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Edited by:

Brendan Eagan, Morten Misfeldt, Amanda Siebert-Evenstone

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**First International Conference on
Quantitative Ethnography:
Conference Proceedings Supplement**

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Understanding Off-Topic Utterances: Do Off-Topic Comments Serve a Purpose in Collaborative Learning?

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Abstract: *School Scene Investigators: The Case of the Mystery Powder* was designed to foster collaborative learning and scientific practice. This study examined three team conversations to resolve whether off-topic utterances deter or support learning. Transcripts were coded for scientific practice and social attributes. ENA revealed that off-topic utterances were strongly connected to communal language at the game's beginning; by the end, the relationship had weakened—communal language became strongly connected to discussing data.

Subject/Problem

For over two decades, researchers have known that groupwork can lead to significantly higher achievement over individual work (Stevens & Slavin, 1995). Recently, students playing collaborative games have started to demonstrate similar achievement gains (Chang & Hwang, 2017). However, research has shown that off-task behavior can impede learning in game-based environments (Sabourin et al., 2011). Yet, off-topic discourse is not entirely bad; Barkaoui et al. (2008) found that off-topic discussions played a critical role in collaborative learning particularly with the social, affective, and cognitive aspects. According to Miyake and Kirschner (2014), we do not fully understand the mechanisms between social interaction and collaborative learning. Therefore, we investigated the network connections between scientific practices and social attributes of language for groups playing *School Scene Investigators: The Case of the Mystery Powder*, a game designed to foster collaborative learning and scientific practice. To assess the extent to which social elements of collaborative discourse are linked with scientific practice, we used epistemic network analysis (ENA), a novel method for analyzing elements in coded data and then representing the connections as dynamic network models (Shaffer, Collier, & Ruis, 2016). Specifically, this study examined: *How do connections between scientific practice and off-topic utterances change during gameplay?*

Design/Procedure

Players were 8th grade science students from a diverse, urban middle school in northeast USA. The game experience consisted of three chapters played over a few class periods. 35 groups played the game; 3 groups were chosen for analysis. The selected teams were audio recorded during the game. All discourse was transcribed to clearly delineate conversational turn-taking. In total, 2700 utterances were coded for scientific practice and social attributes. When students discussed what was known about the investigation, it was coded as *Defining the Problem (SP1.Problem)*. When students discussed characteristics of the experiments, the dialogue was coded as *Interpreting Data (SP4.Data)*. When students addressed the group collectively, it was coded as *Communal*. Other social attributes included expressing confusion (*Confusion*) with statements such as “I have no idea” and off-topic comments (*Off-Topic*) about their clothes, after-school activities, movies, and popular music. Off-topic comments had nothing to do with the task at hand.

Findings and Analysis

To investigate our research question, we created an ENA model. Connections between scientific practice and social attributes in Chapter 1 were compared to connections occurring in Chapter 2 and Chapter 3. Figure 1 shows the plotted points of activities in Chapter 1 (red), Chapter 2 (blue), and Chapter 3 (purple). Along the X axis (SVD1), a Mann-Whitney test showed that Chapter #1 was statistically significantly different at the $\alpha=0.05$ level from Chapter #2 and that Chapter #1 was also statistically significantly

different from Chapter #3. Figure 2 shows that off-topic utterances were strongly connected to communal language in the beginning, yet communal language was strongly connected to interpreting data by the end.

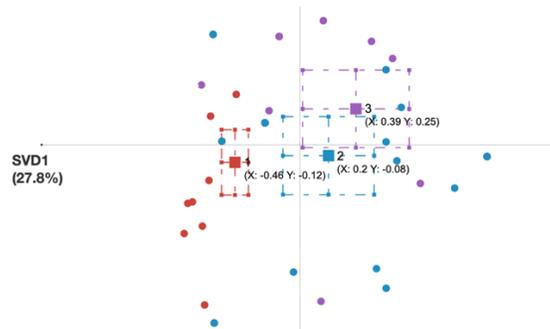


Figure 1. Comparison plot of all game chapters

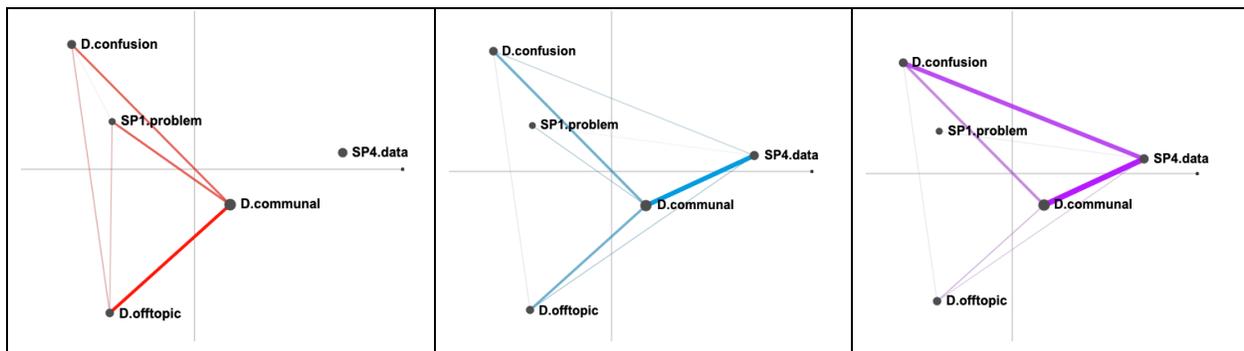


Figure 2. Network diagrams for individual game chapters.

Discussion and Conclusion

Ernest and Reinholz (2018) argue off-topic talk helps groups build trust and work out their power dynamics. In this study, off-topic talk was used early in the game while addressing the group collectively. It seems groups used off-topic comments early to establish trust and community. As the game progressed, off-topic talk faded away; by Chapter 3, off-topic talk does not have strong ties to any codes. The strong relationship between discussing data and communal language pulls the diagram right. With well-organized dynamics established, teams discussed data using productive, supportive dialogue. Group trust led to great team talk.

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A Case Study of #MeToo Analysis with Epistemic Network Analysis

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Abstract: This case study aims to investigate how people made meanings in the #MeToo discourse by analyzing connection patterns of ideas from a Twitter dataset. Using Epistemic Network Analysis, the result showed that two groups divided in terms of time made significantly different patterns of connections. While the first group tended to support the movement with empathic emotions, the second group was interested in the effect of movement with respect to public figures.

Introduction

#MeToo movement, founded in 2006 by social activist Tarana Burke, spread virally in October 2017 with the hashtag ‘Metoo’ to share personal narratives and support survivors. That the #MeToo hashtag has been used more than 19 million times on twitter (Anderson&Toor, 2018) implies that sexual assaults and harassments have been pervasive among women. While previous #MeToo studies focused on a keyword-based analysis (Xiong et al, 2019 & Manikonda et al, 2018) , this paper is a case study of the #MeToo with a limited amount of tweets using Epistemic Network Analysis to investigate how people made connections among different ideas.

According to Philips (2018), one of the most significant aspects of the #MeToo movement is how people resonated with the topic. That is, individuals “added their own personal stories”, rather than simply retweeting or liking. In addition, since #MeToo is a big discourse with diverse topics and agents, people tend to add different stories or opinions on the same topic. For example, when discussing the effect of the movement, one tweet wrote that this can be a great start of the social change, while other tweet argued that this can be a start of a ‘total witch hunt’. Considering this, analyzing how people connected each topic and made meaning out of it can be helpful to understand the discourse of this movement. For the analysis, Epistemic Network Analysis was used, a method providing a quantitative model for how codes are connected in discourse (Shaffer, 2017). I used web-scraped Twitter data dated from November 29 to December 25, 2017 and selected a few of them to form two groups in order to find possible differences of connection patterns between those two groups. Thus, this study asks: *Do two groups show different patterns of connections?*

Method

Data

The original dataset, retrieved from the website *data.world* by the user @balexturner had 390,000 tweets under the #MeToo hashtag dated from Nov 29 to Dec 25, 2017. Using the given metadata, tweets that were not retweets, not truncated and did not have further replies were selected only. Due to the limited time span of the data, I selected the first 6620 tweets (From Nov 29 to Dec 3) as FirstGroup and the last 6621 tweets (From Dec 22 to Dec 25) as LastGroup to investigate any differences within the data.

Discourse Analysis

The discourse was coded with 5 different codes that appeared frequently in the data; MovementEffect, MovementSupport, Backlash, Celebrity and SympathyForAssault. Considering the size of the dataset, I used regular expressions to check existences of the codes in each tweet. Five codes were validated by comparing hand-coded utterances to the automated coding tool, *nCoder*. All of them were statistically significant, with Cohen’s kappa above 0.65 and Rho values below 0.05.

Result



Figure 1. ENA plot of the first group (left) and the last group (right)

In the first group (Figure 1, left), SympathyForAssault was the code that has the most connections between other codes. This might tell us that tweets in the first group had a tendency to connect other ideas with sympathy or even empathic anger. Among them, the thickest line came from the connection between SympathyForAssault and MovementSupport. Given that thickness means how strong the connection is between two codes, this plot implies that tweets in the first group showed a strong pattern of connecting SympathyForAssault and MovementSupport (line weight=3.14). For example, many tweets from the first group showed a very similar pattern like this:

I am trying to come up with words to describe how unbelievably sad(SympathyForAssault) this makes me. <https://t.co/2O4DwHEOML> #BelieveWomen(SympathyForAssault, MovementSupport) #MeToo

From the qualitative data, we found that people in the first group often expressed their sympathy and a sense of support together. Rather than supporting the movement or survivors based on logical reasons such as how this movement can be helpful to change our lives (MovementEffect), the first group supported the movement or survivors with emotions.

On the other hand, the last group showed the thickest connection between Celebrity and MovementEffect (line weight=2.46) according to Figure 1 (Right). One tweet example is as below.

The Economist | The year of(MovementEffect) Hurricane Harvey(Celebrity) via @TheEconomist #MeToo <https://t.co/w8cuzzMwig>
(Re-post of the article from the Economist)

In the last group, all tweets that showed both codes were re-posts of news articles covering the impact that #MeToo movement has. Those tweets did not add any personal opinions but simply shared the titles and hyperlinks of the articles. Therefore, we can conclude that the tweets from the last group were interested in the connection between MovementEffect and Celebrity, specifically in the news articles. This may due to the fact that many news platforms wrapped up 2017 and gave a spotlight to the movement, especially with respect to public figures, as the end of the year came closer. Or that there was no reported celebrity allegation during the timespan of the last group might have given people a chance to look back on those. However, further research with more data is needed to examine those explanations.

Also, Along the X axis, a two sample t-test assuming unequal variance showed that the first group(M=.25, SD=.59, N=375) was statistically significantly different at the alpha=.05 level from the last group(M=-.64, SD=.99, N=145; t(185.06)=10.16, p=0.00, Cohen's d=1.23). Therefore, we can conclude that there is a different pattern of connections between two groups.

Since this is a case study with limited amount of data, further research with more data or a longer timespan is needed to examine different patterns of connections in the #MeToo discourse in-depth.

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Appendix

Table 1. Codebook

Code	description	Example	Rho	Kappa
Movement Effect	Discusses the aftereffect or meaning of the movement	God, I hope its the start of social change. #MeToo https://t.co/skFkhIx7wb	0.01	1
Movement Support	Shows any kinds of support for the movement so that it can keep going on. Mostly 1) expressing messages of support 2) showing that they will not endure any sexual harassments, thereby supporting the movement or 3) supporting the survivors	Let all #metoo show support and encouragement as she joins the movement.	0.01	0.87
Backlash	Shows or mentions any kinds of backlash	meanwhile the feminists in worldwide only plays #metoo as witch hunting game. https://t.co/ykuUBswueJ	0.01	0.86
Celebrity	Mentions public figures or entertainment fields that have been accused of/related to sexual harassment	Geraldo Rivera says "news is a flirty business." #MattLauer #NoMoore #MeToo #WomenResist #RWU https://t.co/3iBw7zmCdc	0.01	0.86
SympathyFor Assault	Shows sympathy or empathic anger for the reported assaults.	Zero sympathy for all the dudes who've been fired and/or humiliated by sexual harassment charges. You deserve it, fuckers. #MeToo	0.04	0.78

Exploring the Lived Experience of a Family Member with Advanced Heart Failure: Using a Text Mining Approach

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Abstract: The purpose of this secondary analysis of serial interviews is to understand caregiving experiences of family caregivers caring for people with advanced heart failure. In this study, text mining techniques (e.g., topic modeling, and sentiment analysis) will be used to develop a robust understanding of the evolving experiences of participants (N = 102). We suggest that the quantification of textual data can improve the quality of qualitative data interpretation functioning as a methodological triangulation.

Background

Due to the fact that heart failure has a progressive, chronic, but unpredictable trajectory of illness, the needs of support for patients and their family caregivers are increasing. Currow, Johnson, and Ekström (2018) stated that family caregivers of heart failure population suffer from the unpredictable duration of caregiving when compared with other family caregivers and their lack of resources for perception of illness, symptom management, and psychological support. Nevertheless, family caregivers of patients with heart failure play a pivotal role in managing patients. For instance, they provide physical assistance with activities of daily living, management of patients' self-care, symptom management, medication adherence, and device (e.g., implantable cardiovascular defibrillator [ICD] and left ventricular assist device [LVAD]) monitoring (Grant & Graven, 2018). A body of theoretical and empirical work has indicated that the availability of family caregivers improves the quality of life of patients with heart failure.

Related Work

Being a family caregiver means an adaptation to new roles and changes regarding daily lives and individual well-being. Supposedly, caregiving for a person with terminal illness affects family members psychosocially as well as physically (Bidwell, Lyons, & Lee, 2017). Over the years, an enormous amount of research has been devoted to identify the negative outcomes from caregiving. For example, family caregivers would experience caregiving burden, anxiety, depression, and isolation, if they were involved in extended caregiving. The review of the literature shows that family caregivers of dying people are more likely to be diagnosed with mental illness and chronic disease, and their mortality rates are higher than non-caregiving population (Grant & Graven, 2018; Gusdal et al., 2016).

Significance of the Study

Firstly, past work has primarily focused on the negative aspects of caregiving experience; the positive experience of family caregiving for patients with terminal illness has been relatively unexplored. At this juncture, discovering positive outcomes from caregiving can redirect the development of interventions or services for family caregivers and enrich the resources for supporting family caregivers.

Secondly, although several scholars have conducted research on caregiving experiences around heart failure population, most of them used cross-sectional and descriptive correlational designs. However, the longitudinal qualitative secondary data derived from the serial interviews will contribute to helping

healthcare professionals understand the changes of family caregiving experiences across the progress of patient's illness.

Thirdly, in qualitative data analysis, the risk of imposing the code or interpretational structure over the original participants' experience or meaning is easily neglected. For this reason, combining a conventional content analysis with a text mining approach can contribute to reducing the over-simplification issues in qualitative data analysis and recovering the actual experiences and its meanings of participants.

