DRK-12 RESEARCH METHODS WEBINAR | APRIL 20, 2020

PERSPECTIVES ON APPLYING SOCIAL NETWORK ANALYSIS TO STEM EDUCATION RESEARCH

MAKING RESEARCH RELEVANT

Host: Melissa Rasberry, EdD
Principal Education Consultant

Moderator: Kyle Fagan, PhD
Researcher

American Institutes for Research

Panelists:

María González-Howard, PhD
Assistant Professor in STEM Education at The University of Texas at Austin

Susan Yonezawa, PhD
Project Research Scientist at UC San Diego–CREATE

Welcome!

Take a moment to introduce yourself in the chat box.

Please tell us: your name, organization, and affiliation with the DRK-12 program (e.g., principal investigator [PI], project team member, evaluator, aspiring PI).

DRK-12 Research Methods Webinar Series

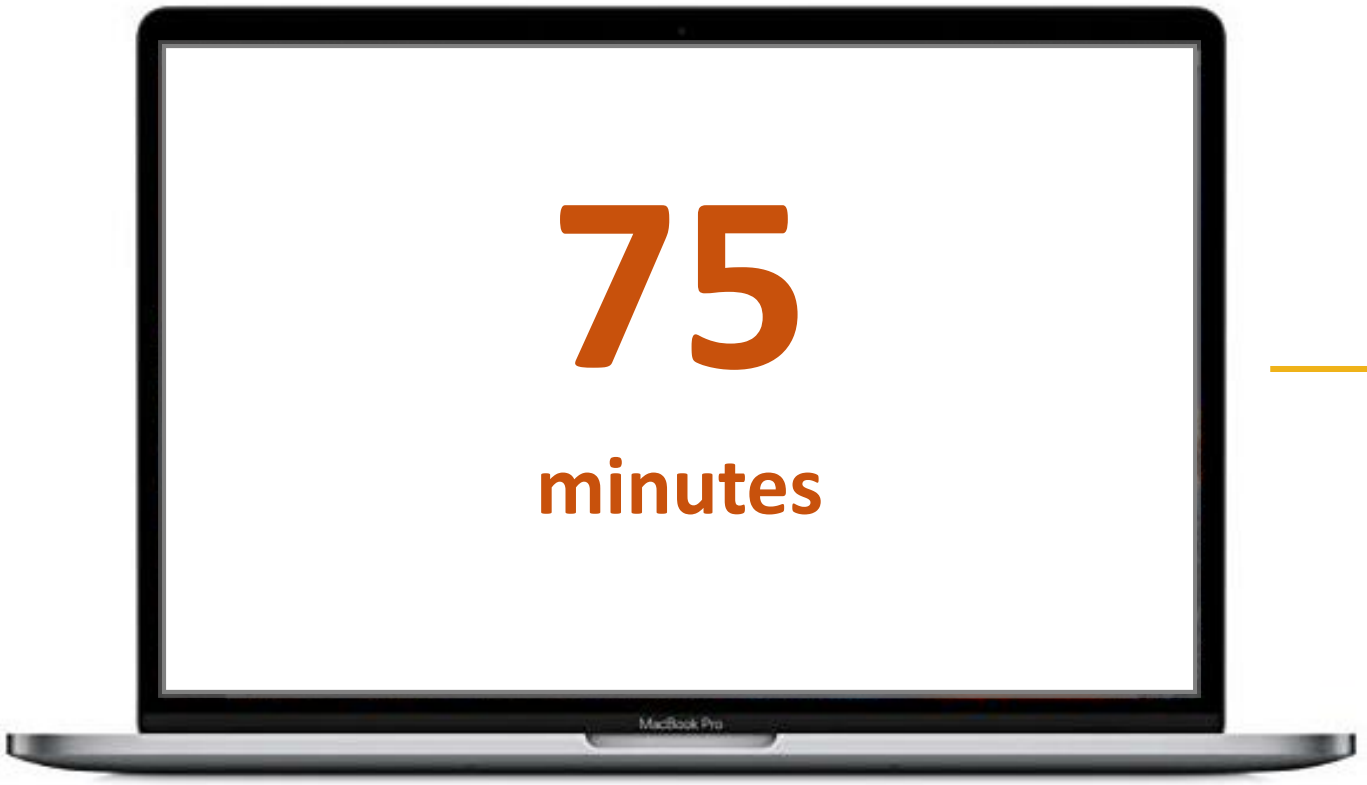
Host: Melissa Rasberry, EdD
Principal Education Consultant
American Institutes for Research

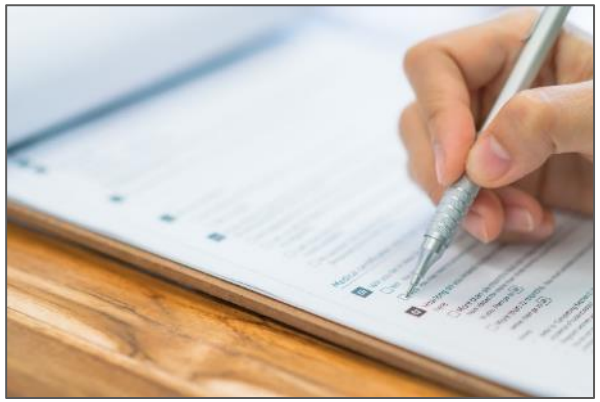
Learning outcomes

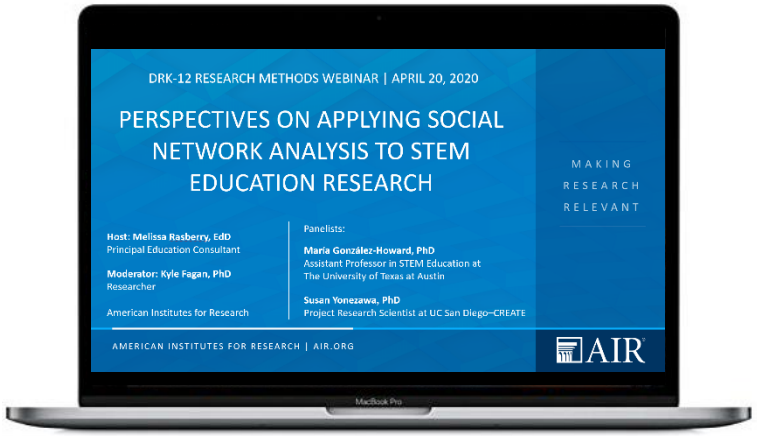
In this webinar, participants will:

- Gain a better understanding of the science, technology, engineering, and mathematics (STEM) research questions that can be addressed using social network analysis.
- Learn about the knowledge generated by using social network analysis.
- Learn about common challenges researchers face when using social network analysis.

Today's webinar



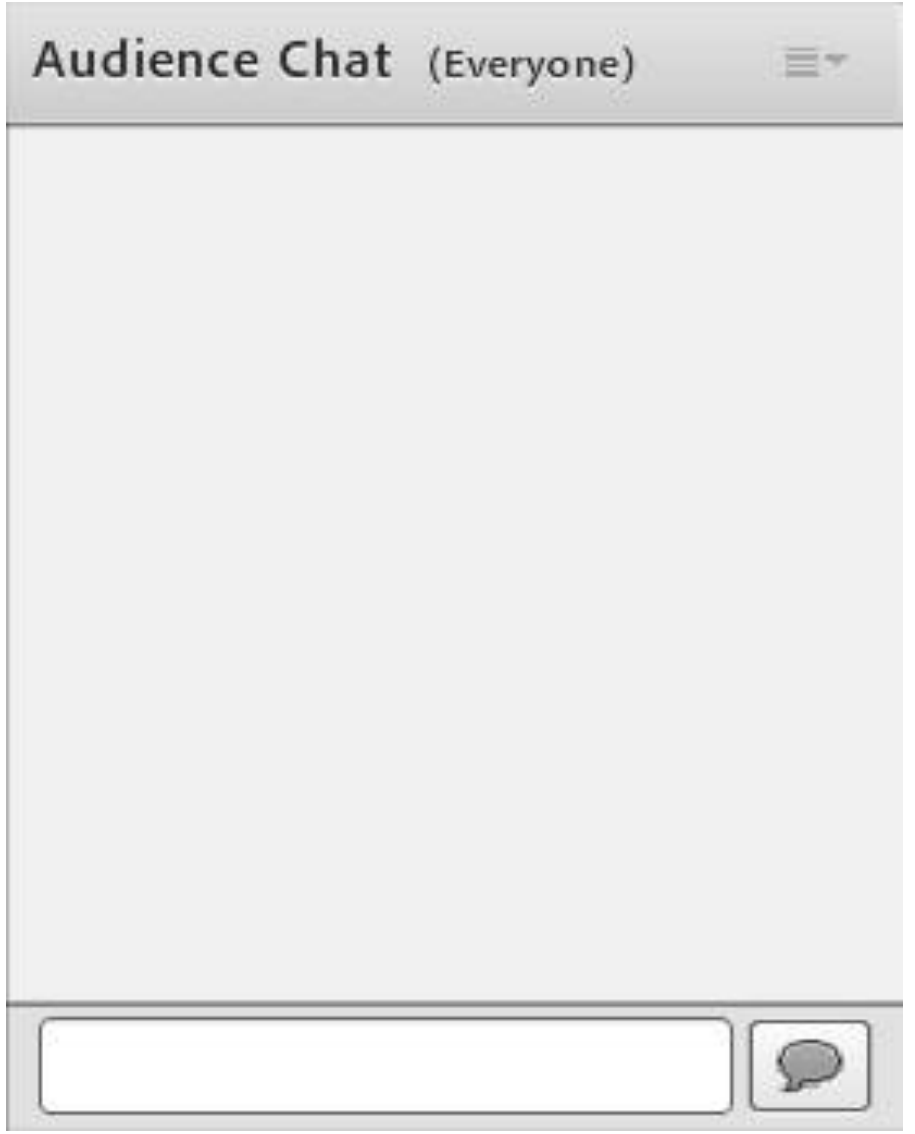




http://cadrek12.org/

Today's webinar

- Listen-only mode
- Use chat pod to submit content and technical questions at any time
- Opportunity for Q&A at the end of the session



Today's webinar

- To see this most clearly, you may want to use the "Full Screen" button in the upper right of the presentation pod.

