SI sessions, matlab, help through TA” (C33) or “There are many different opportunities to achieve a good grade in this course including study groups, lab hours, online peer tutoring, etc” (E2). A large number of students also discussed how they could generally choose what work to do, when, and where they could complete it.

In sum, students focused on their own abilities and motivation to complete the course when they agreed or were neutral with the statement. The actual practice of the assignments was not a focus, and there lacked a significant difference in the opinion of the students in their possibilities to achieve the objectives, even with the different structures between the courses. I argue this is based on the openness of their definition of “objectives,” such as the student who philosophically declared, “There are many paths to success” (C99).

In future research, if we choose to pursue the definition and completion of course objectives, I believe we need to clarify the definition of “objectives” in order to ask highly specific questions on each course objective. Additionally, it could be helpful to ask the students what their own objectives are for the course.

*Independence: Structure of Course*

Last, in relation to independence, students responded to the question, “The structure of this class helped me to feel confident that I could successfully complete the course.”

**Table 5: Question, Post-Survey: The structure of this class helped me to feel confident that I could successfully complete the course. (Experimental and Control)**

	Frequency	Percent	Valid Percent	Cumulative Percent
1	19	8.6	12.7	12.7
2	64	28.8	42.7	55.3
3	41	18.5	27.3	82.7
4	16	7.2	10.7	93.3
5	10	4.5	6.7	100.0
Total	150	67.6	100.0	
Missing System	72	32.4		
Total	222	100.0		

**Table 6. Crosstabulation (Post-Survey): The structure of this class helped me to feel confident that I could successfully complete the course. Experimental (1) and Control (2)**

		Group		Total
		1.00	2.00	
1	Count	10	9	19
	% within Group	27.8%	7.9%	12.7%
2	Count	19	45	64
	% within Group	52.8%	39.5%	42.7%
3	Count	5	36	41

	% within Group	13.9%	31.6%	27.3%
4	Count	2	14	16
	% within Group	5.6%	12.3%	10.7%
5	Count	0	10	10
	% within Group	0.0%	8.8%	6.7%
	Count	36	114	150
Total	% within Group	100.0%	100.0%	100.0%

\*Significant at .002

In this instance, the experimental and control groups were significantly different in their responses. 80.6% of the experimental group agreed (strongly agree and agree), while only 47.4% of the control group agreed/strongly agreed. Thus, while students focused on their own efforts in courses, the structure of the course does matter in students' confidence towards success.

The student comments did vary amongst each other. Some still asserted independence, such as one student who stated, "Structure is irrelevant. Mindset is more important; it is up to the student to work hard and most importantly learn" (C109), while another simply stated that "It [the course structure] hasn't affected my thoughts at all" (C123). Another stated, "It was up to me to do well, not the structure of the course" (C45), or "I feel like I would try to succeed no matter what" (C47). Even in the experimental group a student stated, "My success is based on myself, not my surroundings" (E22).

Most students in the experimental group, as based in the numbers, described ways in which the structure helped. While general, students discussed the multi-faceted format of the course. For instance, one student stated "There are multiple ways to ensure the final grade of a student is at least a passing grade" (E12), while others described how both the "face-to-face and outside of class help" (E17), "there was always a place to get help" (E32), they "had more grades than just test grades and we could work in groups" (E23), or "liked the small groups and lab" (E28). These examples showed how students viewed having multiple outlets for help and support was still important to them. Even while some may argue they, in the end, are responsible for their grades, the availability of different forms of support along the way helped make them feel confident they could complete the course. At the same time, two students did express a sense of feeling overwhelmed in their comments, including one student who stated they "constantly felt as if something was due or required of me" (E34) or that "grading is very particular" (E43). Other than these, exceptions, students generally expressed a sense of independence or that the structure did help to make them feel confident.

Students in the control group did discuss more negatives than in the experimental group. A fair amount of students still phrased their comments based on how they could manipulate the course. One could argue this is based on students' desire for independence in how they complete the course, although based on one

quote, one could also argue the students felt forced into independence. One student declared, “The structure was basically, “Here is what you’re responsible for on the text, now go figure it out”” (C99). Frustration predominately derived from the change in instructors, lack of other ways to earn grades besides tests and quizzes, or the inability to predict grades. In relation to instructors, students stated, “Having two different TAs for the semester (1 for each half) was not a good idea. I would rather have a professor teach the whole time, or at least supervise the TAs during lecture” (C83).