Aims of the Study

The aims of this study are as follows: (1) to investigate the shared experiences of family caregivers of patients with advanced heart failure¹; (2) to describe the longitudinal trajectories of advanced heart failure caregiving experience; and (3) to explore the patterns of family caregivers' emotional changes across their caregiving periods.

Research Design and Methods

The primary study of this secondary qualitative research was a longitudinal, qualitative descriptive study driven by grounded theory (NIH grant ID has been blinded for review). The purpose of the original study was to explore the end-of-life trajectories of patients with advanced heart failure and their family caregivers, and to identify their palliative care needs and determine the optimal time for consulting palliative care services. The dyads were recruited from one academic medical center and one inner city hospital, both located in central Pennsylvania, USA. Finally, 100 patients with advanced heart failure and 102 family caregivers were recruited and interviewed at monthly time intervals until the patients died. The initial interview was 45-60 minutes in length followed by shorter monthly interviews of 15-20 minutes. In this study, the qualitative data collected from 102 family caregivers will be used.

In this proposed secondary data analysis, we will use topic modeling, one of the unsupervised machine learning techniques, to elicit main themes from the huge amount of interview transcripts (Jelodar et al., 2017). Among the methods of topic modeling, latent dirichlet allocation (LDA) which assumes that each document and word are on a probabilistic distribution will be employed. In the meantime, to capture subjective information such as opinions, attitudes, and feelings expressed in text, a lexicon-based method for sentiment analysis will be used.

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¹ In 2007, the Heart Failure Association (HFA) of the European Society of Cardiology (ESC) began to use the term "advanced heart failure" to describe the terminal stage of heart failure characterized by worsening cardiac decompensation, severe symptoms, and poor quality of life.

A Case Study to Examine the Relationship Between Learner-Generated Drawings and Adaptive Reasoning when Middle School Students Work in Pairs on Mathematical Tasks

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Introduction

Current status studies and research: I am currently enrolled in doctoral studies at Utah State University. All coursework is complete. I am expected to propose and conduct my study in the Fall of 2019, with a defense scheduled Spring of 2020. I have completed a class project, piloting my study. Presently, I am exploring the data using the online ENA tool and working with students/staff at University of Wisconsin to better understand results and interpretations.

Expected benefits: to share my project and view others projects with the expectations of learning more about Epistemic Network Analysis (ENA) and qualitative ethnography (Shaffer, 2017). In particular, I am eager to better understand more about the analysis end of using ENA. In my research, I am measuring student adaptive reasoning within a mathematical task through student dialogue and active drawings. I am hoping learn a systematic process for discovering patterns in data and understand boundaries in which to discuss findings of quantitative ethnography.

Study Summary

Abstract

Inquiry learning provides a platform where learners can experience real world problem solving. This case study utilizes mixed methods approach including quantitative ethnography to observe adaptive reasoning of six 7th-grade partnered students as they create learner generated drawings to solve mathematics inquiry tasks. Researcher explores middle school students' unique adaptive reasoning patterns when pairs of students' dialogue as they create drawings representative of mathematical thought. The study utilized a qualitative grounded theory approach, selectively coding screencast task dialog and student drawings for adaptive reasoning indicators such as: situational connections, alternate considerations justifications and explanations, reasons and proofs, prior knowledge integration, deductions, disagreements and arguments, pattern recognition and legitimacy determination. Screencasts of student drawings were coded and analyzed using Epistemic Network Analysis to determine inferences of student dynamic interactions.

Goals of the research

The purpose of this convergent parallel, mixed method study (Teddlie & Tashakkori, 2009) is twofold: 1) to discover how seventh-grade students adapt their reasoning as they converse and draw to solve a 3 Act Math task (Meyer, 2011), and 2) to discover connections of adaptive reasoning use to student achievement during a 3 Act Math task. Additionally, this study provides a mixed methods design effective

in observing mediation and moderating factors within classroom strategies using the combination of qualitative analysis and quantitative ethnography.

Background of the project

Mathematics gives us the power to take a real-life problem, struggle to convert it into a mathematical representation, calculate, illuminate the situation, and push it back into the real world as a solution. Unfortunately, classroom learning time too often focuses on the calculation step rather than viewing the entire mathematics process. This project began as an effort to create opportunities for this real-life transaction to take place in the classroom more often. In researching classroom strategies, the researcher found that Guided inquiry learning, an effective learning strategy (Hmelo-Silver, Duncan, & Chinn, 2007), allows students struggle time with explicit mathematical concepts and affords students a view of the entire process; yet teachers exposed to inquiry learning use it less than they would like (Capps & Crawford, 2013; Maass, Swan, & Aldorf, 2017). The researcher sought out specific inquiry learning strategies, conducive and presently used in to the classroom setting, to observe in a case study format into offer and afford teachers a usable tool and hence increase inquiry learning in the classroom.

Methodology

The strategy chosen in this case study is learner generated drawings of students as they inquire and solve 3 Act Math Tasks. Historically, researchers quantitatively focus studies about inquiry learning by comparing a strategy to posttest results. This study instead observes students more closely as they interact with fellow students and teachers and adapt their reasoning. Treating the inquiry learning that occurs in the task as an element of the class culture, and hence following a more ethnological research model that examines elements of student adaptive reasoning within the context of a detail rich classroom. The following research questions are presented to examine the construct of adaptive reasoning (Kilpatrick, 2001) by observing students as they progress through an inquiry mathematical task using the strategy of drawing with partners.

1. How do learner-generated drawings relate to adaptive reasoning of pairs of seventh-grade students as they discuss and solve guided inquiry mathematical tasks?
 - a. What types of adaptive reasoning occur as seventh-graders draw and discuss a task?
 - b. When and how do seventh-graders use different types of adaptive reasoning as they draw and discuss a 3 Act Math task?
2. What types of adaptive reasoning relate to student achievement of seventh-graders as they draw and discuss guided inquiry mathematical tasks?
 - a. How does learner adaptive reasoning relate to depth of knowledge problem solving processes?

Preliminary or expected findings

Preliminary findings suggestion that seventh grade students use certain types of adaptive reasoning (See example, Figure 1). There is a relationship between a particular pattern of how learners adapt their reasoning and develop mathematical proficiency.

In this study, research expects to find patterns in types of adaptive reasoning uses during different intervals of a task, will emerge, especially in reference to learner generated drawings. Certain types of adaptive reasoning will be prevalent with the 12 to 13-year-old age group. Certain types of adaptive reasoning will occur in intervals within the task. Use of adaptive reasoning indicators will differ given gender makeup of student partners and students that sit near or around a given student. Mathematical proficiency will align with increased use of adaptive reasoning indicators; and/or certain indicators of depth of knowledge required for the task will affect use of adaptive reasoning.

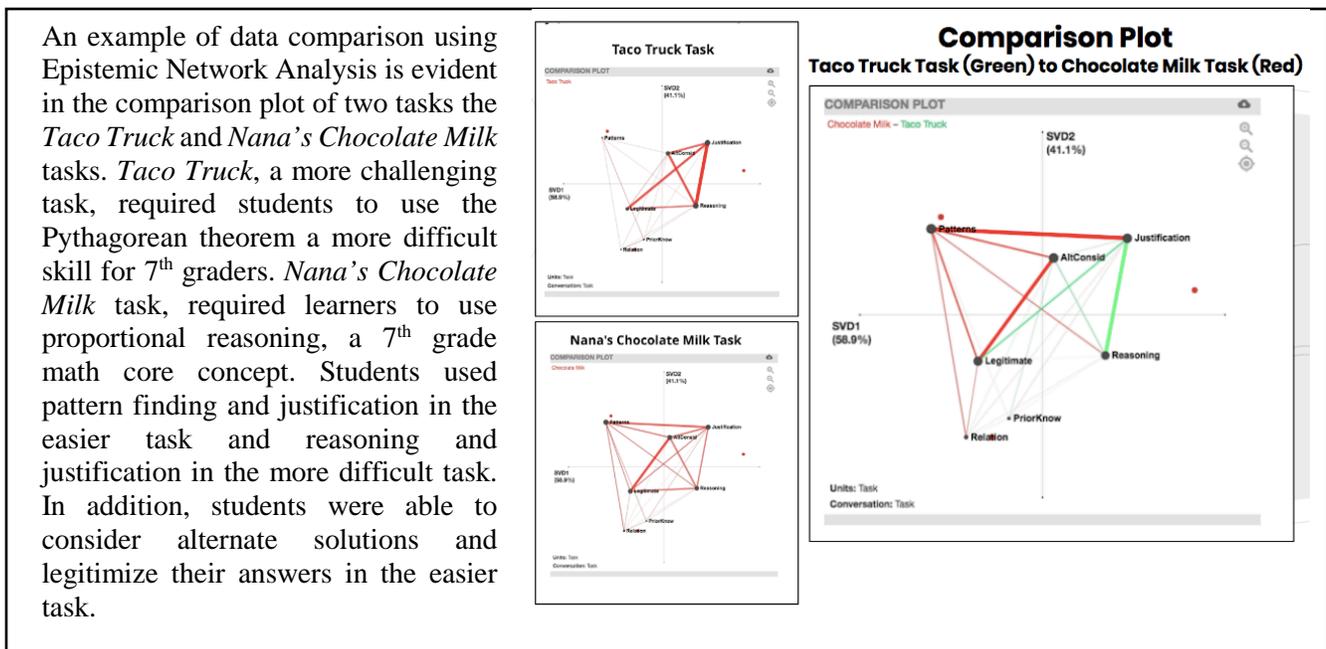


Figure 1. Example of Epistemic Network Analysis of two 3 Act Math tasks.

Expected contributions

This study aims to contribute more detailed analysis of events that occur as students solve inquiry mathematical tasks. This study looks at how to analyze the detail of occurrences as students interact to solve these tasks, observing specifically adaptive reasoning, one indicator of mathematical proficiency. However, it is expected that this contribution could be expanded to include other dynamics of how inquiry tasks may be constructed within a classroom setting. One expansion could include the observation of other indicators of mathematical proficiency such as mathematical conceptual understanding, student productive disposition, procedural fluency and strategic competence (Kilpatrick, 2001). Quantitative ethnography is an excellent way to visually show relations between constructs, while also relatively new to the research community. Use of quantitative ethnography needs to be expanded and used in context to mathematics educational research.

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Teachers' Scaffolding of the Online E-Text *Vidyamap*

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Abstract: This study aims to understand how two teachers scaffold an online e-text differently in an inquiry-based classroom to better support students and teachers in inquiry-based practices. Teacher and student discourse was analyzed using Epistemic Network Analysis, showing that one teacher made direct connections to the tool while the other asked conceptual questions without referencing the tool.

Introduction

Scientific inquiry involves the mindful investigation of natural phenomena through which students generate and resolve meaningful problems using resources, tools, and interpersonal communications (Natural Resources Council, 2012). Inquiry-based learning is often difficult to teach and requires additional scaffolds in the classroom (Kim, Hannafin & Bryan, 2007). When introducing technology, teachers must now scaffold the tool itself, not just the content. Quintana et. al. (2004) state that scaffolding in inquiry classrooms is more than just a layer of supportive features in the software but is mediated by the teacher and other elements in the classroom. Teachers may feel less prepared in this approach, as they are now augmenting the scaffolding and supporting students to evaluate their own ideas and claims (Reiser et. al., 2001), leading to the research question: *How do teachers scaffold an online e-text in an inquiry-based classroom?*

Methods

Audio and video data were collected from 515 eighth grade students and seven teachers in the 2016-2017 academic school year over 13 weeks of a “Make your own compost!” curriculum. The curriculum was designed to scaffold students to collaborate and co-construct knowledge with the help of an online interactive e-text called *VidyaMap*. The data analyzed for this paper was selected from two teachers, Teresa and Brad (names changed), over two consecutive days of student research using *VidyaMap*, following the teacher as they interact with different groups. We analyzed their discourse with student groups to see how the teachers scaffolded the tool in the classroom.

Audio data was transcribed and segmented by turns of talk. We then coded each of our four codes (*use of tool, explicit instructions, questions related to the material, and conceptual science talk*) using the automated tool nCoder. We then performed inter-rater-reliability on 10% of the data set and computed Kappa and Shaffer's rho between myself and a second rater, myself and nCoder, and the second rater and nCoder to ensure reliability. All codes had a kappa greater than 0.65 and a rho less than 0.05.

We applied Epistemic Network Analysis (ENA) (Shaffer, 2017) to our data using the ENA1.5.2 Web Tool (Marquart et al., 2018). The ENA algorithm uses a moving window to construct a network model for each line in the data, defined by turns of talk, to show how codes in the current line connect to codes that occur within the recent temporal context (Siebert-Evenstone et al., 2017), defined as 7 lines within a given conversation. Each conversation was defined by all lines associated with a teacher for a specific day. The resulting networks were aggregated for all lines for each unit of analysis in the model. To test for differences along each axis we applied a Mann-Whitney test to the location of points in the projected ENA space for Teresa and Brad.

Results

Teresa guided their students towards the tool and allowed it to provide the learning, which is shown by her stronger connections between *use of tool*, *explicit instructions*, and *questions related to the material* (Fig. 1 a). Unlike Teresa, Brad made students think conceptually on their own rather than guide the students to the tool. There was little to no scaffolding towards the research they were supposed to be doing, and Brad attempted to monitor students' progress closely. This can be seen in his prominent connection between *questions related to the material* and *conceptual science talk* and the distinct lack of connections to *use of tool* (Fig. 1 c). Teresa had stronger connections between *use of tool* and the three codes: *conceptual science talk*, *questions related to the material*, and *explicit instructions*, creating a 'fuller' network graph, centered around students using the tool as their primary form of inquiry.

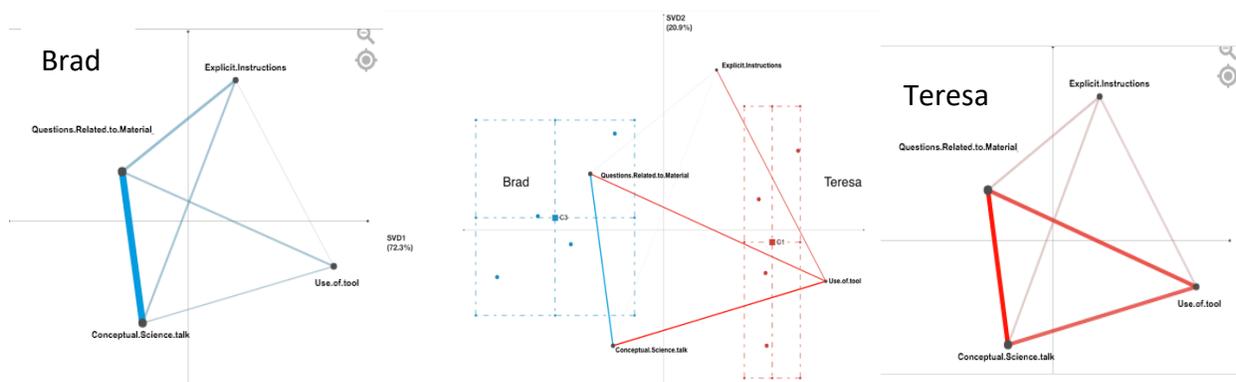


Figure 1 a,b,c: a) ENA model of Brad, b) Subtracted ENA model of Teresa and Brad, c) ENA model of Teresa.