- To submit a question, you will need to click the "Full Screen" button again to resume normal view.

Panelists

María González-Howard, PhD

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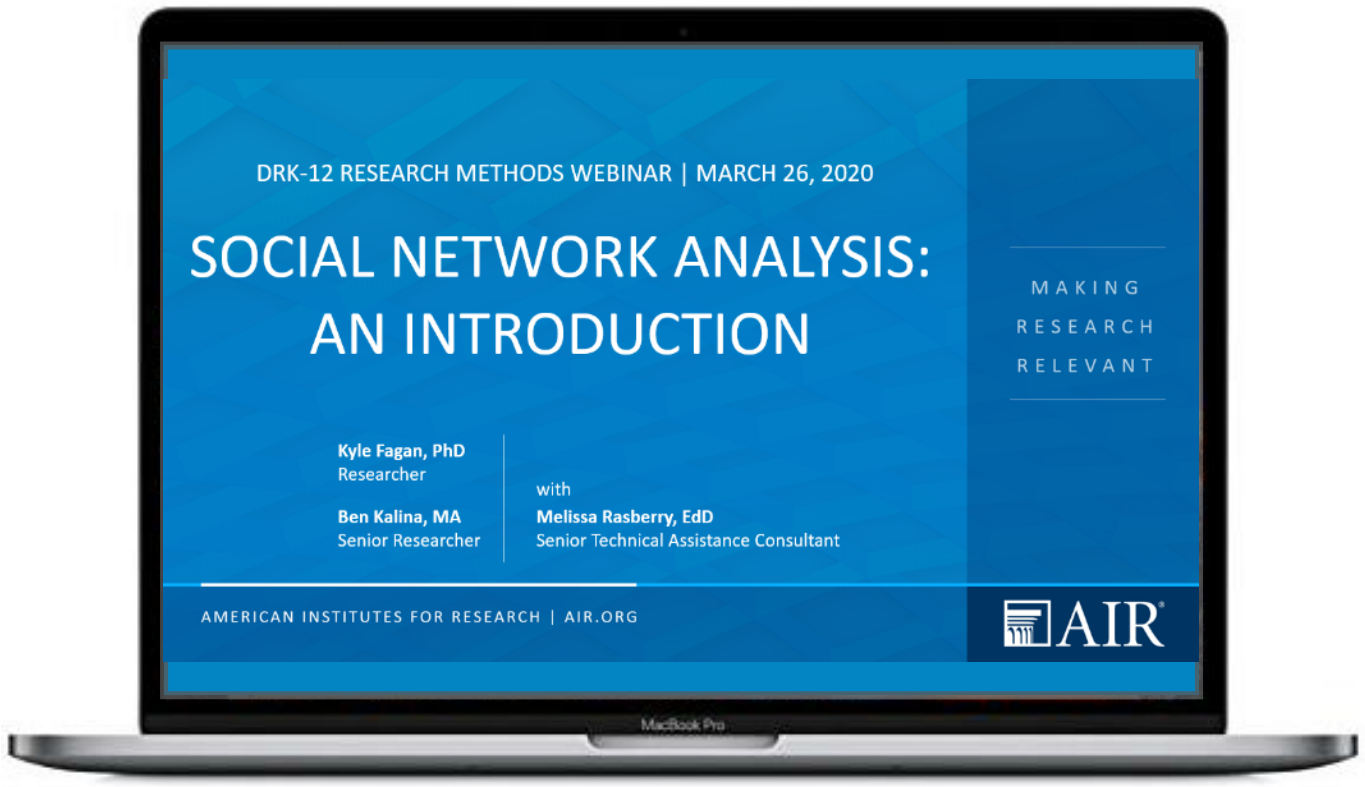
Webinar 1. Social Network Analysis: An Introduction

Recording available online: http://cadrek12.org/



- Introduced and defined key components of social network analysis.
- Described common methods for collecting social network data.
- Presented common measures for analyzing network- and actor-level characteristics.

Webinar 1. Social Network Analysis: An Introduction

Poll: Were you able to attend or watch the recording of the first webinar, *Social Network Analysis: An Introduction*?

Introduction to social network analysis

Social network analysis (SNA)

- A way of thinking about social systems that focuses on the relationships among the actors that make up a system.
- A set of methodological techniques that aim to describe and explore patterns apparent in social relationships that individuals and groups form with one another within a given context.

Research spotlight

María González-Howard, PhD

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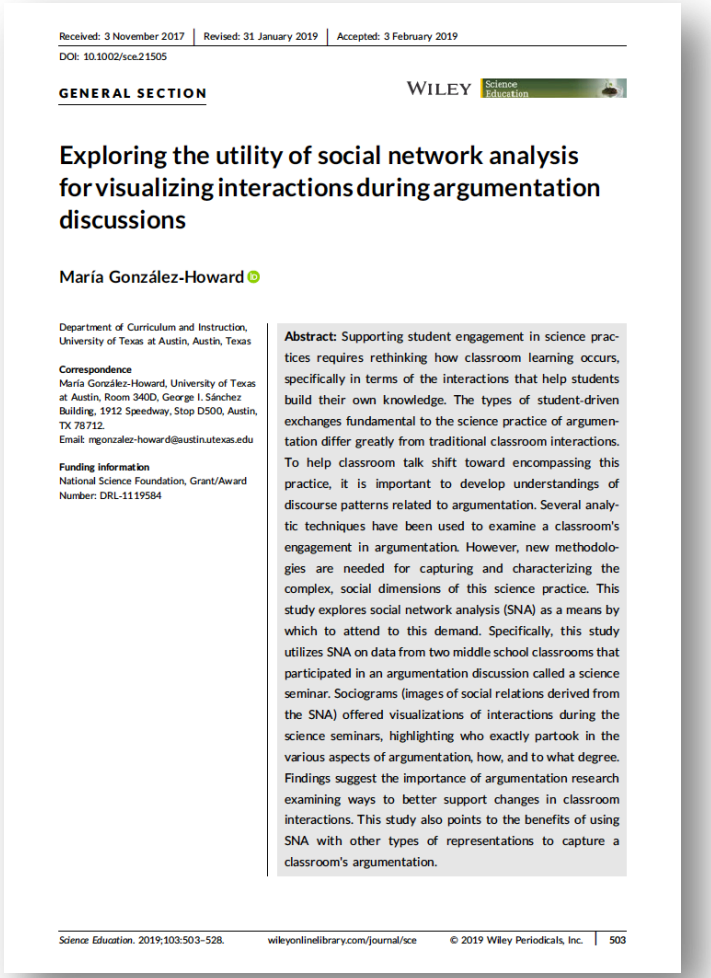
Publications referenced in overview



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GENERAL SECTION

WILEY Science Education

Exploring the utility of social network analysis for visualizing interactions during argumentation discussions

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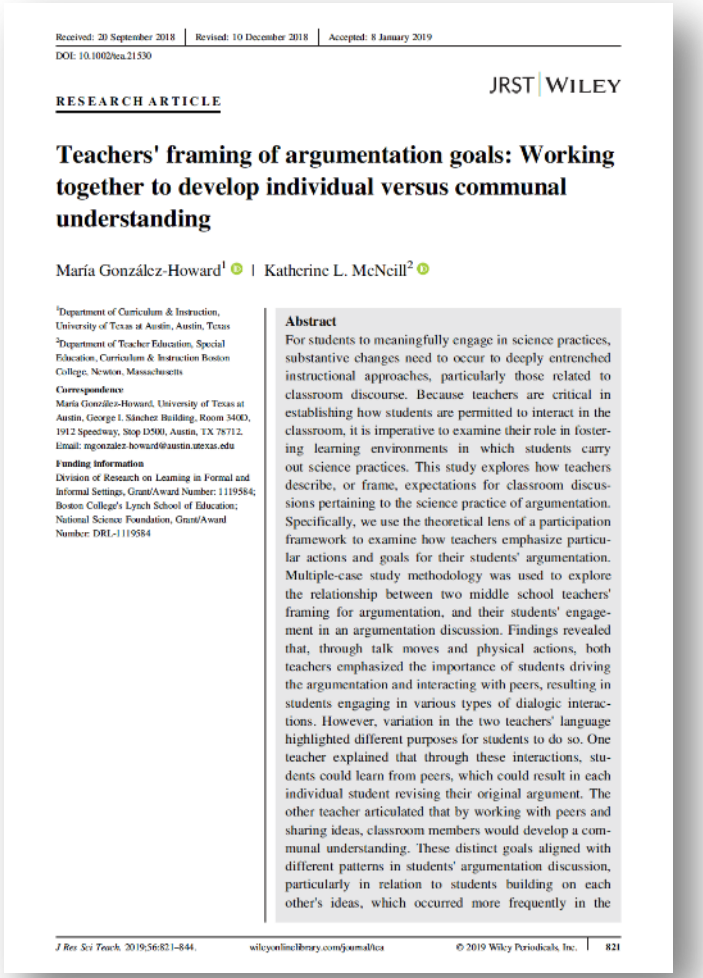
Funding information
National Science Foundation, Grant/Award Number: DRL-1119584