The lack of the multi-faceted format can be seen in a complaint that, “My grade was based solely on tests/quizzes, so there is no buffer or assignments that would help deepen my understanding or prepare me for the tests. It felt like a very “all or nothing” class” (C97) or “At times I felt I would not do well because the class was based on only tests and quizzes. I wish there was homework to help boost my grade” (C96). The uncertainty of standards is demonstrated by a student who stated, “The syllabus was not even set in stone...quizzes are worth 16-20% and we don’t know until the end” (C101), or “I could not predict or accurately estimate my competence in this class, ever” (C41). Thus, it appears students desire the basic structure to allow them to earn the grade they desired, and to know their grade throughout the course. One could argue that this is related to independence, as they do not want to rely strictly on the grading of the instructor on tests and quizzes, or to determine their final grade without their additional tracking of the grade.

One student unfortunately summarized that, “This course consisted of unclear lectures, quizzes (some of which didn’t line up with the material), and tests. We had to teach ourselves” (C114). Another stated, “The class is set up to be very independent work for every student. I don’t mind it but it can be improved!” (C93). In sum, while students feel responsible for their own learning, it does appear that they want the basic support of lectures and the resources for them to take advantage of, according to their learning styles. In this way, students are independent, but desire the infrastructure to help them succeed. There are a fair amount of students who feel they are responsible for their grades no matter the structure, but arguably, it cannot hurt to have these resources available.

## *COMMUNITY*

### *Community: Classroom*

In relation to community, we left the questions open for students’ interpretations of the meaning of “community,” which is one reason we asked them to explain their response choices. I specifically asked about their perceptions of community in relation to both the classroom and professional community.

For the classroom community, there was no significant difference between the pre- and post-surveys, nor between the experimental and control groups. Excluding missing surveys, only 40.4% of students agreed/strongly agreed they felt more invested in the classroom community at the end of a course. The exact same amount (40.4%) was neutral, and 19% disagreed/strongly disagreed. In looking at these responses, I would argue that having 60% of students not agreeing that they feel closer to a classroom community could be an issue to explore to a greater

extent. Investment in the classroom community could lead to a greater investment in the concepts and/or major, thus helping retention in STEM majors. However, we must further explore students' definitions of community.

**Table 7. Question, Post-Survey: I feel more invested in the classroom community at the end of a course. (1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
1	7	3.2	4.6	4.6
2	54	24.3	35.8	40.4
3	61	27.5	40.4	80.8
Valid 4	23	10.4	15.2	96.0
5	6	2.7	4.0	100.0
Total	151	68.0	100.0	
Missing System	71	32.0		
Total	222	100.0		

In relation to these definitions, first, students who did feel more invested claimed this based on friendships or, to a much lesser extent, work put into the course. Two students described how, "Hard work invests myself in the community" (E17) and "Money, hours of studying, [and] showing up to class" (E32) are what makes them feel invested in the classroom community. The majority of students who agreed cited either becoming friends with classmates through their time together, or because they came into the class as friends. For instance, "My classmates have become my friends, therefore I feel invested in them because we've spent time together" (E13), or one student stated they felt invested "Only if I have friends in the class" (E23). Relatedly, another student said, "I make lots of friends – we study together and help each other" (C93) and one student expressed a sense of community because "I feel we're all completing a journey together" (C99). One student who did not explicitly state how they felt a sense of community still clarified it was about making friends when they said, "May have made friends, but mostly acquaintances" (E15). Thus, acquaintances are not what equate to classroom community, but only "friends." Last, another student stated, "The more you get to know the people in the classroom, the more you are able to invest in the community" (C22). For the majority of students who agreed, rather simply, they felt a sense of community when they get to know other students, but in particular, feel that they become friends.