Along the x-axis, a Mann-Whitney test showed a significant difference ($p = 0.03$) between the location of the centroids of Teresa ($mdn = 1.38$, $N = 4$) and Brad ($mdn = -1.67$, $N = 4$). Along the y-axis there are no significant differences.

This analysis is part of a larger research study on how teachers scaffold the online electronic text VidyaMap. Analyzing the scaffolding used in this study allows us to understand the interactions that take place in the classroom, so that we can better design future implementations as well as inform best teacher practices. This research was funded by an NSF DRL grant #1418044 to the last author.

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Development of Epistemic Cognition about Social Knowledge through Collaborative Small-Group Discussions

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Abstract: Fifth-grade students' epistemic cognition about social knowledge was examined through collaborative small-group discussions around complex social-moral dilemmas. Epistemic network analyses of 36 discussions from 12 small groups, three recurrent discussions per group, revealed growth patterns in students' epistemic cognition: the connections among epistemic cognition elements increased and were strengthened across discussions. The findings provide insight into how epistemic cognition evolves through reasoning with others in recurrent small-group discussions.

Introduction

The goal of this study is to examine the effects of small-group discussions on the growth of epistemic cognition about social knowledge in early adolescents. People need to develop systems of *social knowledge* that organize the interweaving relationships between morality, societal rules, and individual concerns when handling various issues arising from human activities and social interactions. A sophisticated level of social knowledge is critical to making reasonable decisions in various social contexts. Students lacking sophisticated social knowledge may be vulnerable to negative social experiences (e.g., bullying) and even long-term detrimental outcomes (e.g., criminal involvement) (Dodge & Pettit, 2003). Developing *epistemic cognition (EC)*—the process of critical thinking about what counts as knowledge and the process of knowing—in a way to understand and accept the intricate and multi-faceted (as opposed to simple or absolute) nature of social knowledge might be the fundamental step to achieve systems of social knowledge.

Method

The sample of the current study includes 36 discussions from 12 small groups (63 students, $M_{age}=10.98$, Female = 52%), three discussions per group, collected from a larger intervention project; Collaborative Social Reasoning (CSR, Lin et al., 2019) was designed to promote interpersonal and academic competencies through small-group argumentative discussions. Students discussed one short fiction story per week for six consecutive weeks in heterogeneous groups of 4-7. They were encouraged to collaboratively and respectfully lead their discussions with minimal teacher scaffolding. The short stories were structured around various complex social-moral dilemmas in school, family, neighborhood, and public contexts.

Informed by the theoretical and empirical research on epistemic beliefs and cognition (e.g., Chinn et al., 2011) as well as from iterative reviews of the discussion data, an epistemic cognition coding scheme was developed (Table 1). The 36 discussions were independently coded by two researchers according to the form of EC reflected in each turn of student talk that involved social knowledge. To model the changes of students' EC in CSR discussions, Epistemic Network Analysis (ENA, stanza size = 7) was conducted.

Table 1. Coding Scheme for Epistemic Cognition in Group Discussions

Epistemic cognition codes		Description	K
Epistemic aims and values	Real-world application	Finding values of the discussion-real world connections	.77
	Argumentation	Trying to demonstrate reasoned arguments	.70
	Discussion norm	Following of the discussion norms	.71
Structure of knowledge	Complexity	Recognizing the complex nature of social knowledge	.71
	Relativity	Recognizing the relative nature of social knowledge	.73
	Uncertainty	Recognizing the uncertain nature of social knowledge	.72

Justification of knowing	Evaluation	Making a judgmental claim	.72
	Intertextuality	Making inter-textual connections	.71
	Causal relationship	Finding causal relationships among two or more ideas	.74
	Hypothesis	Hypothesis making to challenge or support ideas	.77
Source of knowing	Experience	Using own or other's experiences as a reference	.90
	Story text	Using the story text as a reference	.93
	Authority figures	Referencing authority figures such as teachers or parents	.92

Findings and Discussion

The averaged epistemic network graphs from the 12 groups' discussions (Figure 1) indicate an overall increase in the intensity (represented as the brightness and thickness of the lines) and density (represented as the number of the lines) of the EC connections made from students' CSR discussions across time. The weighted network density for each discussion point also suggests the overall growth from week 2 to week 6 ($WND_{w2} = 26.01$, $WND_{w4} = 32.60$, $WND_{w6} = 35.85$). In all three time points, *argumentation* (epistemic aim and value), *evaluation* and *hypothesis* (means for *justification*) and using *story text* (source of knowing) were the most connected EC elements. These elements, however, were more diversely and strongly connected to other elements in the later discussions. Significant growth patterns across the three time points were found in the EC elements concerning *structure of knowledge*—*complexity*, *relativity*, and *uncertainty*.

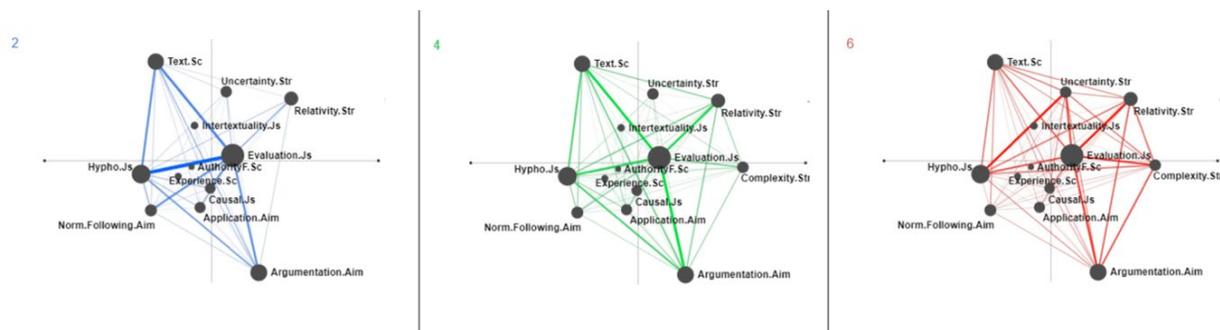


Figure 1. Averaged epistemic network graphs of week 2 (blue), week 4 (green), and week 6 (red) discussions

The current findings suggest that collaborative small-group discussions can be an effective vehicle to promote students' EC about social knowledge. The increasing complexity of the EC networks across time suggests that collaborative social reasoning with others can help students more actively reconstruct and expand their social knowledge schemata. This was particularly supported by the *structure of knowledge* codes. The literature of EC development (e.g., King & Kitchener, 1994) generally reaches a consensus that EC development follows a transition from simple to more complex stances, but the trajectories of growth and catalysts of growth remain largely unknown. Our finding offers the first empirical support to this developmental hypothesis in a group setting (as opposed to individual assessments), revealing significant influence of collaborative small-group discussions on students' recognition of the *uncertainty*, *complexity*, and *relativity* nature of social knowledge.

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Overcoming Skepticism:

Automated Coding to Study an Instructional Coaching Program

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Abstract: This poster documents the iterative process of developing, refining, and validating one automated code using interview data from an instructional coaching program. The ongoing program continues to collect data from interviews, open-ended survey responses, and thousands of coach-teacher reflections. The quantity of qualitative data collected is too vast for the researchers to code in a timeframe that allows for delivery of feedback to coaches. The project started exploring nCoder to understand possibilities of automating codes.

Introduction and Motivation for Exploring Automatic Coding

The Dynamic Learning Project (DLP) seeks to improve teacher use of technology through a school-embedded instructional coaching program that provides personalized support to teachers over the course of four eight-week coaching cycles. In its first pilot year (2017-2018), the DLP was adopted in 50 middle schools in 5 states across the United States, and the program doubled in size to serve 100 schools across 7 states in the 2018-2019 school year. The main purpose of the mixed-method research study of the DLP is to examine and explore factors and dynamics that determine the effectiveness of instructional coaching in teacher use of technology.

During the pilot year of the program, we interviewed coaches, principals, and some participating teachers in four case study schools at three times during the school year, then hand-coded a total of 71 interviews using a complex coding scheme that consisted of 74 codes. Beyond this, we collected open-ended responses from hundreds of bimonthly surveys, as well as thousands of written coach-teacher reflections. Knowing that our program would continue to grow in subsequent years, we were intrigued by the way that nCoder could make developing automatic coding accessible to our team. Using nCoder, we could address the issue of the quantity of qualitative data becoming too vast for human coders and incorporate additional qualitative data sources into our study in a way that would establish inter-rater reliability. However, our team was unsure about the process and skeptical that a computer could identify excerpts to code with the same reliability as a human coder.

Process of Automating the Code “Non-evaluative”

The DLP model conceptualizes coaching as a partnership among the principal, coach, and teacher where consistent support, open communication and collective problem-solving is essential. However, as previous research has shown (Knight, 2017; Aguilar, 2013), the key to an effective coaching partnership is a safe environment where teachers feel ensured that their information will remain confidential and a fear of failure does not impede experimentation. Within the DLP, teachers who reported non-evaluative coaching were more likely to see improvement in their teaching practice as a result of working with their coach (Bakhshaei, Hardy, Francisco, Noakes, & Fusco, 2018; Bakhshaei, Hardy, Ravitz & Seylar, 2019). To explore the potential of automatic coding for our project, we chose to pilot the code “non-evaluative”, which is applied when a coach, teacher, or principal discusses ways in which the support provided by the coach to teachers was non-evaluative in nature.

Two researchers independently generated an initial list of expressions using a semi-supervised natural language processing method. Following this method, the researchers identified both words that were coherent facets of the concept (e.g., nonthreatening, confidentiality, etc.) and words that commonly

occurred in examples of hand coded excerpts (e.g., third party, tattle, etc.), making active decisions about what words to include using grounded qualitative analysis and term frequency in the data set as a guide. Next, the researchers uploaded a qualitative data table containing a sample of nearly 500 lines of hand coded excerpts to nCoder and independently tested their list of expressions, examining concrete examples of differences between the excerpts that were coded by the researcher and those coded by the computer. After comparing the results, the two researchers discussed words that might have been missing as well as words that were misleading, and created a third list combining the most promising terms from each original list. For example, the terms ‘reflective’ and ‘observe me’ were removed from one of the original lists due to considerable overlap with other codes that do not typically co-occur with “non-evaluative”. The process of determining which expressions to include in the list and how to refine them was guided by the use of kappa and rho and the resolution of differences between the human raters and the automated classifier. The fifth iteration showed a sufficient level of inter-rater reliability between the hand coder and the computer (Human Rater 1 & Human Rater 2 kappa = 0.87*, Human Rater 1 & Computer kappa = 0.93*, Human Rater 2 & Computer kappa = 0.84*)*rho < 0.05.

The process of coding non-evaluative was a learning experience for everyone involved. For team members who were already familiar with the automated coding process, it highlighted that concepts for which humans initially rely on a great deal of context to code for require multiple iterations of using kappa and rho to guide refinement of both the conceptual definition and regular expression list in order to automate the coding process. Team members who were not as familiar with the automated coding process learned that the process of automating a code can greatly shorten the time it takes to code a data set while still being done in a reliable and valid way.

Next Steps

Success with the code “non-evaluative” allayed our initial skepticism and showed us a path forward with automatic coding. We see ourselves continuing with traditional hand coding of our interviews while simultaneously moving forward with automatic coding on a subset of our codes on a rolling basis. Given the time commitment of generating and refining word lists for each code, we identified that half of the codes in our codebook are most important in reporting and occur more frequently. To streamline the process of automation, we integrated the step of drafting an initial word list for each of these more valuable codes as part of the interview analysis process. Now that we have built new capacity to use automatic coding, this could enable us to add more open-ended questions to the thousands of surveys that we collect on an ongoing basis. Moving forward, we plan to explore ways that automatic coding could allow us to track changes over time in the thousands of coach-teacher reflection logs that we have collected (and continue to collect).

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Utilizing the Epistemic Network Analysis to Understand Relationships in the Healthcare Technology Acceptance Model

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Consider the use case of Mrs. Spencer, a 70-year-old women, recently diagnosed with hypertension by her doctor. Her doctor recommended that she manage her health by using a healthcare technology (HCT) that is new to her that can support her lifestyle changes. What are the factors that influence her intentions to use this HCT? Behavioral intentions can be defined as “indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior (Ajzen, 1991; p. 181).” By understanding intentions first, actual acceptance/usage of the technology can be predicted (Szajna, 1995; Venkatesh, Morris, Davis, & Davis, 2003).

A multitude of technology acceptance models, that depict even more factors (e.g., perceived use and perceived ease of use), illustrates the influential factors related to behavioral intentions that lead to acceptance of the HCT. The Technology Acceptance Model (TAM; Davis, 1989), the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2; Venkatesh, Thong, & Xu, 2012), and the Senior Technology Acceptance Model (STAM; Chen & Chan, 2014) are models commonly used to help understand acceptance of technology. Common factors across the models that lead to behavioral intentions and/or acceptance are perceived ease of use, perceived usefulness, facilitating conditions, and subjective norm. As proximal factors, they contain different components that help define them. For example, the UTAUT (Venkatesh et al., 2003) the first edition of UTAUT2, combined perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations to help define performance expectancy. Although there are multiple models and factors, these models fail to provide information on which factors are relevant to older adults and healthcare technology. This is due to these models generalizing the consumers of these technologies and the technologies themselves.

A coding scheme was developed to categorize responses to identify the prominent factors that emerged and to assess the frequencies of factors in MaxQDA. There were six factors that emerged that are not in current models of technology acceptance and they are: familiarity, perceived need, perceived benefit, advice acceptance, privacy, and trust. The following research question will be addressed with the ENA:

1. What are the relationships between the factors to develop the conceptual Healthcare Technology Acceptance Model?

The purpose of this research is to understand what the relations between the factors that are emerged when older adults consider using a new healthcare technology. These data are suitable for an epistemic network analysis (ENA; Shaffer, 2017) to understand the connections between the factors. The goal of this poster is to explore insights obtained from ENA from these data.

We recruited 23 older adults between the ages of 65 and 84 who met the following criteria: fluent in English, live independently, self-reported diagnosis of hypertension (high blood pressure), and a score of 21 or higher on the Modified Telephone Interview for Cognitive Status (TICS-M; de Jager, Budge, & Clarke, 2003). Potential participants were contacted over the phone to inquire interest in participating in this study. If the older adult was interested in being in this study, they were pre-screened to assess the inclusion criteria.