Abstract: Supporting student engagement in science practices requires rethinking how classroom learning occurs, specifically in terms of the interactions that help students build their own knowledge. The types of student-driven exchanges fundamental to the science practice of argumentation differ greatly from traditional classroom interactions. To help classroom talk shift toward encompassing this practice, it is important to develop understandings of discourse patterns related to argumentation. Several analytic techniques have been used to examine a classroom's engagement in argumentation. However, new methodologies are needed for capturing and characterizing the complex, social dimensions of this science practice. This study explores social network analysis (SNA) as a means by which to attend to this demand. Specifically, this study utilizes SNA on data from two middle school classrooms that participated in an argumentation discussion called a science seminar. Sociograms (images of social relations derived from the SNA) offered visualizations of interactions during the science seminars, highlighting who exactly partook in the various aspects of argumentation, how, and to what degree. Findings suggest the importance of argumentation research examining ways to better support changes in classroom interactions. This study also points to the benefits of using SNA with other types of representations to capture a classroom's argumentation.



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RESEARCH ARTICLE

JRST | WILEY

Teachers' framing of argumentation goals: Working together to develop individual versus communal understanding

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Funding information
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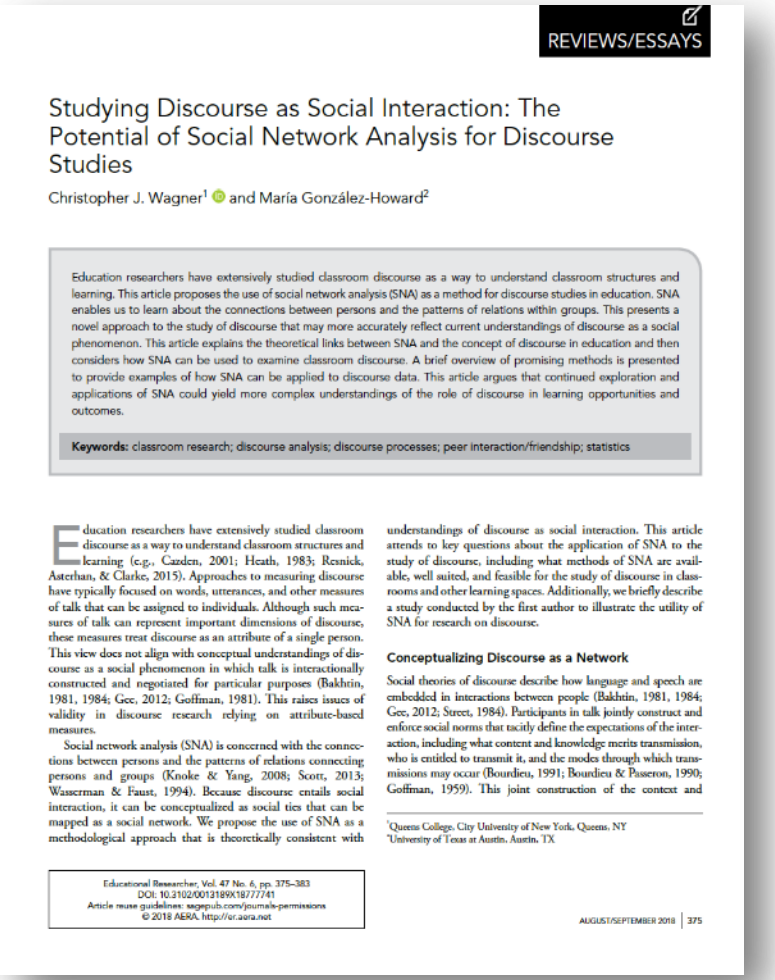
Abstract
For students to meaningfully engage in science practices, substantive changes need to occur to deeply entrenched instructional approaches, particularly those related to classroom discourse. Because teachers are critical in establishing how students are permitted to interact in the classroom, it is imperative to examine their role in fostering learning environments in which students carry out science practices. This study explores how teachers describe, or frame, expectations for classroom discussions pertaining to the science practice of argumentation. Specifically, we use the theoretical lens of a participation framework to examine how teachers emphasize particular actions and goals for their students' argumentation. Multiple-case study methodology was used to explore the relationship between two middle school teachers' framing for argumentation, and their students' engagement in an argumentation discussion. Findings revealed that, through talk moves and physical actions, both teachers emphasized the importance of students driving the argumentation and interacting with peers, resulting in students engaging in various types of dialogic interactions. However, variation in the two teachers' language highlighted different purposes for students to do so. One teacher explained that through these interactions, students could learn from peers, which could result in each individual student revising their original argument. The other teacher articulated that by working with peers and sharing ideas, classroom members would develop a communal understanding. These distinct goals aligned with different patterns in students' argumentation discussion, particularly in relation to students building on each other's ideas, which occurred more frequently in the



REVIEWS/ESSAYS

Studying Discourse as Social Interaction: The Potential of Social Network Analysis for Discourse Studies

Christopher J. Wagner[1] and María González-Howard[2]

Education researchers have extensively studied classroom discourse as a way to understand classroom structures and learning. This article proposes the use of social network analysis (SNA) as a method for discourse studies in education. SNA enables us to learn about the connections between persons and the patterns of relations within groups. This presents a novel approach to the study of discourse that may more accurately reflect current understandings of discourse as a social phenomenon. This article explains the theoretical links between SNA and the concept of discourse in education and then considers how SNA can be used to examine classroom discourse. A brief overview of promising methods is presented to provide examples of how SNA can be applied to discourse data. This article argues that continued exploration and applications of SNA could yield more complex understandings of the role of discourse in learning opportunities and outcomes.

Keywords: classroom research; discourse analysis; discourse processes; peer interaction/friendship; statistics

Education researchers have extensively studied classroom discourse as a way to understand classroom structures and learning (e.g., Cazden, 2001; Heath, 1983; Resnick, Asterhan, & Clarke, 2015). Approaches to measuring discourse have typically focused on words, utterances, and other measures of talk that can be assigned to individuals. Although such measures of talk can represent important dimensions of discourse, these measures treat discourse as an attribute of a single person. This view does not align with conceptual understandings of discourse as a social phenomenon in which talk is interactionally constructed and negotiated for particular purposes (Bakhtin, 1981, 1984; Gee, 2012; Goffman, 1981). This raises issues of validity in discourse research relying on attribute-based measures.

Social network analysis (SNA) is concerned with the connections between persons and the patterns of relations connecting persons and groups (Knoke & Yang, 2008; Scott, 2013; Wasserman & Faust, 1994). Because discourse entails social interaction, it can be conceptualized as social ties that can be mapped as a social network. We propose the use of SNA as a methodological approach that is theoretically consistent with understandings of discourse as social interaction. This article attends to key questions about the application of SNA to the study of discourse, including what methods of SNA are available, well suited, and feasible for the study of discourse in classrooms and other learning spaces. Additionally, we briefly describe a study conducted by the first author to illustrate the utility of SNA for research on discourse.

Conceptualizing Discourse as a Network

Social theories of discourse describe how language and speech are embedded in interactions between people (Bakhtin, 1981, 1984; Gee, 2012; Street, 1984). Participants in talk jointly construct and enforce social norms that tacitly define the expectations of the interaction, including what content and knowledge merits transmission, who is entitled to transmit it, and the modes through which transmissions may occur (Bourdieu, 1991; Bourdieu & Passeron, 1990; Goffman, 1959). This joint construction of the context and

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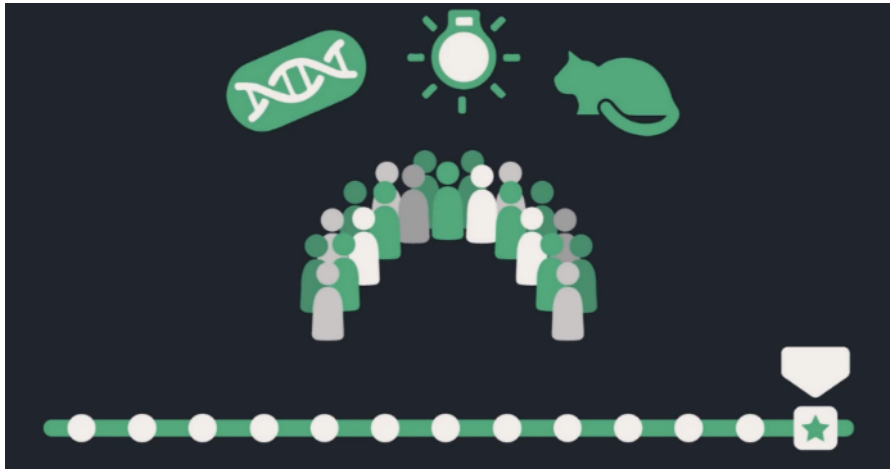
How have I used social network analysis?