On the other hand, those who disagreed with feeling invested in a community either stated there was no sense of community, or they explained this lack of connection through personality traits. Interestingly, a fair amount of students stated they are

“neutral” or “disagree” because of their own preference to not socialize with others. Students, for example, stated, “I don’t care for socializing” (E16), “I am not a people person” (C113), or, “I don’t typically connect with peers” (C103). Others similarly said, “I don’t talk to anyone” (C23), “I do not talk much to my classmates” (C70), and “I don’t much interact with my fellow students” (E3). In these instances, their lack of connection to a classroom community stems from their own personal preferences regarding socialization. One could argue, in a similar way, that small group work will only be effective for a certain population, if students feel that they are not particularly social. I would argue this is the case for students who, in the experimental group, responded negatively to group work. Two people stated they “prefer to work on my own or with ONE other person” at a time (E40) and that they “work better alone or by asking random questions to my peers...occasionally” (E36). One viewed it as congruent to homework (E15).

Based on certain studies, if students do not have an intrinsic value attached to a course goal, then there is a lack of influence instructors can have on the course. In upcoming studies, it could be extremely helpful to ask a question that includes an option specifically about their own interests in socializing. This could help us determine the extent to which we can encourage a sense of classroom community.

Last, in relation to classroom community, certain students argued there was not a community, based for the most part on their own lack of motivation. For instance, “Nothing motivates or gears my mind toward the community, UCF community or otherwise” (C18) and “I don’t feel obligated” (C92). Other reasons include that they do not “keep in touch with classmates and/or the professor” (E34) or that they “do not like to become too attached to any one instruction style or group of people” (C43). One student broadly declared that “Mostly everyone’s on their own” (E46). As opposed to the above population of students, even though students do not currently feel motivated, it could be possible to define a classroom community at the beginning of the semester, and then work to incorporate community-building exercises into the course to increase their motivation or sense of obligation to a community. Another option is to help re-define what a classroom community means, so that the exercises already in-place in the experimental course could be defined as “community-building,” and this could also help to increase a sense of community.

#### *Community: Small Group Work*

In returning back to the topic of small group work, one could argue for the helpfulness of small group work in building community. If students define community as related to friendships, time spent together, and an obligation to those peers they have built these relationships with, then small group work has a strong potential to increase involvement and investment in the course.

For this particular study, our focus was not specifically on community (which can be done in the future), but instead of helping understanding of class concepts.

**Table 8. Question, Post-Survey: Assigned small group work in classes helps my understanding of class concepts. (1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
1	19	8.6	12.7	12.7
2	64	28.8	42.7	55.3
3	43	19.4	28.7	84.0
4	21	9.5	14.0	98.0
5	3	1.4	2.0	100.0
Total	150	67.6	100.0	
Missing System	72	32.4		
Total	222	100.0		

**Table 9. Question, Post-Survey: Assigned small group work in classes helps my understanding of class concepts. (1=Strongly Agree; 5=Strongly Disagree)**

		Group		Total
		1.00	2.00	
1	Count	6	13	19
	% within Group	16.7%	11.4%	12.7%
2	Count	19	45	64
	% within Group	52.8%	39.5%	42.7%
3	Count	7	36	43
	% within Group	19.4%	31.6%	28.7%
4	Count	3	18	21
	% within Group	8.3%	15.8%	14.0%
5	Count	1	2	3
	% within Group	2.8%	1.8%	2.0%
Total	Count	36	114	150



% within Group	100.0%	100.0%	100.0%
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\*Pearson Chi-Square: 0.358

As can be seen in Table 9, the differences between the experimental and control groups are not significantly different. However, this is telling in and of itself. Findings from the control group suggest that students look to take advantage of small group work even when it is not assigned. Because they viewed study groups they created and SI as helpful in the control group, students remained generally positive about assigned small group work even when other control-group respondents blatantly wrote, “No small group work” in the course. In future studies, it could be important to understand the place of SI to a greater extent, particularly to understand if it could be as effective as assigned small group work in a course. Additionally, students still discussed group work in the control groups, and asked there be more group work. The one student who stated, “The class is set up to be very independent work for every student. I don’t mind it but it can be improved!” also declared, “I would like more group work. Group work encourages student to do better, and therefore they learn more than otherwise” (C93).