The study was 1.5 hrs in length and included three parts. Part 1 of the study was the Technology Experience Profile (Barg-Walkow, Mitzner, & Rogers, 2014) and the Technology Readiness Index 2.0 (TRI 2.0; Parasuraman & Colby, 2014). Part 2 was the Healthcare Technology Acceptance Interview to

assess participants' opinions and beliefs regarding factors related to acceptance of HCTs. Participants' verbal responses were audio recorded to be transcribed and analyzed later. Part 3 was the Demographics and Health questionnaire (Czaja et al., 2006) to collect information about the participants' general demographic information and the Multi-dimensional Health Locus of Control Form C (MHLC-C; Wallston, Stein, & Smith, 1994) to understand health/medical condition beliefs about their control over their own illness or disease. Participants were encouraged to ask questions and take breaks when needed during the interview. Once all parts were completed, the participant was debriefed and compensated with a \$25 Amazon Gift Card for their participation.

The data collected from the four questionnaires were analyzed using descriptive statistics in Excel to describe the characteristics of the participants. The audio files from the interviews were transcribed using Scribie, a professional transcription service they were then checked for accuracy by a researcher. The primary coder segmented these transcripts within MAXQDA, a software program designed for qualitative and mixed methods data, and then the coding scheme was applied by the primary and the two secondary coders. The focus of the coding was to identify the factors related to older adults' intentions to use or not use a new HCT. The coding scheme was developed using an integrated approach to include factors that participants consider when thinking about the acceptance of HCTs (Mitzner, Bixter, & Rogers, 2016). To minimize researcher bias, there was one primary coder and two secondary coders. Interrater reliability of 80% was the minimal threshold of agreement between the primary coder and the two secondary coders. Once frequencies are determined using MaxQDA, data will be formatted to utilize the ENA understand the relationship between the factors that emerged. Factors includes advice acceptance, convenience, trust in the person, and familiarity. The initial conceptual model of the relationships to be explored is presented in Figure 1. Understanding of factors that influence their technology acceptance decisions can increase the benefits of new technology developments for older adults.

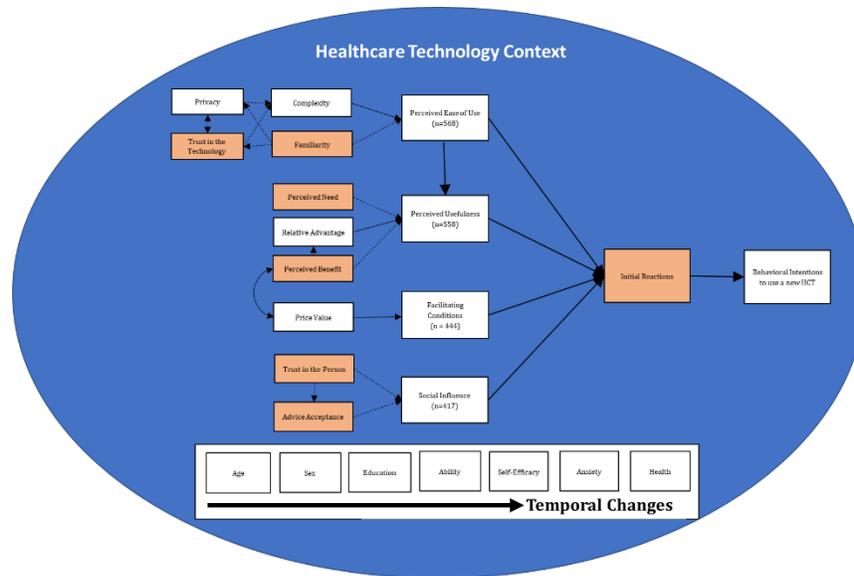


Figure 1. The Healthcare Technology Acceptance Model for older adults is a conceptual model, highlighting the new factors. The blue represents the context that HTAM is in, the context of healthcare technology. The orange represents the new factors. White represents factors that had been identified in previous models of technology acceptance. Solid lines represent relationships reported by the literature, and dotted lines represent hypothesized relationships.

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Research on the Constituent Elements of Innovative Education in Primary and Secondary Schools: Use ENA to Analyze the Investigation Materials of Innovative Education

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Abstract: This study aims to use the Epistemic Network Analysis method, conduct a field survey on a number of primary and secondary schools, and record their innovative education development status. Based on the materials obtained from the survey, try to find the network relationship of innovative education concepts, environment, resources, teachers, teaching design and other elements of innovative education, and form effective and feasible innovative education operation mechanism and safeguard measures.

Purpose

In China, in the research on the cultivation of innovation ability in primary and secondary schools, some researchers discuss the effective ways to cultivate innovation ability in a certain discipline from the theoretical level. Some researchers integrate innovative ideas and methods into traditional subject teaching to cultivate students' innovative ability (Zhong Lin, 2011; Feng Li, 2000; Meng Ne, 2017). In recent years, researchers have also conducted a lot of discussions on Maker Education and interdisciplinary learning (STEM) education in mainland China aimed at cultivating students' innovation ability. Visualization analysis was carried out on relevant papers of Maker Education which can be found on <http://www.cnki.net/> (CNKI, China National Knowledge Infrastructure), the research summarizes the current research status of Maker Education in mainland China, found four research hotspots in Maker Education in China: construction and service of maker space, construction of maker education teaching mode, theory and practice of maker education curriculum design, and relationship between Maker Education and STEM Education. More and more attention has been paid to the research on the components of the school Maker Education system (Xijin Fu, Yanlin Zheng & Yun Ma, 2018). However, in the research on Maker education in schools, especially in primary and secondary schools, it is rare to explore Maker Education as a system, that is, the relationship between various components of maker education in primary and secondary schools is not discussed. Through the analysis of Chinese STEM education papers (By search STEM/STEAM/STEM education on CNKI and analysis papers' titles, keywords and abstracts), it can be found that they are mainly concentrated in theoretical studies of STEM education, STEM education teaching cases and comparative study of foreign STEM education, similar to Maker education, also lack of primary and secondary schools in STEM education in schools to carry out the exploration of the relationship between the various elements.

In the process of carrying out innovative education, school education is highly expected. Schools as systems composed of sites, resources, teachers, students, administrators and other elements. When carrying out the innovative education, various elements play different roles, and form different relationships between elements. The relationships between the elements in the form of a certain combination, can form different operating mechanism, the innovative education in schools to carry out the present different paths. Therefore, it is necessary to take innovative education in primary and secondary schools as a system, study the relationship between the components of the system, and explore an effective operation mechanism of innovative education in primary and secondary schools.

Methods

Semi-structured Questionnaire & Interview

A semi-structured questionnaire has been designed to investigate the development of innovative education in schools of school administrators or teachers responsible for innovative education. A semi-structured questionnaire has been designed to investigate the development of innovative education in schools of school administrators or teachers responsible for innovative education. Questionnaire contains various components involved in the school education innovation questions, including six aspects of problems: school administrators or teachers' understanding of the theory of innovative education, innovative education environment of school (hardware, software, and resources, etc.), the innovative education teaching activities carried out on the construction of situation (teaching mode, teaching content, etc.), the innovative education teachers (teachers' reserve, teacher training, etc.) and the goals of school to carry out the innovative education.

An interview outline was also prepared for interviewing schools' administrators and teachers to get detailed information on innovative education in schools.

ENA (Epistemic Network Analysis)

ENA creates a network relationship model based on community sessions which based on the session recording and coding of community interactions. Among them, "network nodes" represent framework elements. By calculating the relationship structure and strength between these nodes, researchers can observe the development of each member's cognitive framework in the community and get objective evaluation results.

This study attempts to use ENA tool to encode and analyze the questionnaire answers and interview materials obtained from schools. According to the network map formed by ENA, the situation of innovative education in schools and the whole region was compared and analyzed. Among them, "network node" represents different components of innovative education. By studying the relationships between the components of innovative education in different schools, this study hopes to find several models for the development of innovative education in schools.

Participants

We have invited several administrator or teachers from primary and secondary schools to participate in our research, and it is expected that the whole research will study the innovative education of more than 20 primary and secondary schools.

The expected results

The ENA method will be used to encode and analyze the research materials, so as to obtain the network diagram of each component in the innovative education in schools. The network diagram will be compared and discussed based on the field investigation. The modes of carrying out innovative education in primary and secondary schools under different conditions will be summarized, and the representative cases should be discussed.

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Comparing Online Critical Thinking Processes of College Students Based on ENA

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Abstract: This study adopts the epistemic network analysis to compare students' online critical thinking processes between high-level group and low-level group of academic performances. The results show that there is a significant difference between two groups. The high-level group involves more connections and interactions between phases of critical thinking. With the use of ENA, more accurate evaluation of critical thinking processes can be obtained, which can provide references for cultivating student critical thinking while engaging them in online collaborative learning.

Keywords: critical thinking, online collaborative discussion, difference, ENA

1 Introduction

One of the methods for studying how to cultivate critical thinking (CT) is to compare students with high-level performance and students with low-level performance. Critical thinking is the process of analyzing and evaluating thinking to improve thinking (Paul, 2006). By means of Internet technologies, online discussions can be a way to develop critical thinking. However, there is a lack of research in characterizing students' critical thinking processes in the online discussion. This study aims to adopt epistemic network analysis (ENA) to analyze the online collaborative discourse of college students in one semester, and tries to explore the differences in their CT processes between high-level performance groups and low-level performance groups.

The research questions of this study are: 1) Is there a difference in the CT between the high-level performance group and the low-level performance group when they have online collaborative discussions about tasks? 2) What are the differences in CT between the high-level performance group and the low-level performance group?

2 Participants, Methods, & Data Collection

27 students (3 males and 24 females) who attended a course named "Instructional System Design" were invited to participate in this study. They were assigned into 9 groups, and every group needed to complete a design project by the end of the course. Students were provided an online platform where they can share their thoughts and conduct peer reviews during the three-month learning and designing. In the discussion forum, three stages were designed to guide topics of student discussions on the projects. In the end of the semester, each group was required to submit a report about their projects. Those reports were graded by teacher carefully according to aspects of instructional design. Two groups were then identified according to the scores, a group with high-level performance and the other with low-level performance.

To explore the differences between the high-level group and the low-level group, this study encodes each discussion post in three stages in two groups in one semester and the epistemic network analysis (ENA) is adopted for analysis. Coding schema refers to Murphy's CT model, which is an instrument to support thinking critically about CT in online asynchronous discussions (Murphy, 2004). Murphy divides CT into five phases: Recognize/Understand/Analyze/Evaluate/Create, coding as R/U/A/E/C. If the discussion does not involve CT, the code is "null". ENA is a novel method for identifying and quantifying connections among elements in coded data and representing them in dynamic network models (Shaffer, 2016).

Two researchers coded all posts with a consistency factor of $\alpha=0.932$. A total of 90 posts in a high-level group and 85 posts in a low-level group were selected for analysis, and a series of data processing was performed in the web version of the ENA tool (<http://app.epistemicnetwork.org/>).

3 Results and Discussion

Through ENA, we get the CT centroid maps with confidence intervals of two groups (see Figure 1a), mean networks of each group and their subtracted network in all three periods (see Figure 1b,1c,1d). The high-level group discussion is marked in red and the low-level group is marked in blue.

For question 1, it can be seen from Figure 1a that the confidence intervals for the high-level and low-level groups are completely independent, indicating that there is a significant difference in CT between the two groups. For question 2, as can be seen in Figure 1b, for the codes of CT (R, U, A, E, C), there are 6-7 strong connections, showing that the phases of CT involved in the high-group are comprehensive and extensive, and different CT phases interact more. It can be seen from Figure 1d that although there are connections in the low-level group, but only 3 phases (A, E, and U) are strongly connected. And the R and C are weakly connected with other phases, indicating that there is less coexistence and interaction between the CT phases involved. Overall, the difference between the two groups indicates that the use and interaction of the CT phases embodied in the high-level group discussion is more complicated. It can be seen from the subtracted network of Figure 1c that the high-level group is significantly stronger than the low-level group in the phases C-A (Create-Analyze) and R-U (Recognize-Understand), and the low-level group is stronger in U-A (Understand-Analyze). This reveals the difference between high group and low group when applying CT.

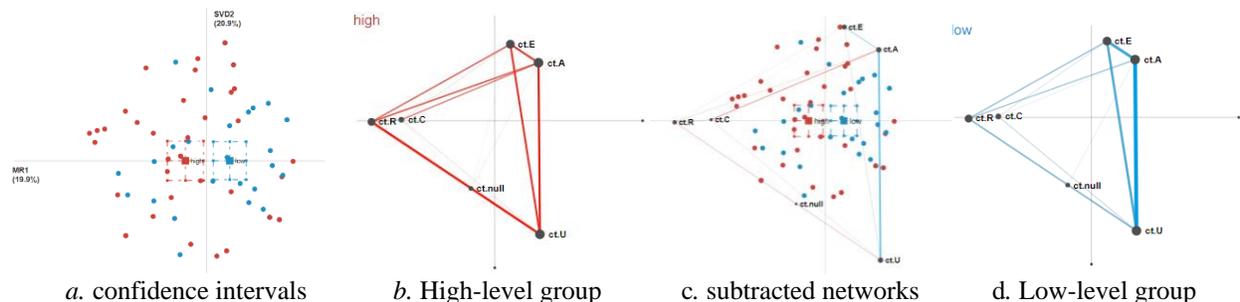


Figure 1. Centroids and confidence intervals of two groups and their mean networks, subtracted network

4 Conclusion

This study explores the differences in epistemic network analysis of CT between high-performance group and low-performance group students in an online collaborative discussion environment. The results show that there is a significant difference in the CT epistemic networks between two groups who perform differently in the project design (as academic performances). And the high-level group are more active and involves more connections and interactions between CT phases. The use of CT in the low-level group is relatively simple, and the interaction of different phases is less. On the one hand, CT affects project design. On the other hand, the discussion and interaction in the project design process also promotes the development of CT. Therefore, this study suggests: 1) encouraging students to discuss online and deeply think about others' discourse so that their CT can be developed in the process; 2) teaching students CT skills so that they can think critically and perform well in online platform and other situations.

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Study of Group Learning with Complex Systems Models: The role of quantitative ethnography in learning analysis

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Abstract: I propose how I will go about studying collaborative learning using quantitative ethnography. I am researching three questions: (1) How to measure student elaborations in open-ended learning tasks? (2) Can we identify windows of learning through association with affective states? (3) What role does discussion serve in game mediating learning? I will use a multimodal data analysis to develop learning traces in physical spaces to study these questions. These methods of analysis let us evaluate open-ended learning, which should be useful as schools move towards implementing more open-ended learning and project-based curricula. To conduct this work, I will use a mixture of qualitative coding and learning analytics to study learning. It seems this approach can have some impact as we develop more collaborative learning systems that share powerful ideas through mediating tools like tabletop games.