- To capture and characterize the complex, social dimensions of scientific argumentation. Questions I have examined include:
  - *How can SNA be used to visualize the interactional nature of argumentation discussions?*
  - *What interactional patterns emerge around "critique" during argumentation discussions?*
  - *How does the way a teacher frames an argumentation discussion align with students' engagement in this science practice?*

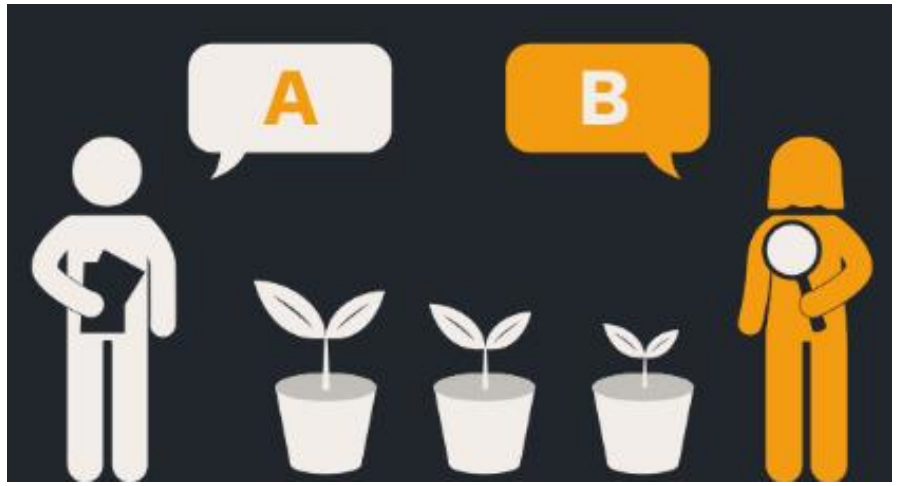


This research was funded by National Science Foundation grant DRL-1119584.

Conceptualizing scientific argumentation

Structural component

The framework of an argument includes a claim that is supported by evidence and reasoning.



Dialogic component

This component encompasses questioning and critiquing the strength of competing claims, as well as the revision of claims.

This research was funded by National Science Foundation grant DRL-1119584.

Creating sociograms

Step 1

Broke the transcripts into utterances

Step 2

Coded the utterances across the structural and dialogic components of argumentation, as well as ties between turns of talk

Step 3

Created valued, directed matrices

Step 4

Inputted all matrices into UCINET 6, and then used NetDraw (a visualization tool within UCINET 6) to create sociograms

This research was funded by National Science Foundation grant DRL-1119584.

Creating sociograms (Step 1 and Step 2)

Table 6: Coding Scheme for Dialogic Interactions

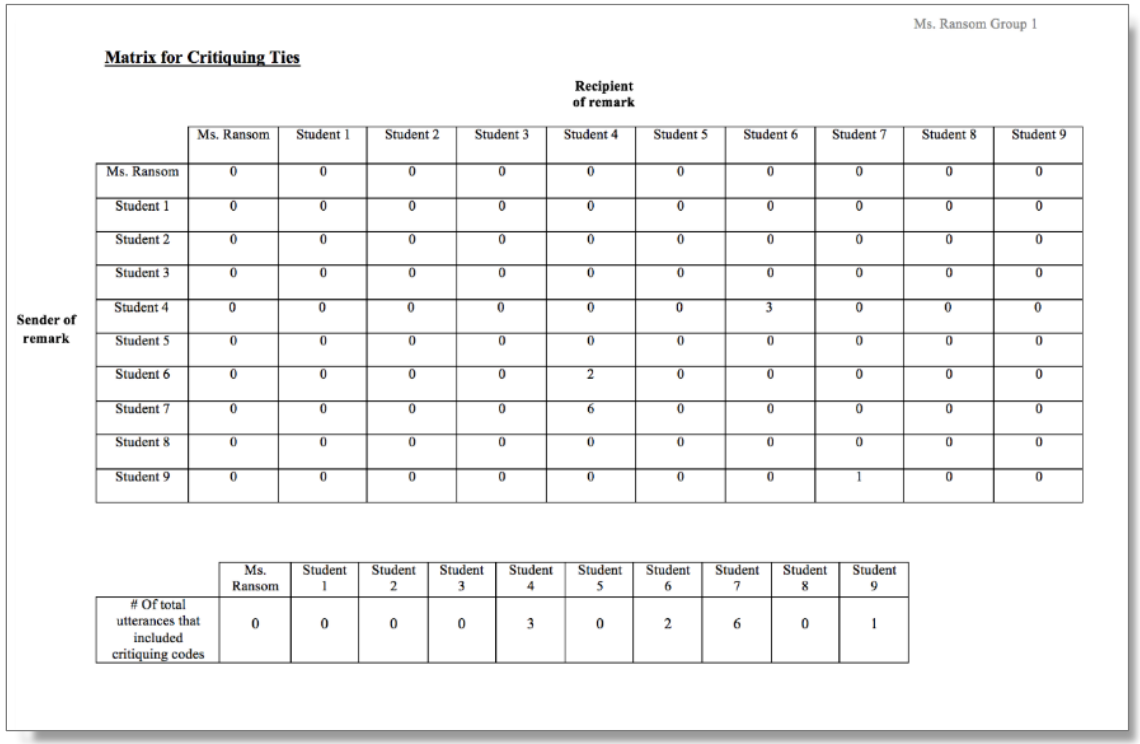
Code	Description	Example[1]
Questioning	Asking about some aspect of the discussion	"Does training to become an athlete cause you to have more mitochondria or bigger mitochondria?"
Critiquing	Evaluating some aspect of the discussion, which may include feedback	"I think the experiment where your data comes from is flawed…Just because they're twins doesn't mean their bodies are the same."
Building on other's ideas	Recognizing some aspect of a previous contribution and utilizing it to further the discussion	"Both of those are good points, and I actually think it's those two factors combined. So an athlete's body is better at releasing energy because of a combination of a larger lung capacity, and more mitochondria."
Other	All other utterances not included in the three previous codes for dialogic interactions	"I wasn't able to complete the simulation test of the athletic and non-athletic twins."

[1]Examples are embedded in the context of the *Metabolism* science seminar

Classroom Transcript		Structure	Dialogic	Ties
Turn 1				
Ms. Norman:	Why is the Atacama Desert the driest place on Earth? / It has not had any precipitation in over one hundred years.	Other / Other	Questioning / Other	None: Start of conversation
Turn 2				
Student 4:	Because, umm it stays very dry because it's not on the side of the mountain where the rain is coming. / And then, the Atacama Desert it's on, it's like right next to the Andes Mountains,/ so the Atacama won't get any rain.	Claim / Evidence/ Reasoning	Other / Other/ Other	Student 4 → Ms. Norman
Turn 3				
Student 3:	I think the reason that it's dry is because it's near cold currents / because on the map on page 13 it shows that the purple current is cold, / and it's closer to the Atacama Desert. / But then again, right near it, it gets some rain. / But it might like have the umm it might rain there but when it gets to the Atacama Desert it stops. Or it has like one drop of rain.	Claim / Evidence / Evidence / Evidence / Reasoning	Other / Other / Other / Other / Other	Student 3 → Student 4
Turn 4				
Student 9:	Also, I think the Andes Mountains might be creating a rain shadow effect on the Atacama Desert. / Umm so like all like the water there or something can't get there.	Claim / Reasoning	Building / Building	Student 9 → Student 4
Turn 5				
Student 5:	I agree with Student 9 / 'cuz like the mountains they like they might be like blocking the water or something.	Other / Reasoning	Building / Building	Student 5 → Student 9
Turn 6				
Student 3:	I disagree they might be blocking / because like clouds go higher than the mountains, but they can like the clouds might get tired and rain on the base mountain.	Other / Reasoning	Critiquing / Critiquing	Student 3 → Student 5

This research was funded by National Science Foundation grant DRL-1119584.

Creating sociograms (Step 3)