Overall, most students agreed that they liked group work when it was available. For instance, in the experimental group, those who agreed each stated that other students helped their understanding. Each student quoted relatively similar reasoning, such as group members helping “with weekly assignments if I got stuck” (E9) or that at least one member always “understood the lesson when others did not comprehend it completely” (E12). Additionally, students explained that by studying together, “by helping them learn, I began to understand it better” (E23) and by studying and doing the homework together, it “solidified the understanding of concepts a lot better” (E28). While certain students did state all of the work was time consuming, the positive side can be seen from the student who explained that small group work “forced me to work on the assignments and explain concepts to others” (E19). These explanations help to show why 69.5% of the experimental group agreed/strongly agreed that small group work helped.

On the other hand, even though there was no assigned group work in the control group, and, as mentioned, students explicitly wrote in there was no small group work, students still wrote about the positives of SI and their own study groups. 50.9% of the control group agreed/strongly agreed that small group work helped, and almost 32% were neutral, even without assigned group work. Students explained these responses regarding small group work and SI by stating, for instance, “only in SI sessions, never had group work in class” (C60) or that “SI helped us get together and figure the problem out” (C2). Others explained the helpfulness of the study groups they created. One stated, “The only group work we did was meeting to study. And yes, that helped my grade very much” (C108), while another said, “Working in small groups helped outside of class because some of my peers had a lot more knowledge, which helped me” (C96). Last, another chose the option that there was no small group work, but went on to state that, “However, the study group we formed to do homework helped me in this course” (C122).

Overall, even with the independence declared by students, 69.5% of the experimental group and 50.9% of the control group agreed/strongly agreed that

small group work helped their understanding. With another 19% in the experimental and almost 32% feeling neutral in the control group, in which there was no small group work, this is arguably a highly effective teaching technique to be maintained. Beyond this, this finding can show support for students as collaborative, a trait arguably present in the digital generation. One item to consider is the importance of allowing students to choose their own groups. While this may advantage students who know each other, it may also allow students to build community if they can continue to work with these students over time. Additionally, based on the students' feeling of responsibility over their grade, I would suggest that small group work still retain independence in grading, so that each student feels they are being graded on the work they are inputting.

*Community: Professional*

In relation to community, we also asked regarding their sense of connection to a professional community. Once again, there was no significant difference between the experimental and control group. However, it is interesting to note that 42.6% agreed in the control group that they felt more connected, while 28.6% in the experimental group stated they felt more connected. Beyond this, 25.7% disagreed in the experimental group, while only 9.6% did in the control group. I believe this could be an issue to pursue in future studies, if we are interested in this half of community connectedness, and to understand if these findings are based on the group of students or in the classroom setting. Particularly as students in the experimental group felt the structure of the course made them feel more confident they could successfully complete the course, then one could argue that being connected to a professional community is not within students' definitions of "success."

**Table 10. Question, Post-Survey: I feel more connected to a professional community at the end of a course. (1=Strongly Agree; 5=Strongly Disagree)**

	Frequency	Percent	Valid Percent	Cumulative Percent
1	8	3.6	5.3	5.3
2	59	26.6	39.3	44.7
3	59	26.6	39.3	84.0
4	20	9.0	13.3	97.3
5	4	1.8	2.7	100.0
Total	150	67.6	100.0	
Missing System	72	32.4		
Total	222	100.0		

\*No significant difference between pre- and post-survey results.

**Table 11. Crosstabulation (Post-Survey): I feel more connected to a professional community at the end of a course.**

**Experimental (1) and Control (2)**

		Group		Total
		1.00	2.00	
1	Count	2	6	8
	% within Group	5.7%	5.2%	5.3%
2	Count	10	49	59
	% within Group	28.6%	42.6%	39.3%
INCOMM2 3	Count	13	46	59
	% within Group	37.1%	40.0%	39.3%
4	Count	9	11	20
	% within Group	25.7%	9.6%	13.3%
5	Count	1	3	4
	% within Group	2.9%	2.6%	2.7%
Total	Count	35	115	150
	% within Group	100.0%	100.0%	100.0%

\*Pearson Chi-Square: 0.155

While many students were neutral regarding a professional community, most students who did agree stated it was because they were learning the concepts and language of that community. This closeness additionally includes getting closer to earning their degree. For instance, “I understand the topics of the course so I can relate to that community” (E32), or “I have a greater understanding of the work that my major entails” (C67), and a “course can bring to light certain subjects or issues that can be better discussed within the professional community” (C102). One succinctly stated that they “feel closer to my degree, and therefore profession” (C42). For this who agreed, this was the primary reasoning.