Goals of The Research

As shown in Figure 1, I take the perspective that learning is always mediated by tools, peers and adults. A long-standing question faced by educators when evaluating learners in open-ended learning environments is deciding what to measure. What metrics of success should we record to study student progress? What to do when students learn outside the framework? What happens when they generate new ideas? Education,

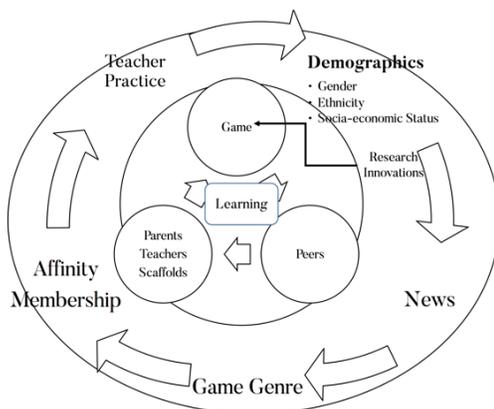


Figure 1. Tools, peers, parents, and teachers scaffold learning in a wider sphere of influences.

in many ways, is a way of thinking about how individuals approach tasks, creativity, learning, communication, teamwork, grit or resilience among many other potentially meaningful potential outputs of education. In other words, the values we place on the educational endeavor often determine what we look for as outputs. This often confines reform to data points we normally collect in education: grades, teacher perception of students, student perception of teachers, attendance, comparative growth. These measures are a result of our instruments of measurement. But with quantitative ethnography, we have many other tools available to us. If we look at measures like elaboration of ideas, emotions during learning, or persistence in collaboration we can begin to shift our educational values. In this thesis I will investigate the following three questions that work toward how to make the shift in measures. (1) Does Constructionist Dialogue Mapping show students' elaboration of complex systems in an open-ended learning task, Ant Adaptation?

(2) Based on the theory that when people are emotionally stimulated they learn more, can we identify windows of learning through association with affective states? If students learn during these short interactions, and we can identify windows of learning through affect tracking in an automated way, what role does discussion serve in mediating this multi-touch interactive table top interaction? The shift of evaluation could allow us to understand how people construct themselves and their interaction types in context, to find what each student is doing in relation to their peers and teacher in a particular space (Vygotsky, 1978; Holland, 1998; Geertz, 1979), we can find how people learn through their performance as an individual and in a sociotechnical system (Hutchins, 1995). Currently, it is hypothesized that this

information can be gathered through several sensors and then synchronized using methods of big data and computational field methods (Martin, Wang, Baine and Worsley, 2019).

Background of the Research

I will situate this investigation in the literature of four theories: (1) Constructivist theory, where a learner’s mental model drives his or her construction of understanding and internal cognitive structures (Piaget, 1983). (2) Constructionism, a method of learning through doing. Constructionist learning environments weave together the themes of redesigning education systems and empowering learners (Papert, 1986). (3) Complexity Education, where people have argued learning complexity is difficult, for instance, Thinking in Levels (Wilensky, 2006), and even incommensurable (Chi et al., 2012). (4) Technological mediation, tools mediation and learning, whereas shown in Figure 1, learning happens between an individual, a mediating object, peers and teachers (Vygotsky, 1978). This means that thought results from action in the world. This action then takes place in a wider social circle of Figure 1, of practice affinity, demographic and the media (Bronfenbrenner, 1977). As a result of this literature, I imagine two means to measure learning in designed, “open” environments.

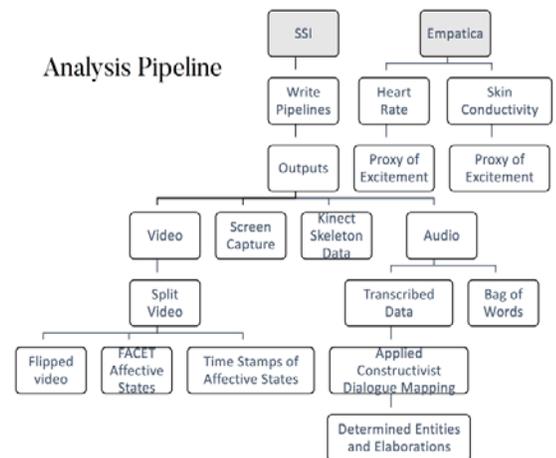


Figure 2. I will use Social Signal Interpretation (SSI) to collect synchronized video, and audio data.

Methodology

To study open-ended, mediated learning I will implement a two-phase study design. While participants play the game in a museum and in a classroom, I will gather field data to investigate how students learn in groups around the game. As shown in Figure 2, in both phases I will use Social Signal Interpretation (SSI) (Wagner, Lingenfelter, Baur, Damian, Kistler, & Andre, 2013) to collect synchronized video and audio data. I will process this data into transcripts for Constructivist Dialogue Mapping and individual videos of participants for affective state detection of facial expressions in FACET. I will use Empaticas to monitor proxies for biological engagement, heart rate and skin conductivity. I will use the two novel analysis methods I have been developing and publishing on: computer augmented ethnography (Martin, Wang, Bain & Worsley, 2019), and Constructivist Dialogue Mapping (Martin, Horn & Wilensky, 2018). The program analysis pipeline will follow Figure 1, focusing on learning at the center, seeing it as mediated by peers, the game, parents, teachers and other scaffolds, I will view these interactions affected by wider social aspects, such as demographics, the media climate, genre, learners’ affinity membership and practices of where the learning happens.

Preliminary or Expected Findings

This environment will serve as a testing ground for building multimodal learning traces in classroom studies. I will study learning in two contexts and provide comparisons: First, I demonstrate complex science learning with ants in a museum to study the use of these systems in an informal learning setting. Second, I will co-design a classroom space with a teacher to develop a demonstration of the use of an open-ended learning game for formal learning in a middle school classroom. The study of both these contexts will demonstrate the use of multimodal learning traces in physical learning environments.

Expected Contributions

Outcomes improve when students engage with powerful ideas (Papert, 1980) through mediating objects (Vygotsky, 1978), such as well-trained teachers and refined education technology to explore ideas, discuss their meaning, and learn self-regulation and move towards higher goals. With MMLA we can study how students learn powerful ideas from mediators. The challenges of this work are integrating different modes

of observing human action, into an integrated picture of learning. I will be testing the means to demonstrate this open-ended learning and quantifying the association between joy, and other emotions and learning gain.

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Automating the Engineering of Expert-Coded Features from Student Interaction Log Data

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Abstract: Student interaction log data generated by digital learning environments can be analyzed to study and improve the learning process. However, such analyses often rely on surface level information which lacks an expert’s interpretation of the students’ behaviors. As the process of including expert interpretation can be tedious, we present an automated data coding tool, implemented as a modification of nCoder that facilitates the creation of expert-coded features by applying expert-defined rules to large datasets.

Introduction

Digital learning environments generate massive amounts of log data as students interact with them. Analyzing these log data can provide deeper insight into student behaviors, learning outcomes and effectiveness of the learning environment. However, such analyses often rely on the calculations of descriptive features, variables summarizing the students’ actions, that do not necessarily represent meaningful element of an expert’s interpretation of the students’ behaviors. Creating features that are more representative of expert interpretations can be beneficial for analyses of student behaviors (Paquette & Baker, 2019). However, the creation of such expert-coded features requires active involvement from experts in the feature engineering process as well as involvement from knowledge elicitors capable of capturing the experts’ knowledge and replicating it through feature extraction scripts. As such, the process of creating expert-coded features can be time consuming and is often neglected in favor of more traditional features.

To facilitate the use of expert-coded features in interaction log data, we propose a modification to the nCoder¹ tool, a learning analytics platform that automatically applies coding schemes to large text datasets. This tool will speed up the process of creating expert-coded features and encourages the use of more sophisticated expert-coded features over descriptive features.

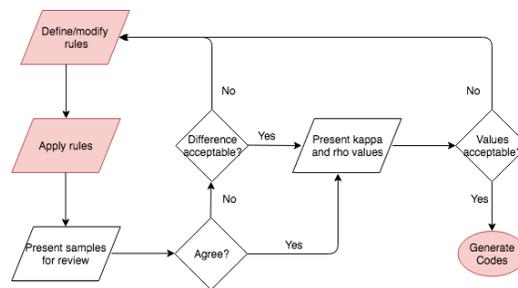


Figure 1. The nCoder workflow. The steps that we modified are highlighted.

nCoder

nCoder is designed to assist experts in coding textual data by asking them to define sets of regular expressions describing desired codes. The use of nCoder follows the process illustrated in figure 1. Expert starts by defining regular expressions associated to each of the codes. nCoder then applies the regular expressions to the entire dataset and presents randomly selected samples of coded data points for the expert

¹ <http://www.n-coder.org/>

to review. Following this, nCoder calculates Cohen's kappa and Shaffer's rho (Eagan et al., 2017), to measure inter-rater reliability and evaluate the extent to which the coded samples match the expert's codes. Finally, disagreements in the codes are presented to the expert who is provided with an opportunity to revise their regular expressions. This process is repeated until acceptable inter-rater reliability is achieved.

Current Work

In contrast with textual data, interaction log data often includes many different fields of various data types (including numerical and textual values). While the general coding process defined by nCoder (figure 1) can be applied to interaction log data, modification is needed to support non-textual data. We created an alternative version of nCoder designed to allow experts to use logical expressions to describe desired expert-coded features. Experts can specify raw fields in log data that are relevant to generating a feature. Logical expressions can be formed by comparing raw fields with threshold values or with other fields. nCoder evaluates the expressions to code features. For example, an expert might be interested in coding for instances of joint attention in a collaborative learning environment. In this context, log data might contain fields related to a student's current page number, the group's current page number, the maximum difference between the student's scroll position and that of other members of the group, etc. To code whether a student is showing signs of joint attention with their group, an expert could define the expression:

```
Rule 1: Student's Current Page == Group's Current Page
Rule 2: Maximum difference in scroll position < 75
Joint attention = TRUE if Rule 1 && Rule 2
```

Applying the above expression on the entire dataset produces coded values for joint attention. A limitation to our work is that only Boolean values can be assigned to codes. To support encoding of features with more than 2 values requires users to define their own evaluation function.

Future Work

We plan to perfect our implementation and apply it on log data gathered from C-STEPS (*Collaborative Support Tools for Engineering Problem Solving*), a web-based collaborative problem-solving environment. Past work on C-STEPS studied how interaction log data can be used to develop automated detectors of student engagement (Paquette et al., 2018), with the goal of using such detectors to support instructors by automatically providing collaborative prompts. Past detectors were developed using traditional descriptive features gathered from interaction logs. Given the potential advantage of building detectors based on an expert's interpretations of the students' actions (Paquette & Baker, 2019), we are interested in using our forked nCoder to investigate whether detectors could be improved by using expert-coded features, for example to identify when students are showing signs of joint attention. In addition, the creation of expert-coded features would allow for the use of analytic approaches such as Epistemic Network Analysis (Shaffer et al. 2009) to obtain a more in-depth understanding of group interactions within C-STEPS.

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Using Epistemic Network Analysis to Explore Emergent Discourse Dynamics of a Grade 2 Knowledge Building Community

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Abstract: This study uses Epistemic Network Analysis (ENA) to visualize emergent dynamics that support idea improvement during Knowledge Building discourse. Knowledge Forum notes were coded using a “ways of contributing” framework, and students were grouped based on their use of Knowledge Forum scaffolds. Findings indicate that the epistemic networks for theory, question, and source groups were significantly different from one another, yet complementary. The potential for ENA to support reflection and metadiscourse is discussed.

Introduction

Discourse is a powerful “tool of inquiry” (Gee, 2010), however, not all discourses are created equal (see van Aalst, 2009). In contrast to most forms of classroom discourse, Knowledge Building discourse is a self-organized process characterized by purposeful and sustained efforts among members of a community to advance collective understanding through the continual improvement of ideas (Scardamalia & Bereiter, 2014). During Knowledge Building Discourse, students formulate questions, propose explanations, and synthesize available ideas to improve their theories. Research by Chuy and colleagues (2010) shows that seeking out new ideas and working with evidence plays a major role in theory improvement. This study explores emergent dynamics in a grade 2 Knowledge Building community through network visualizations of the relationships between different ways students contribute to their Knowledge Building discourse.

Methods and Analysis

Epistemic Network Analysis (Schaffer, 2017) was applied to discourse data in Knowledge Forum (Scardamalia, 2017) using the ENA Web Tool. Over 250 Knowledge Forum notes were coded using Chuy and colleagues’ (2010) “ways of contributing” framework (questioning, theorizing, obtaining evidence, working with evidence, creating syntheses/analogies, and supporting discussion) and students were grouped based on their use of Knowledge Forum scaffolds (“My theory is”, “I need to understand/INTU”, and “New Information + Source”). In a class of 22 students, 22 were in the theory group, 20 were in the question group, and 16 were in the source group. The ENA Web Tool generated a normalized network model for the three groups based on the six discourse codes before they were subjected to dimensional reduction followed by optimization routines that maximized the variance explained by each dimension while minimizing the difference between the plotted points and their corresponding network centroids. Figure 1 shows the network centroids for the three groups of students along a two-dimensional plane, with the x-axis accounting for 34.8% of variation and the y-axis accounting for 20.7% of variation.

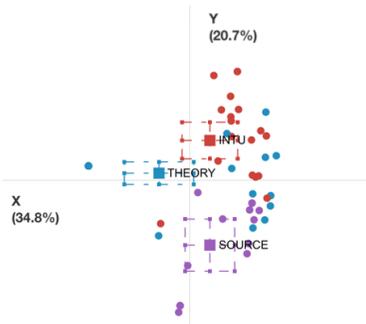


Figure 1. Network centroids for theory group (blue), question group (red), and source group (purple).

It can be seen that each group has a relatively distinct profile, with the theory group (“My theory is”) occupying the top-left quadrant, the question group (“I need to understand/INTU”) occupying the top-right quadrant, and the source group (“New information + Source”) occupying the bottom-right quadrant. Mann-Whitney tests at the $\alpha=0.05$ level showed that the theory group was more significantly different from the question group along the y-axis ($U=392.00$, $p=0.01$, $r=-0.43$) than the x-axis ($U=212.00$, $p=0.17$, $r=0.23$). The theory group was also more significantly different from the source group along the y-axis ($U=40.00$, $p=0$, $r=0.80$) than the x-axis ($U=150.00$, $p=0.17$, $r=0.25$). At the same time, the question group was significantly different from the source group along the y-axis ($U=15.00$, $p=0.00$, $r=0.91$).

Findings and Discussion

The epistemic networks of the three groups were visualized using network graphs where nodes correspond to codes, and edges reflect the relative frequency of co-occurrence between two codes. The model had co-registration correlations of 0.97 (Pearson) and 0.97 (Spearman) for the first dimension and co-registration correlations of 0.86 (Pearson) and 0.85 (Spearman) for the second dimension, suggesting a good fit.

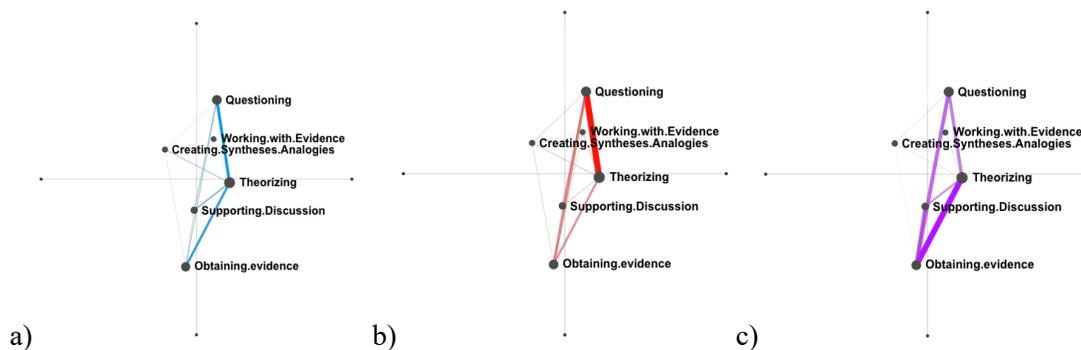


Figure 2. Mean networks for a) theory group, b) question group, and c) source group.