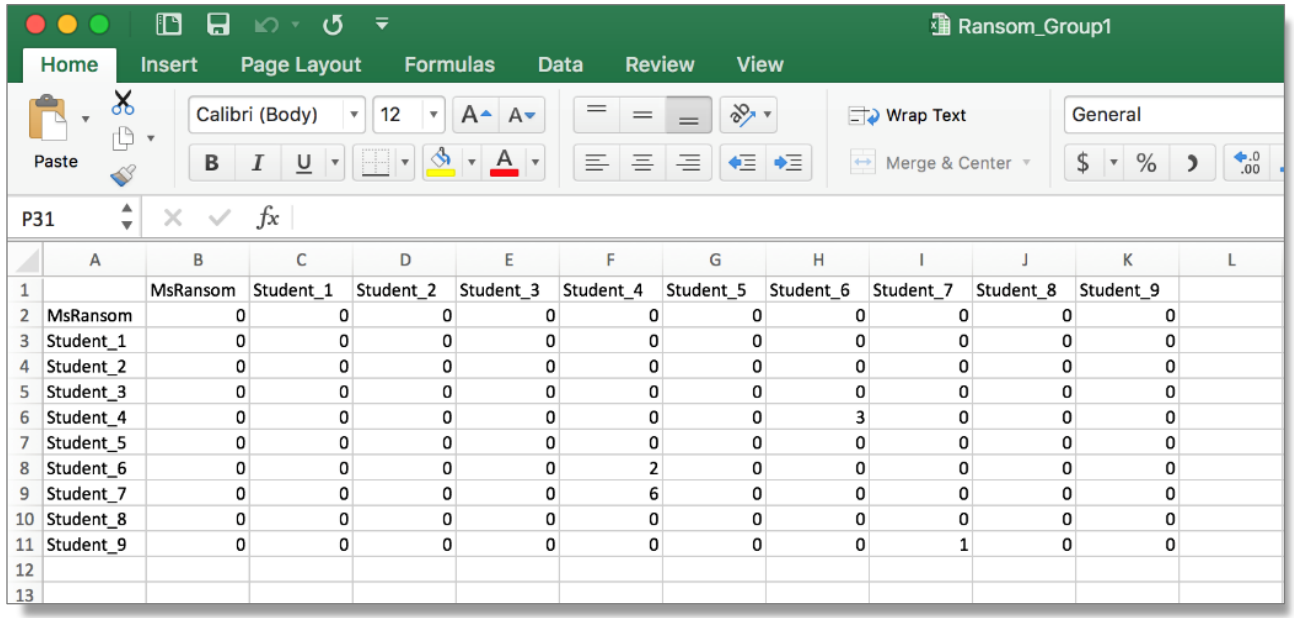


Ms. Ransom Group 1

Matrix for Critiquing Ties

Sender of remark \ Recipient of remark	Ms. Ransom	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9
Ms. Ransom	0	0	0	0	0	0	0	0	0	0
Student 1	0	0	0	0	0	0	0	0	0	0
Student 2	0	0	0	0	0	0	0	0	0	0
Student 3	0	0	0	0	0	0	0	0	0	0
Student 4	0	0	0	0	0	0	3	0	0	0
Student 5	0	0	0	0	0	0	0	0	0	0
Student 6	0	0	0	0	2	0	0	0	0	0
Student 7	0	0	0	0	6	0	0	0	0	0
Student 8	0	0	0	0	0	0	0	0	0	0
Student 9	0	0	0	0	0	0	0	1	0	0

	Ms. Ransom	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9
# Of total utterances that included critiquing codes	0	0	0	0	3	0	2	6	0	1



Ransom_Group1

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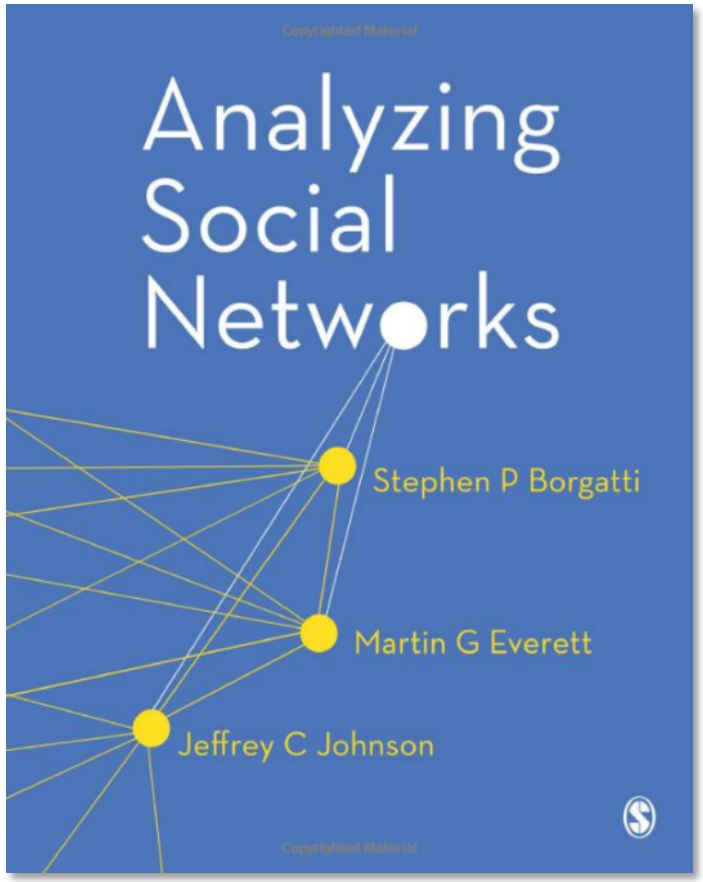
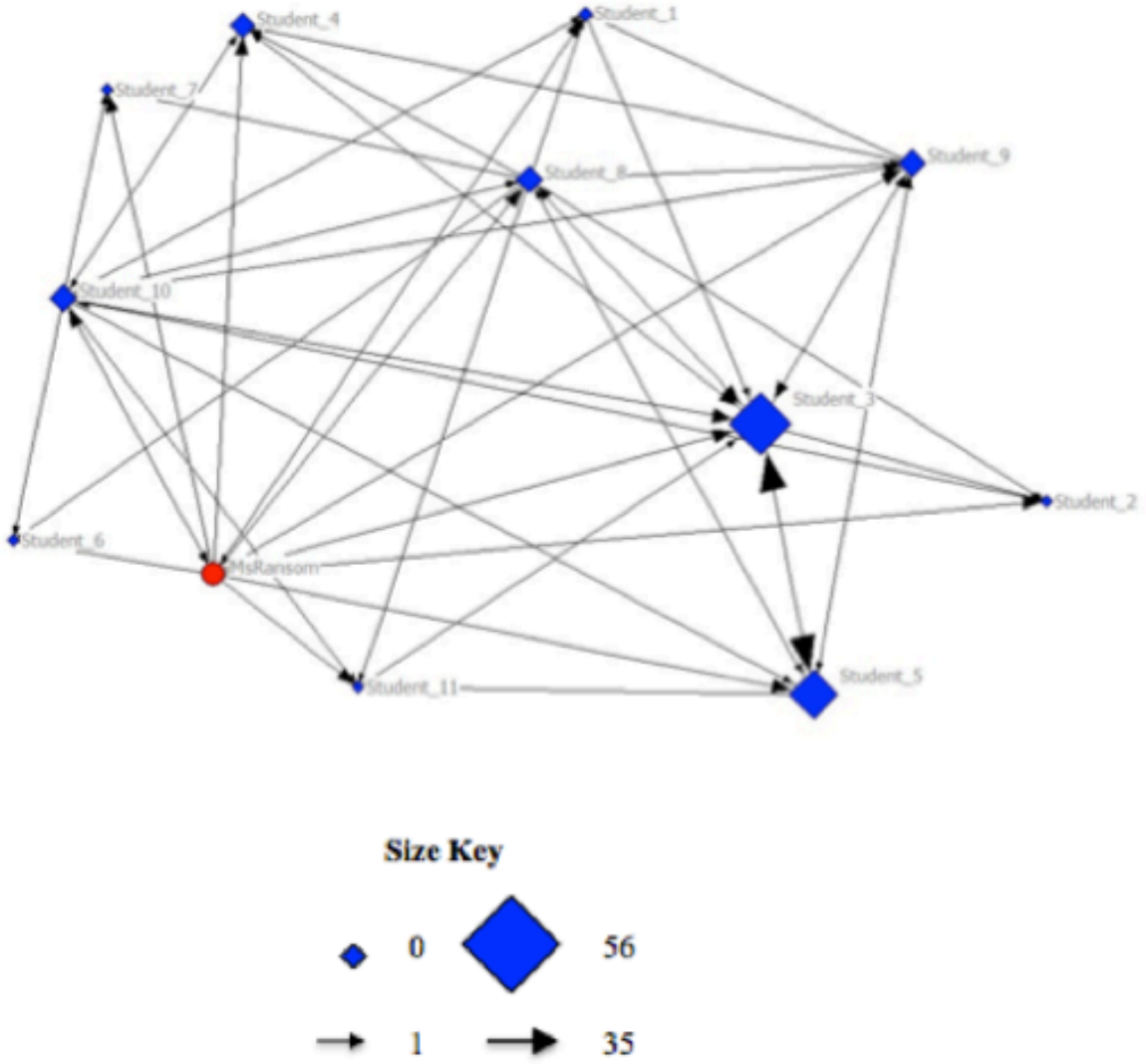
P31

	A	B	C	D	E	F	G	H	I	J	K	L
1		MsRansom	Student_1	Student_2	Student_3	Student_4	Student_5	Student_6	Student_7	Student_8	Student_9	
2	MsRansom	0	0	0	0	0	0	0	0	0	0	
3	Student_1	0	0	0	0	0	0	0	0	0	0	
4	Student_2	0	0	0	0	0	0	0	0	0	0	
5	Student_3	0	0	0	0	0	0	0	0	0	0	
6	Student_4	0	0	0	0	0	0	3	0	0	0	
7	Student_5	0	0	0	0	0	0	0	0	0	0	
8	Student_6	0	0	0	0	2	0	0	0	0	0	
9	Student_7	0	0	0	0	6	0	0	0	0	0	
10	Student_8	0	0	0	0	0	0	0	0	0	0	
11	Student_9	0	0	0	0	0	0	0	1	0	0	
12												
13												