Other students mainly felt they associated with their peers and/or professor, though some disagreed if this meant becoming closer to a professional community. For example, one student clarified that, “I feel I understand my career and what it requires of me more. At the end of the day, I am working and studying with my future co-workers” (C93), but another stated that “Although your teacher is a professional, there aren’t many opportunities for professional networking during a

course” (E47). In part, students may have disagreed in this way because they separated work from school, as two students disagreed, citing that they were not “in a professional setting” (C91) or were in classes with “college students who don’t have networks yet” (E13).

Additionally, other students disagreed for the same reason that other students agreed – “Although I have learned about a subject, I don’t feel closer to the people that work in that field”

(E35). The majority who disagreed mainly believed that there was not an attempt made to create those connections. For instance, one student argued, “Most classes don’t teach topics of professionalism or connect the student with professional in their field in any way” (E2), and another declared, “No outside professional networking takes place” (E17). While this clarifies why students disagreed with feeling a sense of connection, another student’s comment offers an additional way to build professional community through the use of real-life examples. This student stated, “Courses do not often provide real-world experience or examples” (E34). The variance in reasons for why students disagree implies various forms of definitions regarding community.

While some students may agree with the statement based on their learning concepts and skills, other students may disagree because they have different definitions of professional community. If this is an issue we would like to pursue in the future, based on arguments that the digital generation pursues professional connections for experience in their areas of interest, I argue that explicitly including this goal in course objectives, which are then discussed with students, would be beneficial. By doing this, we can operationalize the goal, help to create one understanding of professional community with our student population, and additionally test the goal. Based on these various definitions, we could pursue additional applied examples, in addition to making students find real-life examples on their own, in order to encourage these connections. In relation to learning styles and community, we need to test (1) if this is something of importance to students and (2) if we can integrate professionals, or their research, into the classroom and make this apparent.

### *SOCIAL MEDIA*

In regards to social media, the primary findings relate to how students chose to use social media in relation to the course. Comments regarding Discuzz predominately revealed that students did not use it, which is information we already understood.

The only comments pertaining to social media specifically (i.e. students said “social media” in their comment) touch on points discussed in earlier sections. In the first instance, one student falls under the category relating to personality. This student stated, “I do not like collaboration. Lectures are how I best learn. The social media connection seemed redundant” (E3). Second, another student commented regarding the convenience of social media use, an issue we have discussed as important in earlier meetings. This quote also relates to the availability of multiple formats for learning: “For summer term Excel lab is only available after the class each day. The only way social media would work for a math class would be if you could video chat (takes too long to explain problems for Calc 2 when you have to

type)” (E5). Last, in relation to the control group, one student commented that, “Social media was not really necessary in this class except for tutoring” (C96). Based on this comment, we may be able to further explore how students are already integrating social media, even in control groups. While this is something we attempted to touch on in this pilot, I believe our initial questions were too broad. Now that we have these preliminary findings, we can ask more specific questions on their social media use and schooling.

Overall, social media predominately is used to find out homework assignments and due dates, and to facilitate future face-to-face meetings. For the experimental group, social media was used most (84.4%) to find out homework assignments, second most to find out due dates (75%), and third to coordinate future meetings (65.5). This is the same order for the control groups, with only slightly lower percentages (67.7%, 65.7%, and 64.6%, respectively). Students used social media least to find out how to submit assignments. Below, I include each of the options students selected in relation to social media use. As can be seen in Table 12:A, the only use that was significantly different between the experimental and control groups was that students in the experimental group used social media more to find out homework assignments.