Figure 2a) shows the mean network for the theory group, with the strongest connections from questioning to theorizing to obtaining evidence. Figure 2b) shows the mean network for the question group, with the strongest connections from theorizing to questioning to obtaining evidence. Figure 2c) shows the mean network for the source group, with the strongest connections from theorizing to obtaining evidence to questioning. In all three networks, the weakest points of connection are from questioning to creating syntheses/analogies to obtaining evidence, pointing to the challenge of “rising above” to higher-level ideas in Knowledge Building discourse. At the same time, it is interesting to note that the theory group is the only network that holds all the codes together and has the strongest connection to creating syntheses/analogies along the x-axis. Based on the “ways of contributing” framework, the y-axis depicts levels of abstraction involved in theory-building from obtaining concrete evidence to asking conceptual questions. The x-axis taps into explicit and implicit processes involved in transforming knowledge, from problem definition to reflection and metadiscourse (Bereiter & Scardamalia, 2017). Future work will explore the use of epistemic network analysis in classrooms to support student reflection and metadiscourse during Knowledge Building

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Building an ENA Model with Peer Assessment Data

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Abstract: Choosing the right variables to develop Epistemic Network models is a challenge. This exploratory study investigates this issue by constructing multiple epistemic networks based on a variation of variables from a peer assessment dataset. By modelling student reactions to the feedback that they received on their work, this study explores how different variables influence the epistemic network structure and the meaning that can be derived from it.

Introduction

Peer Assessment (PA) describes students grading and/or giving feedback to another students' work (Patchan & Schunn 2015). In order for feedback to be effective, it should lead to some action – revision, performance improvement, or self-reflection (Perpignan 2003). One way to facilitate student self-reflection is feedback-to-feedback, where students express their thoughts about the feedback that they received on their work.

Epistemic Networks are “mathematical representations of the patterns of connections among Codes in the epistemic frame of a Discourse” (Shaffer 2017, p. 333). The foundation of building an Epistemic Network model is having well-defined codes. Data coding, however, is not a straightforward process. The same variables can be grouped and coded in different ways. In this research, we examine how an Epistemic Network Analysis (ENA) model changes by the inclusion of different variables. An educational dataset of student reactions to the feedback they received is used to build three ENA models using different variables. We will address the following research questions:

1. What are the characteristics of student reaction to the feedback that they received on their work?
2. Which combination of variables in epistemic networks tells us most about the patterns in student reactions to the feedback that they received on their work?

Peergrade Dataset

Peergrade (peergrade.io) is an online platform that not only facilitates peer assessment, but also embeds student reaction to feedback as a part of the PA activity through grading, commenting, and a multiple-choice question. The Peergrade dataset collected in 2015-2017 includes 10,197 unique student IDs and 6,329 unique course titles. The dataset was fully anonymized and comes from a variety of high schools and higher education institutions.

A typical PA activity on the Peergrade platform starts with a teacher creating an assignment and a corresponding rubric according to which a student should evaluate another student's work. The rubric can include boolean, numerical, and free-text questions. After solving the assignment, students upload their hand-ins to the Peergrade platform. In the next step, students typically receive 3-5 hand-ins on which they give feedback by answering the rubric that the teacher has created. Finally, students receive feedback from 3-5 peers on their own hand-in and can react to it through *feedback grade*, *reaction comment*, and *improvement suggestions*.

Feedback grade is a numerical score on a scale from 1 to 5 that indicates feedback usefulness:

- 1 - Not useful at all
- 2 - Not very useful
- 3 - Somewhat useful, although it could have been more elaborate

- 4 - Very useful, although minor things could have been better
- 5 - Extremely useful, constructive and justified

Reaction comments are free text comments where students can express their reaction to feedback that they received on their hand-in. Our dataset includes 7,660 reaction comments. The median text length is 69 characters, the average is 104 characters. The shortest comment is 7 characters, and the longest is 2735 characters. Reaction comments were coded by using simple string matching into three categories:

- *Accepting*: Reaction comments expressing praise, error acknowledgment or intention of revision
- *Defending*: Reaction comments expressing confusion, criticism or disagreement
- *Gratitude*: Reaction comments expressing gratitude

The unit of analysis was one reaction comment, which meant that every comment could be coded with one or more categories.

Improvement suggestions is a multiple-choice question with five categories that indicate how the feedback that student received on their work could have been improved. Student can choose none, one, or many from five categories: *constructivity*, *specificity*, *kindness*, *justification*, and *relevance*.

Three models were built depicting student reaction to the feedback that they received on their work. Each model included a variation of three main variables (*reaction comment length*, *reaction comment*, *improvement suggestion*) and was grouped by the *feedback grade*. Two groups were compared: 1) student reactions to the feedback that they found extremely useful, and 2) not useful at all.

Conclusions & Discussions

Developing different ENA models by including different variables or grouping of variables led to more in-depth insight about the data. It seems that the *reaction comment length* variable had a strong effect on the plot structure, which in some cases enhanced the understanding of the model but might have made invisible the connections between the other variables if we did not develop ENA models without it.

Students that found the feedback extremely useful show a strong connection between praise, error acknowledgment or intention of revision, and gratitude in their *reaction comments*. Moreover, there is a strong association between only *gratitude*, only *accepting*, or both *gratitude* and *accepting* codes and the *reaction comment length*. Finally, only *gratitude*, only *accepting*, or both *gratitude* and *accepting* codes are strongly connected to zero selected *improvement suggestion*.

In comparison, students' reaction to the feedback that they perceived as not useful at all characterizes a strong connection between *reaction comments* expressing confusion, criticism or disagreement and *reaction comment length*, *relevancy*, *constructivity*, and *specificity improvement suggestions*, and zero or one selected *improvement suggestions*. Particularly, this finding poses an interesting question: is the process of disagreeing with the feedback and trying to defend one's own work useful from a pedagogical perspective, even if the students do not perceive it as such? If so, how would such a conclusion influence the teacher's development of PA rubrics and students' preparation for the PA activity? These aspects require further investigation.

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Towards Schools for Indigenous Futures: Storywork & Epistemic Network Analysis

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Abstract: This paper is based within a 3-year participatory design research and became more community-based (Bang & Vossoughi, 2016) in an urban Indigenous school in Thailand. My dissertation is divided into two parts. First, I focus my analysis drawing from the stories of a group of 20 teachers to trace their ethical relationships and types of connections they were making within their individual stories. Second, following six families as they walked and storied their homelands, I use epistemic network graphs to understand mathematics within Indigenous knowledge systems and part of family responsibilities. I use a mix of case studies, interaction analysis, and epistemic network analysis (Jordan & Henderson, 1995; Shaffer, 2017; Yin, 2013) as a way to visualize the shifting conceptions the role of school from nation-state agenda to ones concerned with the collective continuance of family and village life – that is, towards Indigenous futures.

Introduction

Indigenous communities have long have operated from their own knowledge systems, ethical intelligence, and ways of being (Bang, 2009; Deloria Jr. & Wildcat, 2001; Leepreecha & Meixi, 2018; Simpson, 2011; Smith, 1999). This dissertation illustrates pathways towards Indigenous futures through the importance of living in *reciprocal relations* among teachers and students, school and home; home contributes to the intellectual health of school and school, in turn, contributes to the community health and family life. I draw on Kyle Whyte’s work on collective continuance to refer to Indigenous communities’ ability to be “adaptive in ways sufficient for the livelihoods of its members to flourish into the future” (Whyte, 2014, p. 602). It is an ethic of being, based on strong moral relationships and responsibilities that members have to each other, to care and contribute to the well-being of their family, land, and community. In this context, epistemic network analyses lend itself to making visible the complex web of connections and relations that often characterize Indigenous knowledge systems (Shaffer, 2017). Using both storywork – the storytelling and story listening with each other (Archibald, 2008) and epistemic network analysis (Shaffer, 2017), this dissertation traces the shifts ethical relationships of 1) educators as told stories of themselves in school and 2) six Indigenous families as they storied and walked their homelands in northern Thailand.

Goals of Dissertation

The goal of my dissertation is to illuminate possibilities and pathways to Indigenous futurity in Thailand in two ways. First, I aim to trace the shifting ethical relationships and identities of 20 teachers as they move across the landscapes of home and school. I focus on new connections and frames that teachers were layering onto their stories and narratives of self. Second, using mathematics as a focal practice, I examine how mathematics is routinely embedded within larger familial and communal responsibilities within Indigenous families. My central question is: How can schools be generative partners in expanding Indigenous communities’ collective continuance? What emerges when researchers, teachers, students, and families collectively design and enact radically different relationships with each other?

Background of Project

The global onslaught of Eurocentric schooling was a project in colonization, extinction, and assimilation (Adams, 1995; Brock-Utne, 2000; Hyun, 2014). Under guises of democracy and nation-state agendas, public schooling routinely engages in cognitive manipulation and Indigenous erasure to separate and discredit non dominant forms of knowing while validating Eurocentric knowledges based in capitalist ideologies and settler logics (Bang, Warren, Rosebery, & Medin, 2013; Battiste, 1986; Tabulawa, 2003). In Thailand, compulsory state education tries to assimilate all ethnic-linguistic groups under the blanket of “Thai-ness” or *ความเป็นไทย* (Keyes, 1991). Mi’kmaq scholar Marie Battiste (1986) identifies this as a kind of “cognitive imperialism” resulting in daily barrages of epistemic violence on Indigenous people where “superior” Eurocentric school knowledges perpetuate problematic narratives of progress (Buadaeng & Leepreecha, 2009; Marker, 2006). Moreover, ignoring the rich family-based knowledges that young people bring into classrooms debilitates the intellectual health of schools. At a global level, this structures the loss of human diversity through global epistemicide (Santos, 2014), turning us into an “imbalanced species that justifies violence to our planet and to others” (Belcourt, 2018, p. 117).

My dissertation grows out of a 17 year-long relationship with Sahasat School, an urban Indigenous¹

¹ I use the term Indigenous people in Thailand to mirror the movements and efforts of self-identifying Indigenous peoples in Thailand.

school in Chiang Rai, Thailand, where movements for Indigenous education are taking root (Leepreecha & Meixi, 2018). Over three years, we engaged in a participatory design research (Bang & Vossoughi, 2016) and iterated on a practice called *Tutoría* that originated in México. *Tutoría* required teachers to attune differently to young people and their relations, and ultimately uncover and resist the state-mandated expectations, structures, and purposes of school. By reorganizing classrooms in *Tutoría*, we shifted control of teaching and learning, how knowledge is validated, and redirected the purposes of schooling towards community ends (Cámara et al., 2018). I find that restor(y)ing relations within *Tutoría* made visible the ethical and political dimensions of our work, where state-mandated directives lost power while other possibilities, such as family and community futures, gained power and purpose (Bang et al., 2014; Sengupta-Irving & Enyedy, 2015).

Methodologies & Preliminary Findings

In my dissertation, I use a mix of storywork and narrative analysis (Archibald, 2008; Ochs & Capps, 1996; Wortham, 2001) as well as epistemic network analyses (Shaffer, 2017). My dissertation is divided into two manuscripts. In the first manuscript, I trace shifts in our design ethics at Sahasat school through the stories teachers, families, and young people told to each other. This paper offers theoretical contributions by demonstrating how collective storywork opens up more humanizing and equitable forms of teaching, learning, and research (Archibald, 2008). Dian Million (2014) writes that “[Stories] are a felt knowledge that accumulates and becomes a force that empowers stories that are otherwise separate to become a focus, a potential for movement” (p. 31-32). Through bringing “otherwise separate” stories across the landscapes of home and school, I ask: *How and in what ways did the politics and ethics of our participatory design research shift over time through stories?* I follow two sets of 17 teacher stories from two events to examine how storywork educated our hearts, minds, and spirits (Archibald, 2008). By creating network graphs of the ways teachers’ stories and epistemic frames stayed the same and shifted over three years, I show how specific shifting frames around heterogeneity and reciprocity supported alternate imaginaries of learning and education and strengthened our resolve to design towards families’ collective continuance.

In the second manuscript, “Our stories of home: Walking and storying lands as everyday resurgence,” I examine a key point of evolution of our design where we began walking and storying home villages with six Indigenous young people and their families. I use interaction analysis and epistemic network analysis within six case studies and to illustrate the ways that home is a site of rich intellectual work that strengthens the collective continuance of families (Jordan & Henderson, 1995; Yin, 2013). I explore: *What stories – relations, knowledge, and dreams- emerged through walking and storying homelands with families? How does this expand current conceptions of mathematics?* I highlight the ways that telling stories with land (e.g. fishing, rice harvesting, traditional Akha games) carried integral theories of being, mathematical expertise, and ecological knowledge that uphold Akha, Karen, and Hmong families’ responsibilities to sustain the land and more-than-human life in the village and forest. This paper contains methodological contributions to growing literature on mobility and how land is an actor in the co-constitution of space and cognition in the learning sciences (Marin & Bang, 2018; Taylor, 2017).

Expected Contributions

The ways we engaged with each other, helped to frame what we wished to see in the world and in our homes, was the transformation itself. Through this work, I contribute to much-needed scholarship in Indigenous studies by showing how self-identified Indigenous people in Asia are adapting and expanding their own possible futures and collective continuance, with implications for similar work in trans-Indigenous contexts.

Using Quantitative Ethnography to Investigate Self-Assessments of Progressive Entrustment in Surgery Education

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Abstract: Entrustable Professional Activities (EPAs) are the newest approach to competency-based surgery education. This approach requires collecting large numbers of micro-assessments on clinical skills from both attending surgeons and surgical resident trainees. We propose utilizing Quantitative Ethnography to better understand how residents in surgery training programs understand their learning progressions by analyzing their self-reflections of their performance on EPAs.

Introduction

Entrustable Professional Activities (EPAs) are an approach to training in surgery in which trainees are frequently assessed on routine activities that are essential to patient care. In an attempt to better define and assess performance on what are considered core procedures and disease processes, the American Board of Surgery has partnered with other key stakeholder organizations in surgery training. Their goal has been to define behaviors that are essential for general surgery residents to demonstrate proficiency, or entrustment, in before leaving their residency training for fellowship or independent practice. As such, the proposed method for measuring development of EPAs is through assessment of observable units of work that residents engage in on a daily basis. A method by which to judge performance in this context is the level of supervision needed by a resident engaging in these tasks, which corresponds to a level of entrustment that can reasonably given to a resident engaging in these routine yet essential activities of patient care (Greenberg & Minter, 2019). The goal of EPAs assessment is to be both formative and summative, providing the trainee with valuable information about performance strengths and weaknesses that can be modified on the next clinical encounter, until they reach an acceptable entrustment level of either requiring indirect supervision or no supervision at all (ten Cate, 2016). This work seeks to understand residents' perspectives of their learning trajectories in core EPAs using Quantitative Ethnography (QE) and Epistemic Network Analysis (ENA).