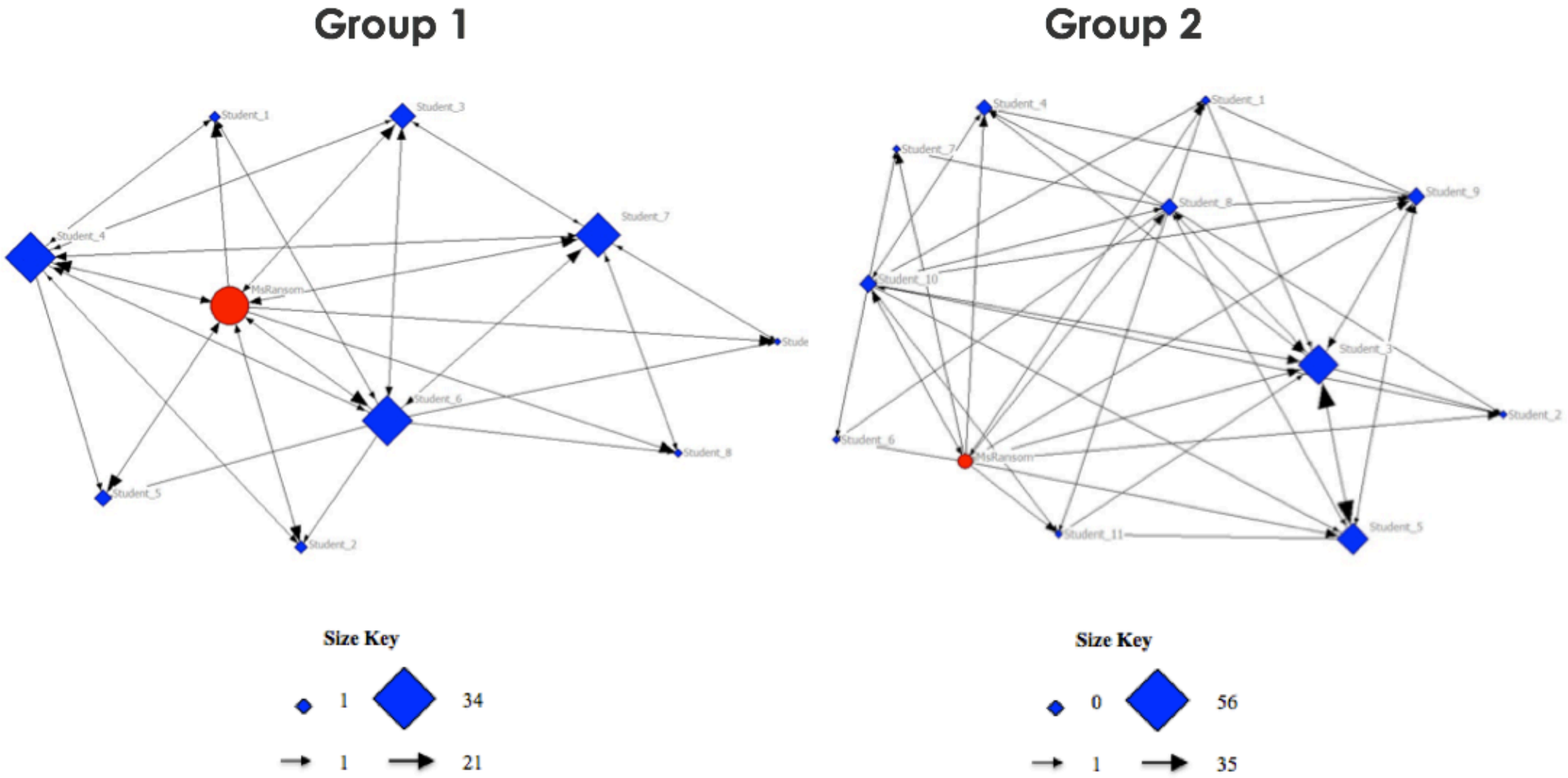
This research was funded by National Science Foundation grant DRL-1119584.

Creating sociograms (Step 4)



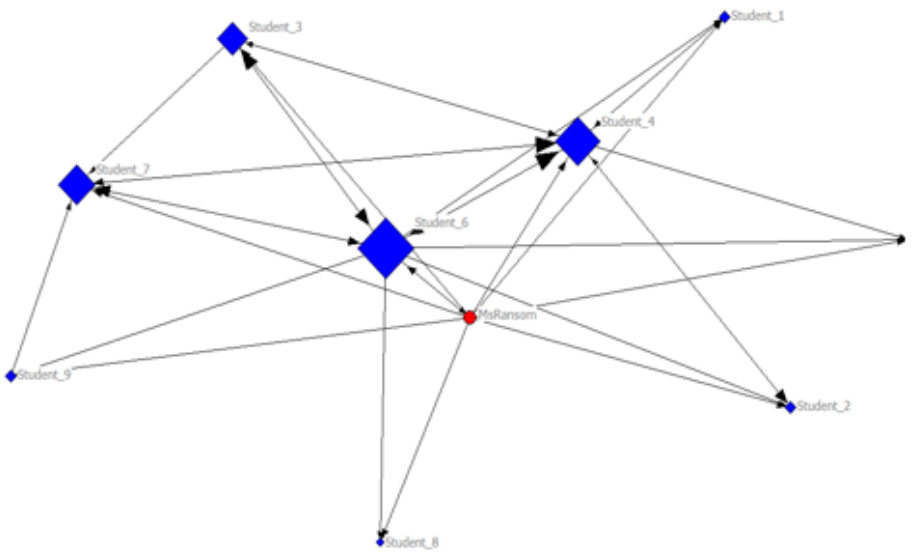


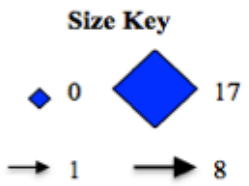
Visualizing scientific argumentation through sociograms



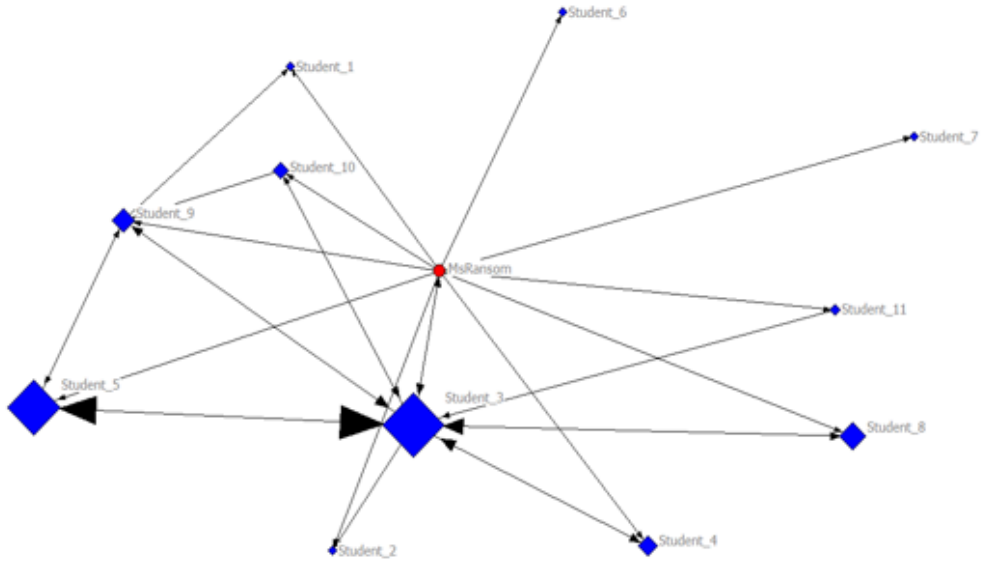
Visualizing scientific argumentation through sociograms