**Table 12. Question, Post-Survey: In what ways do you use social media for class purposes? Choose all that apply. (A-I)**

**A. To find out homework assignments.\***

		Group		Total	
		1.00	2.00		
CLASSUSE2A	0	Count	5	32	37
		% within Group	15.6%	32.3%	28.2%
	1	Count	27	67	94
		% within Group	84.4%	67.7%	71.8%
Total		Count	32	99	131
		% within Group	100.0%	100.0%	100.0%

\*.068 – significantly different between groups at 0.1

**B. To find out due dates.**

		Group		Total	
		1.00	2.00		
CLASSUSE2B	0	Count	8	34	42
		% within Group	25.0%	34.3%	32.1%
	1	Count	24	65	89
		% within Group	75.0%	65.7%	67.9%
Total		Count	32	99	131

% within Group	100.0%	100.0%	100.0%
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**C. To ask for clarification of class concepts.**

			Group		Total
			1.00	2.00	
CLASSUSE2C	0	Count	18	42	60
		% within Group	56.2%	42.4%	45.8%
	1	Count	14	57	71
		% within Group	43.8%	57.6%	54.2%
Total	Count	32	99	131	
	% within Group	100.0%	100.0%	100.0%	

(.172)

**D. To ask for help on completing assignments.**

			Group		Total
			1.00	2.00	
CLASSUSE2D	0	Count	17	60	77
		% within Group	53.1%	60.6%	58.8%
	1	Count	15	39	54
		% within Group	46.9%	39.4%	41.2%
Total	Count	32	99	131	
	% within Group	100.0%	100.0%	100.0%	

**E. To coordinate study groups and others meet-ups with students**

			Group		Total
			1.00	2.00	
CLASSUSE2E	0	Count	11	35	46
		% within Group	34.4%	35.4%	35.1%
	1	Count	21	64	85
		% within Group	65.6%	64.6%	64.9%
Total	Count	32	99	131	
	% within Group	100.0%	100.0%	100.0%	

**F. To complete collaborative projects.**

			Group		Total
			1.00	2.00	
CLASSUSE2F	0	Count	14	46	60

	% within Group	45.2%	46.5%	46.2%
1	Count	17	53	70
	% within Group	54.8%	53.5%	53.8%
	Count	31	99	130
Total	% within Group	100.0%	100.0%	100.0%

**G. To find out how to submit assignments.**

		Group		Total
		1.00	2.00	
0	Count	23	82	105
	% within Group	74.2%	83.7%	81.4%
1	Count	8	16	24
	% within Group	25.8%	16.3%	18.6%
Total	Count	31	98	129
	% within Group	100.0%	100.0%	100.0%

**H. To share notes and other material.**

		Group		Total
		1.00	2.00	
0	Count	16	50	66
	% within Group	51.6%	50.5%	50.8%
1	Count	15	49	64
	% within Group	48.4%	49.5%	49.2%
Total	Count	31	99	130
	% within Group	100.0%	100.0%	100.0%

**I. Other.**

		Group		Total
		1.00	2.00	
0	Count	30	93	123
	% within Group	96.8%	95.9%	96.1%
1	Count	1	4	5
	% within Group	3.2%	4.1%	3.9%
Total	Count	31	97	128
	% within Group	100.0%	100.0%	100.0%

As an additional note, students listed three online resources they additionally used in conjunction with the control groups:

- chegg.com (C12)
- google, wolfralphd.com (not really social media) (C39)
- Rely on patrickJMT.com (C114)

## Future Directions

***Social Cyberlearning Platform:*** an integrated mobile, anytime anywhere technological platform that integrates all student-learning needs in a single platform: social networking, social collaborative environment, texting and constant contact, mathematics notation easy editor for collaboration, micro-blogging, wiki authoring, etc. This platform builds on the informal learning processes that students are already familiar with and refocus them as valuable tools for their formal learning experience.

***Computer Science:*** This platform is designed in particular for STEM (Science Technology Engineering and Mathematics) students and can be adapted easily to core courses in the undergraduate computer science program.

***Rewards Systems:*** Encourage student's engagement in the class by making the class more fun to be involved in, and by emphasizing competition among students

***Gamification: Badges,*** Leaderboards, etc. Positive peer pressure creates an environment on which students have to perform and compete.

***Mobile Learning:*** Making the class more present in student lives by allowing them to be in constant contact with their learning, class does not stop when they leave the classroom, but student is constantly immersed in its learning experience. One standard-issue mobile device per student