Methods

An application for mobile devices was designed by our department to allow for the collection of EPA micro-assessment data (See Figure 1).

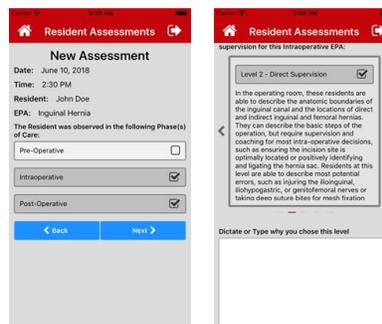


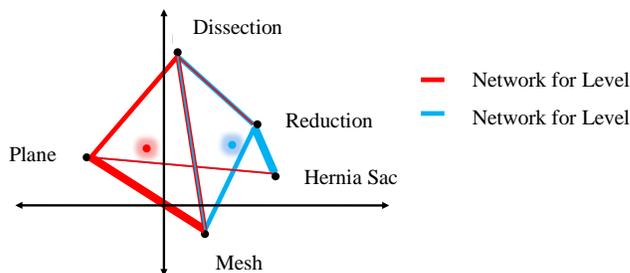
Figure 1. EPA Assessment App Used for Data Collection

Setting, Participants, and Data Collection

General Surgery residents self-assessed on core EPAs throughout one academic year. Attending (supervising) surgeons also assessed residents on the core EPAs. However, this work focuses on residents' self-assessments to gain a better understanding of how they perceive their development in these core areas. In order to implement competency-based education approaches, such as the development of entrustment, we need to better understand learning trajectories in medicine from the perspective of trainees (Gruppen et al., 2017). We will investigate both perceived development of individual residents over time as well as differences between residents of the same training level. As of April 2019, 470 micro assessments completed by residents.

Proposed Analysis and Anticipated Results

The following are a resident's self-assessments for inguinal hernia repair on two consecutive days, Level 1: "Able to perform most steps, needed help with identifying some of the correct planes for reduction, need to work on not getting holes in the flap"; Level 2: "Know and able to perform most steps of the procedure, need guidance on ensuring the correct extent of dissection inferiorly and laterally and help with mesh placement." With multiple self-assessments, we can code the components of the procedure that are referenced and create network representations,



such as the example in Figure 2, to represent residents' perceptions of their development of entrustment using QE and ENA. Quantitative Ethnography (Shaffer, 2017) will allow us to better understand residents' perceptions of their performance as they progress in training, and ENA (Marquart, Hinojosa, Swiecki, Eagan, & Shaffer, 2019) can represent changes in connections among performance elements over time.

Figure 2. A potential learning progress for inguinal hernia repair as visualized by ENA based on residents' self-reflections

Future Directions and Implications for Training in Surgery

Investigating residents' perspectives of learning trajectories will inform understanding of what residents perceive as their performance at different levels of entrustment and how their performance progresses across levels. Knowing this will allow us to better align these perspectives with those of attending trainers. This will facilitate the promotion of the development of entrustment in essential areas of surgical practice to reduce variability in outcomes and permit graduated independence in training.

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Exploring Physics Education in the Classroom and the Laboratory with Multimodal Learning Analytics

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Abstract: We are developing a process and framework for combining website server logs from a set of online university physics learning tools with multi-modal learning analytics of video/audio of students in across diverse learning and laboratory situations. We aim to use this emerging framework to get a richer picture of student behaviours in connection with learning about neutron scattering in settings that blend digital and face-to-face learning and lab work. We set up a pilot research design, where we followed a master-level physics course at a university to a research facility where they participated in on-going research for their capstone project. The framework relies on network analysis of online student actions and real-life actions. Nodes in our networks correspond to students, artefacts, and actions and links correspond to the direction of talk, order of actions, and nature of their physical interactions.

Introduction

There is a good amount of evidence set out in recent reports that show the rising importance of working with other agents, both people and machines, to solve complex problems across subjects. The significance of collaborative problem solving (CPS) is recognised by policy-makers and the Organisation for Economic Co-operation and Development (OECD) as one of the critical skill for 21st-century learning. In the case of physics education with the focus on neutron sciences in preparation for the European Spallation Source (ESS), many teaching/learning initiatives have been launched that allow for collaborative problem-solving in authentic contexts, the laboratories. Some of these initiatives are computer-based and can be used in various teaching situations ranging from blended learning to pure online courses (Bruun, Jensen, & Udby, 2015). However, little is known about how the various learning tools prepare the students for actively participating in scattering experiments at the physical labs. In the on-going case presented in this paper, we investigate how students learn in the course and how they perform in the laboratory through network analysis and multimodal learning analytics (MMLA) that capture the log-data from the digital learning activities, and interaction between students and objects from video and audio. Our research aim is to examine how the students' actions change from the classroom to the laboratory to understand how the coursework can further support the laboratory work in real scientific experiments.

Context

We are investigating student behaviour in a neutron scattering science course using a combination of server logs, MMLA and observations of learners in the classroom and authentic experimental environments. We expect some students to display behaviour, which are in-depth learning strategies, while other students display behaviours more associated with surface learning. However, a given student may display in-depth learning strategies at one point in time, and surface learning strategies at other points in time.

During the course, the students have used various e-learning tools (e.g. wiki-textbook, quizzes, and live-simulation of data), and we will utilise the server logs of sessions to create network maps of student behaviour (Bruun et al., 2015). Concurrent with logging and analysing online behaviour, we will use video and audio recording student interactions with online course material during class and during group

work that will be analysed by human and machine with ongoing MMLA work, that explores group collaboration (Cukurova, Luckin, Mill An, & Mavrikis, 2018; Spikol, Ruffaldi, Dabisias, & Cukurova, 2018). We aim to understand better, how to design virtual simulations to prepare students to conduct experiments with complex physics instruments in the lab (Overgaard et al., 2016).

Methodological Approach

Our experimental approach aims to investigate how to create a rich epistemic analysis approach that combines Bruun and colleagues (Bruun, Lindahl, & Linder, 2019) Thematic Discourse Network Analysis (TDNA) and Cukurova and colleagues (2018) Nonverbal Indexes of Students' Physical Interactivity (NIPSI). The concept is to combine the discourse and the physical interactions of the learners in the different learning situations and environments. These learning activities in the course are seen through the lens of epistemic frames (Shaffer, 2006) since the classroom activities need to be applied to the real-world laboratory for the student's capstone project. The work is inspired by Activity-Centred Analysis & Design (ACAD) framework (Martinez-Maldonado et al., 2017), which defines physical, epistemic and social dimensions as critical. However, we frame our methodology, starting with the TDNA as the guide to analysis the multimodal observations. Additionally, our approach lays the foundation for designing and developing augmented (automated) approaches to help with the analysis utilising some of the work (Spikol et al., 2018).

Expected Outcomes

The expected outcome of this project is to expand and create the different frameworks for combining network analysis of the students' social interactions and conceptual mappings with the physical interaction action patterns of the group work. Additionally, we aim to explore how MMLA more data-centric approaches can be used to understand the challenges the students encounter when shifting from learning about science to doing science in the lab. The framework relies on network analysis of online student actions and real-life actions. Nodes in our networks correspond to students, artefacts, and actions and links correspond to the direction of talk, order of actions, and nature of the interaction. Additionally, the need to develop timely and if not real-time feedback for collocated collaborative learning is a challenge that will help make MMLA relevant to learners and teachers. The underpinnings of Quantitative Ethnography can support a balanced approach to guide technology and theoretical contributions.

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Developing STEM Career Identity in Minoritized Middle Schoolers in an Informal Learning Environment: A Mixed-method Study

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Abstract: This study focuses on 19 minoritized students' perceived STEM career identities and tracks their learning as perceived STEM career identity in a summer camp for one week. Individual and social perceptions are tracked in three time points based on the tenets of the theoretical framework, Projective Reflection. Quantitative Ethnography techniques and tools is used to recode quantitative data based on nineteen students' data sources including survey, focus-group interviews, observations notes, project artifacts, and multimedia data.

Research Goals

The aim of conducting this study is two-fold. First, this study adds to the literature of STEM identity exploration in informal learning environments by facilitating and tracing identity exploration in a STEM summer camp. It contributes to the limited literature in this area of research by focusing on different aspects of STEM career identity exploration on racially minoritized students in responding to how students' identities develop (Capobianco, Ji, & French, 2015). It further adds to the literature by using Projective Reflection (PR) as a comprehensive theoretical and methodological framework for tracking students' identity change in an informal learning environment. In an attempt to trace students' identity change, new methodological insights such as Quantitative Ethnography (QE) techniques will be incorporated to better explore the patterns of students' behavior in their natural learning contexts (Shaffer, 2017).

Second, this study tries to increase STEM career interest among racially minoritized and low-income students by developing a one-week project-based curriculum which supports multiple aspects of STEM identity exploration. By providing an immersive informal learning environment for the students, the researcher wants to simulate STEM careers for the students so that they explore different roles and have a more realistic approach toward their interests. Specifically, this study will give students the opportunity to bridge their interests to possible future STEM careers by choosing among three different STEM-related projects: (1) astroengineering, (2) astrophysics and (3) astrobiology and work with their peers on a Mission to Mars project.

Background

STEM career identity has been defined as a way that individuals see themselves in relation to other professionals in Science, Technology, Engineering, and Mathematics (STEM) (Simpson, 2018). Since perceptions have been defined as peoples' attitudes and views (Pajares, 1992; Richardson, 2003), STEM identity can be defined as people's perceived identity (Dutton, Dukerich, & Harquail, 1994) as related to perceptions of self in one or more disciplines, and their surrounding environments (Simpson, 2018). This study's conceptual framework focuses on two broad streams in the literature: individual perceptions and social perceptions as two types of perceptions that shape individuals' perceptions of career choices (see Figure 1). In the literature, individuals' perceptions have been connected to self-efficacy, interest, motivation, and competence. Social perceptions are further connected to role models and social support. The theoretical framework of this study, Projective Reflection further allows tracing students' identity changes in three time points: starting self, exploring role possible selves, and new self (Foster, 2014).

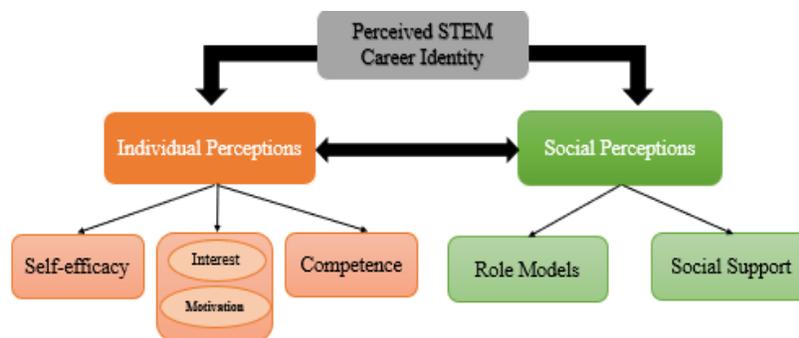


Figure 1. The Conceptual Framework

Methodology

Nineteen middle schoolers participated in this study and completed a Likert-scale survey before and after the completion of the camp in addition to focus group interviews. Two researchers recorded their progress as students were completing their projects in a mission to Mars. Students' projects artifacts, reflective daily journals, and multimedia data were also among data sources. The curriculum was designed to have some STEM career identity development pieces to support minoritized students in a summer camp. For instance, role models were highlighted in the curriculum as the literature endorses the effectiveness of STEM career role-playing activities in increasing STEM interest, engagement, and creating accurate perceptions of these roles (Stout, Dasgupta, Hunsinger, & McManus, 2011; Zeldin, Britner, & Pajares, 2008). The design of this study is an embedded mixed-method design with a primary qualitative research question of "how do students' perceived STEM career identities develop in a summer camp?" and a secondary quantitative question of "is there a significant difference in perceived STEM career difference from before to after summer camp and based on gender?"

Expected Findings and Contributions

Different patterns of identity exploration are expected to be seen using the Epistemic Network Analysis (ENA) which is one of the tools of QE. These patterns may explain the reasons gender and racial minorities have remained minoritized in STEM workforce. The effectiveness of some of the design features of the curriculum such as providing role models will also be tested which will be a great resource for future implementations. This study will contribute to the limited literature in STEM career identity exploration of minoritized students in informal learning environments using new theoretical and methodological insights.

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Using Epistemic Network Analysis to Measure and Identify Racial Identity Development Stages

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Abstract: Significant theory surrounds the study of Racial Identity Development with much of the complimentary empirical work focusing on survey data. In this work, I take a novel approach to examining stages in the racial identity development process, combining Epistemic Network Analysis of Qualitative Data with Cluster Analysis techniques to identify three distinct stages of Racial Identity Development among a sample of 16 black high school students. I find the three stages I identify are similar to those originally conceived by Phinney (1993).

Introduction

There are various racial identity development models each laying out processes with specific steps for how individuals acquire positive racial identities. Generally, these models all follow a similar trajectory, from a negative internalized perspective on one's racial identity (viewing themselves as inferior for being black for instance) to understanding mechanisms of oppression as stemming from whites and having positive racial identity that stands against that. Phinney's (1993) "Three-Stage Model of Ethnic Identity Development in Adolescence" is one of the most well-cited identity development models, as well as arguably the simplest (as measured by number of stages). Stage One of the model, *Unexamined Ethnic Identity* is characterized by a lack of positive views of one's own group and dominated by the views of the mainstream group. The second stage, *Ethnic Identity Search/Moratorium* centers around experiences of discrimination/racism that incite individuals to be open to reinterpret their identity/search for an ethnic identity. The third stage, *Ethnic Identity Achievement*, centers around a confident, proud internalization and acceptance of the subject's racial identity.

Methods

Data for this project comes from "A Qualitative Investigation of Black Student's Perceptions of School Racial Climate" (Byrd, 2019). This study consisted of semi-structured interviews with black high school students at a predominantly black high school. The study consisted of 16 subjects across 20 transcripts. I read the transcripts and proposed codes by identifying topics most commonly brought up in the text that are also relevant to Racial Identity Development. These codes were validated for reliability and automatically applied to the text via nCoder. Next, I used Epistemic Network Analysis (ENA; Shaffer, 2017) to measure and model the connections between codes. Finally, I used the resulting ENA scores and applied a k-means clustering algorithm which produced 3 clusters.