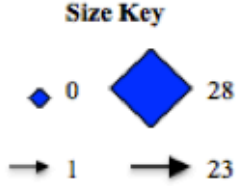
Group 1



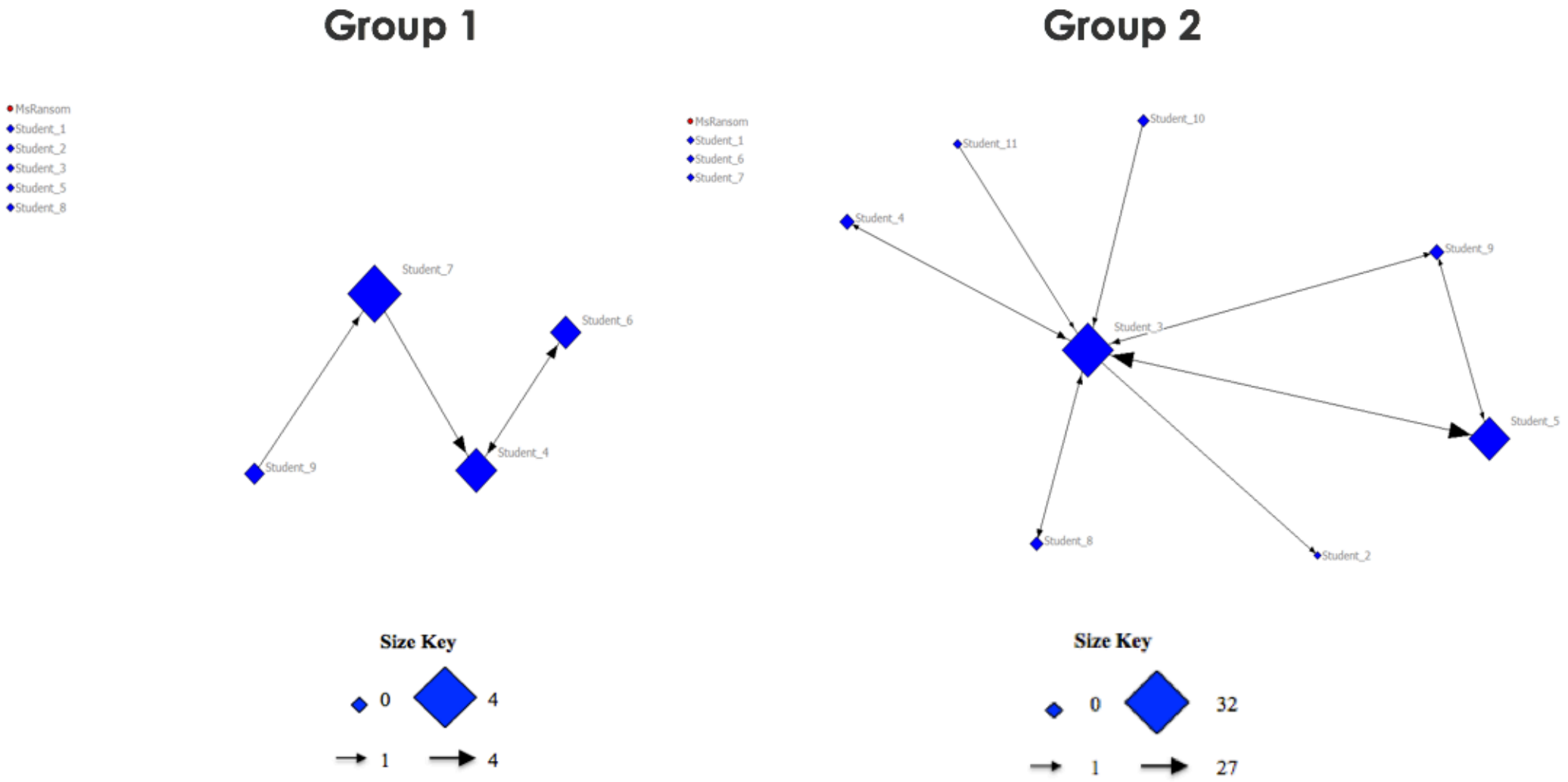


Group 2





Visualizing scientific argumentation through sociograms



Potential use of SNA for future discourse research

- To study change in classroom discourse patterns over time (e.g., exploring the ways sociograms developed from classroom discussions at different time points of the school year change).
- To examine factors (e.g., race, gender, language[s] spoken) and how they might relate to engagement in classroom discourse.
- To support teacher and student learning (e.g., providing sociograms to classroom members to help them examine various aspects related to their own engagement during classroom discourse).

Before we move on,
are there any questions?

Research spotlight

Susan Yonezawa, PhD

Project Research Scientist

University of California San Diego – CREATE

syonezawa@ucsd.edu

SAN DIEGO MATH NETWORK

A social network for regional math teachers

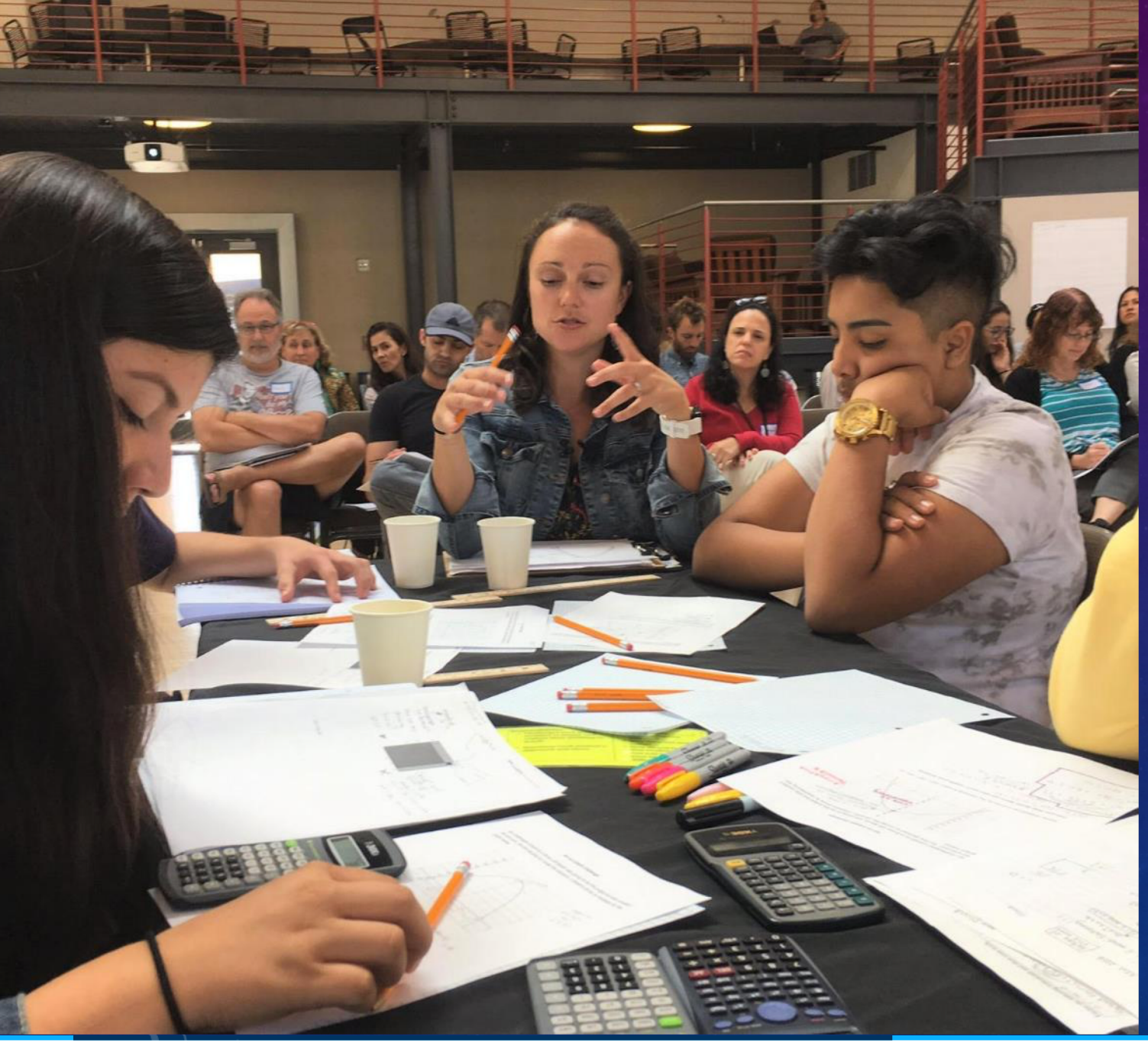
A BMGF-funded project: Yonezawa, Pollock, and Daly

RESEARCH QUESTIONS

1. What are the current state of network connections within and across districts' mathematics teachers and mathematics leadership?
2. What are the current mathematics struggle points for students and teachers in the elementary and middle school transitional grades; that is, where do kids struggle the most to learn and to retain the mathematics; what are teachers struggling the most to teach well; what are the key leaks in the K–12 "pipeline," specifically those problems surrounding the elementary to middle school transition point?
3. How can innovative instructional practices and curriculum be shared to improve classroom practice within the network and beyond?

LEARNING TO GROW A NETWORK OF EDUCATORS

- **Four-year project** funded by the **Gates Foundation fostered, tracked, and improved math educator networks** across four school districts.
- SDMN learning events engaged **hundreds of distinct participants** across approximately **30 learning events** annually, with many educators returning for multiple events.



LEARNING TO GROW A NETWORK OF EDUCATORS

SDMN first focused on district "intermediate" resource teachers.

- Network analysis over time revealed that **principals** were key nodes – seeking and sharing resources and catalyzing teacher participation in learning.
- **Over time, teachers**, too, emerged in network maps as key influencers in some districts.

Table 2: Network Relations and Interaction Scale Under Study

Network relation	Network question	Interaction scale
Advice	How often do you typically turn to each individual for advice to strengthen your own mathematics teaching?	Yearly, monthly, weekly, and daily
Collaboration	How frequently do you collaborate with each individual around strengthening your math teaching (by "collaborate" we mean mutual work, sharing, and exchanging ideas)?	Yearly, monthly, weekly, and daily
Materials	Please select the frequency of interaction with the individuals from whom you receive instructional materials related to math that you use in your teaching (by "instructional materials" we mean any tangible item you use in your math practice such as worksheets, online tools, manipulatives, assessments, lesson plans, rubrics, or other related materials).	Yearly, monthly, weekly, and daily
Positive energy	When you interact with this person, how does it typically affect your energy level?	Strongly deenergizing, deenergizing, energizing, strongly energizing, n/a

FINDINGS

As the network became more robust:

- **"Instructional support staff" (district office personnel) became the least newly active across the network and had the least amount of growth in interactions.**
- **Meanwhile, educators were doubling or tripling their ties in network cohesion.**

FINDINGS

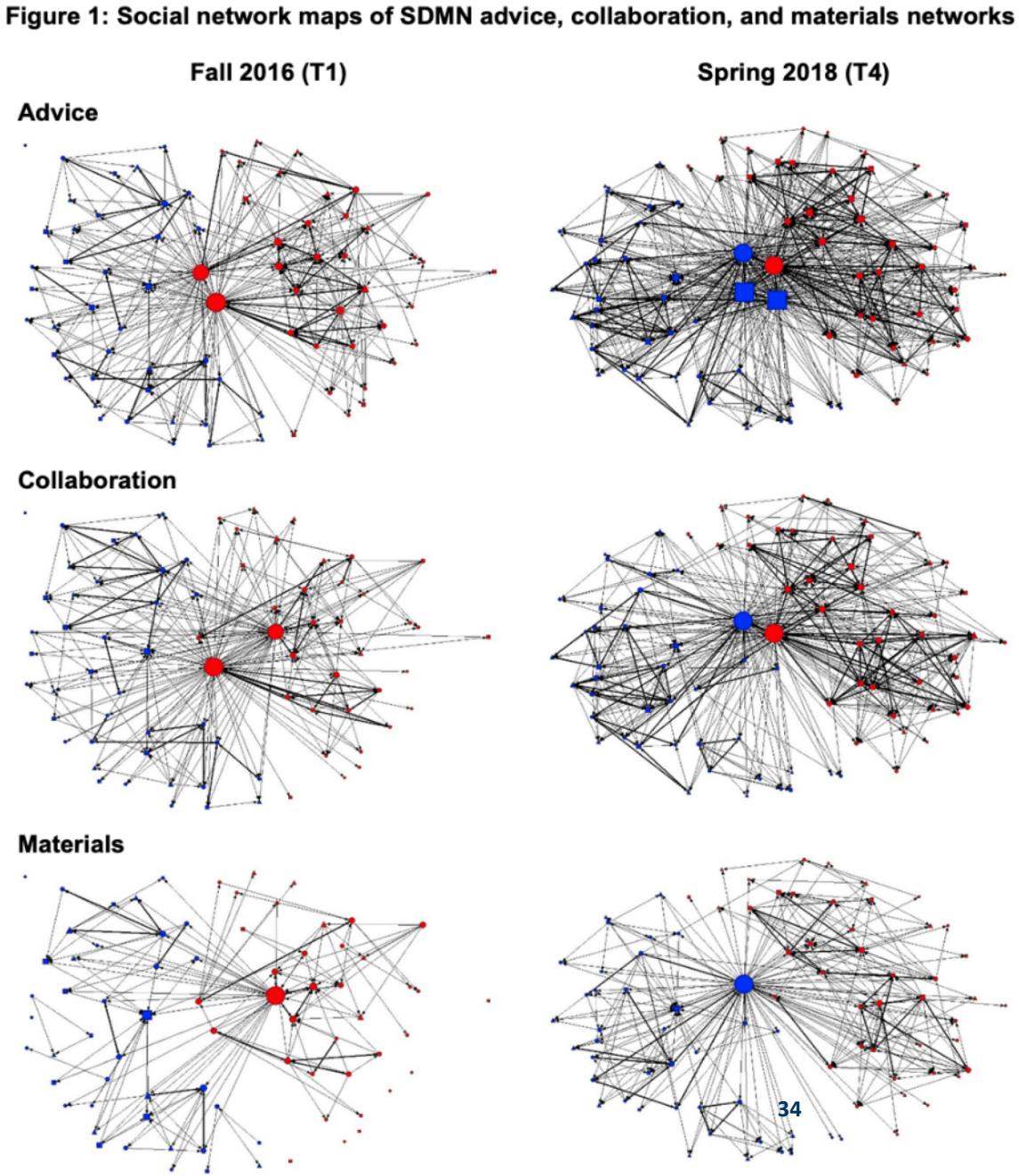
- **RISE OF THE TEACHER – Teachers developed more connections to one another. Everyday teachers of mathematics were connecting to one another more.**
- **Diffusion of expertise was occurring, and there were more pathways for concentrated expertise to get to teachers… and thus into the hands of more folks.**

Table 4: Network Cohesion Measures

Measures	Fall 2016 (All participants)	Spring 2018 (All participants)	Fall 2016 (Stayers)	Spring 2018 (Stayers)
Advice				
Average Degree	5.2 ties	9.3 ties	3.9 ties	8.3 ties
Density	7%	11%	7%	15%
Fragmentation	0.57	0.39	0.75	0.40
Reciprocity	14%	18%	9%	19%
Collaboration				
Average Degree	4.2 ties	6.7 ties	3.5 ties	5.9 ties
Density	6%	8%	6%	10%
Fragmentation	0.70	0.39	0.77	0.44
Reciprocity	13%	21%	11%	22%
Materials				
Average Degree	2.2 ties	3.8 ties	1.6 ties	3.2 ties
Density	3%	5%	3%	6%
Fragmentation	0.84	0.74	0.88	0.74
Reciprocity	9%	13%	9%	13%
Positive Energy				
Average Degree	3.6 ties	5.1 ties	2.3 ties	5.1 ties
Density	5%	9%	4%	9%
Fragmentation	0.51	0.36	0.78	0.36
Reciprocity	23%	27%	20%	27%

SAN DIEGO MATH NETWORK

ADVICE, COLLABORATION, AND MATERIALS NETWORKS



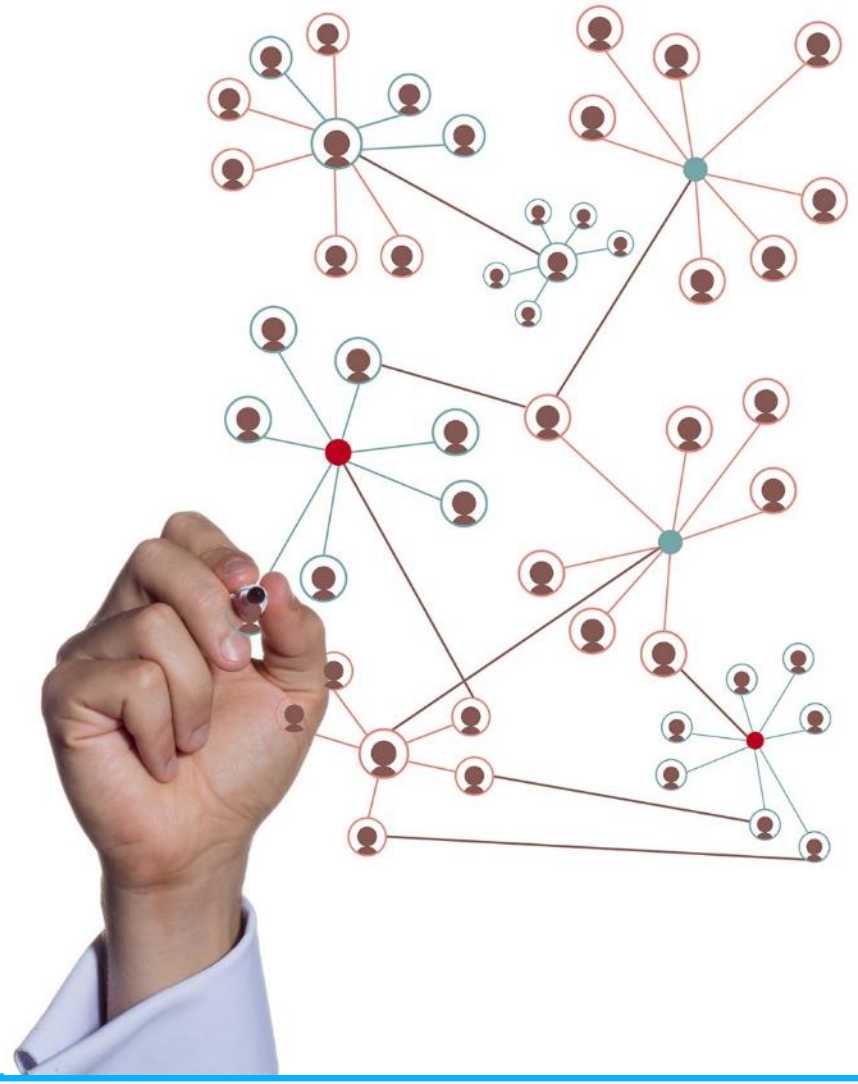
Before we move on,
are there any questions?

Discussion

Discussion

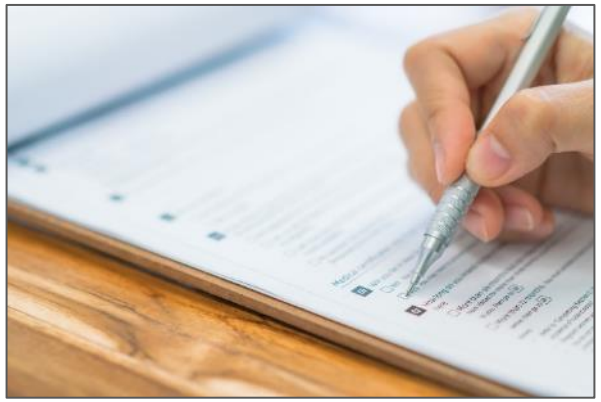
- What **key things should researchers consider** when designing research using social network analysis?
- What **challenges did you face** using social network analysis, and what guidance would you give someone for **how to address such challenges**?
- What are some **resources or tools** that helped you learn and apply social network analysis?

Add your questions in the chat pod!



Looking forward

Looking forward



Please fill out a feedback survey following the webinar.

http://cadrek12.org/

Recording will be available soon on the CADRE website.

Look for webinars this summer on systematic literature reviews and meta-analysis.

Thank you!

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MAKING
RESEARCH
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THANK YOU

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