Results

In general, the 3 clusters to some extent resemble the three stages of Racial Identity Development as proposed by Phinney (see Figure 1). Subjects in Group 1 made the least connections between BLACKNESS and POSITIVITY and tended to centralize WHITENESS. Subjects in Group 2 connected RACISM to BLACKNESS at a similar extent to subjects in Group 1 but importantly did not centralize WHITENESS as much and connected BLACKNESS to POSITIVITY to a greater extent. Subjects in Group 3 connected BLACKNESS and POSITIVITY the most and made few connections to RACISM.

Group 1

Subjects in this group's tendency to centralize WHITENESS overwhelmingly indicated a failure to genuinely understand what racism is, especially as it related to being black, as well as indicated a general Eurocentric perspective. One student, for instance, apologetically described an incident where they referred to a white woman as "white" rather than "Caucasian" as an example of themselves, a black student, as being racist towards a white person.

"I was like "the white woman, the white woman". He like "Caucasian". I'm like, "you know, I wasn't trying to be racist. You know what I meant. I wasn't trying to be racist."...But I'm glad he didn't take offense to that because I wasn't really trying to..."

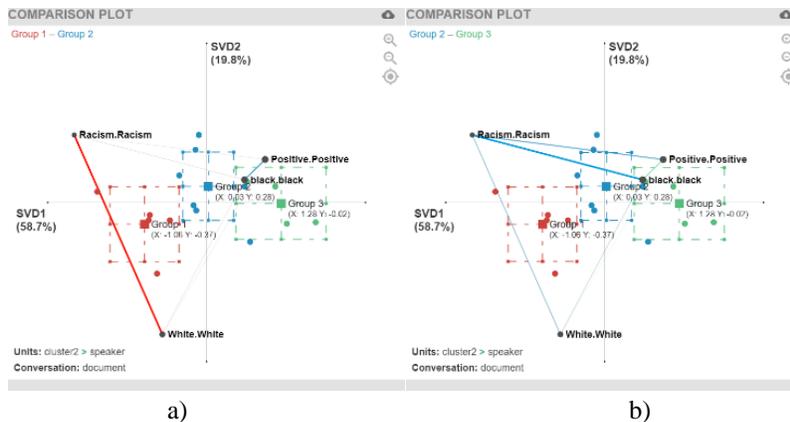


Figure 1. Mean network subtractions for a) Group 1 vs. Group 2, and b) Group 2 vs. Group 3.

Group 2

Subject's in this group highlighted an uncompromising connection between RACISM and BLACKNESS, indicating an understanding of the role racism plays in blackness and had an overwhelmingly focus on raw experiences of racism or references to racism's systematic impact on black people.

"...I yelled at a boy for knocking my books off the table. So I'm like "Why did you do that?" I'm like yelling at him and he said "you need to stop little black girl". I was like "what did you say" and he said "Don't get your black girl attitude with me".... And I was like, that's such a stereotype"

This group also featured greater connections between blackness and positivity.

"My role model is Ben Carson. He provided me a good example of a good black male because he grew up in Detroit, and was considered a ghetto kid and now he is a world famous neurosurgeon."

Group 3

Subject's in this group made a high degree of connection between BLACKNESS and POSITIVITY and a lack of focus on RACISM and WHITENESS. This group indicated they were the most secure and content with their blackness.

Discussion

Considering Phinney's mode, Group 1 most closely aligns with the Unexamined Ethnic Identity stage, Group 2 most closely aligns with the Ethnic Identity Search/Moratorium stage, and Group 3 most closely aligns with the Ethnic Identity Achievement stage. Ultimately, examining racial identity, I find evidence of three distinct groups of black adolescents, one which lacks connections between blackness and positivity, one which centers around experiences of racism, and one that centers around connections between blackness and positivity. These groups to some extent resemble the groups proposed by Phinney. The specific application of Epistemic Network Analysis suggests a new method by which identity development can be quantitatively measured.

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Acknowledgements

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Parsing the Democratic Debates: A Bimodal Epistemic Network Analysis

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Abstract: This study illustrates the value of a bimodal approach to Epistemic Network Analysis (ENA). Using bimodal ENA, we model debate discourse between the 2019 Democratic presidential candidates based on two classes of codes: “positioning” and “content.” Interactions between the two sets are analyzed to better understand how candidates presented themselves in the debates. Specifically, we use ENA to visualize the co-occurrences between positioning and content codes while masking intra-code-set connections. We report preliminary results that indicate the potential of this bimodal approach.

Introduction

Bimodal analyses capture interactions between two classes of objects while masking intra-class interactions. Epistemic Network Analysis (ENA) models connections between coded data by quantifying the co-occurrences of codes and producing a weighted network from them (Shaffer, 2017). Therefore, bimodal ENA would be useful in examining datasets in which connections between two classes of codes, but not intra-class connections, anchor the analysis. The 2019 Democratic debates provide one such dataset.

Political personas are public *narratives* (Fischer, 1984). That is, by synthesizing rational, argumentative themes with aesthetic and emotional themes, public figures project messages about who they are and what they stand for. We posit that *positioning*, or the ways in which candidates discuss pertinent issues, provides insight into distinctions between political personas. Positioning, however, exists in relation to content. Therefore, in order to analyze the debates through this lens, we built a bimodal ENA model.

Methods

We analyzed transcripts from the first five 2019 Democratic primary debates. Our unit of analysis focused on the 21 competing candidates. We used a grounded iterative approach to derive two sets of codes, one for positioning (PROMOTES COLLABORATION, INDICATES PLANS, FIGHTS FOR, CALLS FOR CHANGE, SECURES AGAINST THREAT, ADVOCATES SOCIAL JUSTICE, RELATES PERSONAL EXPERIENCE) and one for content (CLIMATE CHANGE, ECONOMY, FOREIGN POLICY, HEALTH CARE, IMMIGRATION). Coded data were then modeled using ENA to visualize the co-occurrence of codes within the recent temporal context (Siebert-Evenstone et al., 2017), defined here as eight lines of discourse.

To create a bimodal model, we employed the rENA package in R (Marquart et al., 2018) and masked co-occurrences so that positioning codes could only connect to content codes, and vice versa. The resulting networks were aggregated for each candidate using a binary summation in which a given line shows the presence or absence of the co-occurrence of a permitted pair of codes. Lines are weighted to reflect the relative amount of co-occurrence throughout the discourse. The ENA model normalized the networks before subjecting them to a dimensional reduction, which produced a unique space that maximized the variance explained by each

dimension while optimizing the position of each plotted point. While the ENA space is constructed to show the variance across all 21 candidates, individuals' networks can be compared to one another by subtracting one weighted network from another.

Results and Discussion

Figure 1 shows the subtracted networks of the top polling Democrats: Joseph Biden against Elizabeth Warren, and Joseph Biden against Bernie Sanders.

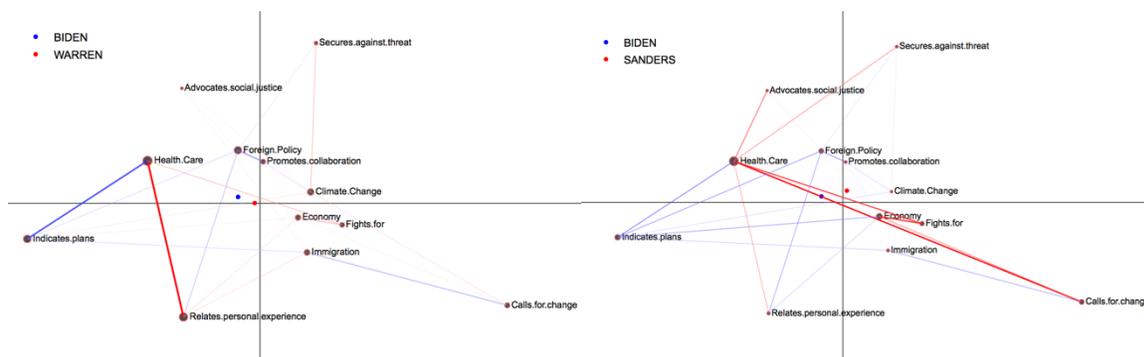


Fig. 1. Subtracted networks for Biden and Warren (left) and Biden and Sanders (right). Biden's network is blue in both models.

The extreme locations of the codes CALLS FOR CHANGE and INDICATES PLANS along the x-axis and SECURES AGAINST THREAT and RELATES PERSONAL EXPERIENCE along the y-axis indicate that these four positioning codes explain the most amount of variance in the model. Noteworthy here is that the majority of content codes, with the exception of HEALTH CARE, hover near the center of the graph. This indicates that while the 21 Democratic candidates all discussed the content issues displayed in the model, it was the manner in which they discussed them that accounted for the most difference.

Importantly, our bimodal analysis offers interpretative power unavailable to a unimodal approach. For instance, the three candidates can be seen to distinguish themselves around the important topic of HEALTH CARE. Biden indicates plans, demonstrating organization and reliability. Warren relates personal experience, appearing grounded and relatable. Sanders calls for change and is, apparently, willing to fight for it. Thus, our bimodal model reflects distinctions in the interactions between the two classes of codes, which in turn offers insights into distinctions between the political personas exhibited in these Democratic debates.

Future work will deepen the analysis of political discourse and explore the use of bimodal ENA in other domains.

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Front-Line vs. Leadership Perceptions of Health IT Implementation

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Abstract: In this study we assessed how dispensing pharmacists and pharmacy administration personnel compared when implementing a new health information technology. Pharmacy administrators, removed from the day-to-day workflow of dispensing pharmacies, presented a rather thin depiction of the medication discontinuation process compared to front-line personnel. This emphasized the importance of end-user consideration when implementing a new innovation, because front-line workers and leadership may have differing views of not only the solution, but the problem itself.

Introduction and Theory

When a patient is seen in an outpatient clinic, the clinician will routinely stop or discontinue medications electronically in the patient's electronic health record (EHR). Although these changes are documented in the clinic's system, there is no automatic transmission of this information to the pharmacy's dispensing software. This creates discrepancies between the clinics and pharmacies and makes patients vulnerable to medication errors. Within the last decade, a new health information technology (IT) functionality, termed CancelRx, has emerged to electronically send a medication cancellation message from the clinic's EHR to the pharmacy's dispensing software and automatically discontinue the prescription record (NCPDP, 2014).

Epistemic Network Analysis (ENA) is a quantitative ethnography technique to model the structure of connections within data (Shaffer, 2017). This technique provides insight into the epistemic frame, or how individuals make sense of the world around them by describing the linkages found within discourse. ENA provides a systematic way to compare networks and understand how connections differ between people. Implementation science principles emphasize the importance of considering the front-line workers and not just leadership personnel when preparing to roll-out new, innovative practices (Kitson & McCormack, 1998). Thus, how individuals view health IT or frame the problem it is intended to solve may differ based on their role within the organization. In this study, we aim to assess how dispensing pharmacists and pharmacy administration personnel compare when considering CancelRx implementation.

Methods

CancelRx functionality was implemented in October 2017 at an academic health system. At nine-months-post implementation, our research team interviewed a convenience sample of pharmacists (N = 6) and pharmacy administrators (N = 3). The pharmacists and administrators were asked questions regarding the: prescription dispensing process, medication cancellation process, and more.

Interview discourse from the pharmacists and pharmacy administrators were segmented by sentences. A set of codes was created to encompass the components of the work system: person (pharmacist), tasks (CancelRx), tools and technology (electronic health record and documentation, CancelRx, prescriptions), organization (prescriber, clinic staff) and physical environment (Carayon, 2006). Each sentence from the interview transcripts was coded using an automated expression-based coding approach (ncodeR, 2018). Codes were validated by comparing hand-coded units to the automated coding system. Shaffer's Rho scores were all significant below a 0.05 threshold, and Cohen's Kappa scores were all significant above 0.65.

We modeled pharmacist and pharmacy administrators' connections between cancellation messages (CancelRx) and other work system components using ENA (Shaffer, 2017). The ENA algorithm used a moving stanza window of 4 sentences to construct a network model (Siebert-Evenstone et. al., 2017).

Results and Discussion

The qualitative data and ENA illustrated different connections between pharmacists and pharmacy administrators. Pharmacist 1, a staff pharmacist at a dispensing location (Figure 1) stated:

They [the provider] discontinued the Lisinopril before they started the Losartan. That being said, if I got a new script coming through in their profile review, I would have seen that and documented it and then take care of it in that manner too. So it's caught, but just because that's what we've always done, but it's kind of cool when it's [CancelRx] done the appropriate way (Pharmacist 1).

On the other hand, Pharmacy Administrator 1, a clinical pharmacy supervisor (Figure 2) stated:

We have access to the electronic medical records, so we can just toggle between a screen, read through the practice notes, and be like, oh, yep, they said we're going to cancel this (Pharmacy Administrator 1).

Pharmacy administrators, removed from the day-to-day workflow of dispensing pharmacies, presented a rather thin depiction of the medication discontinuation process and inferred that the CancelRx was a way to communicate information from the EHR with little reference to the other components of the system. On the other hand, pharmacists working in dispensing roles viewed the medication discontinuation process as a reconciliation of information from the providers, prescriptions, and the electronic health record—viewing CancelRx as a tool, but an imperfect means of correspondence.

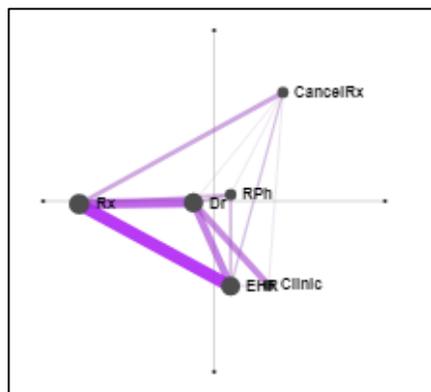


Figure 1. Pharmacist 1 Network Graph

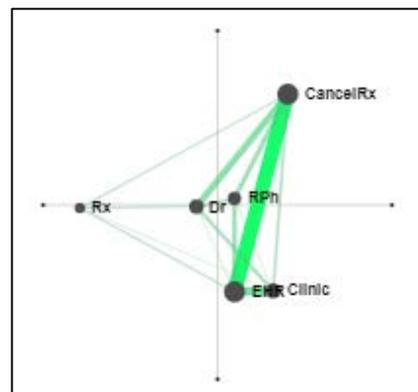


Figure 2. Pharmacy Administrator 1 Network Graph

Ultimately, these findings emphasize end-user consideration when implementing a new innovation, because front-line workers and leadership may have differing views of not only the solution, but the problem itself.

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Amazon Alexa: A New Source of Social Support

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Abstract: Product review of in-home conversational agent (ICA) contains rich data including users' expression of social support received from ICA. By analyzing the product review of Echo Dot using Epistemic Network Analysis (ENA), this study investigates how different user groups perceive different structure of social support. Two factors, users' age and the use of other ICA-controlled devices, are found to explain the perceived social support. The study suggests that the ENA could provide a promising approach to understanding the mechanisms of HCI.

1. Theory

Social support has been defined as “information leading the subject to believe that he is cared for and loved, esteemed, and a member of a network of mutual obligations.” (Cobb, 1976, p. 300) There are several types of social support, including informational support, instrumental support, companionship and emotional support. Social support has a beneficial effect on people's wellbeing (Cobb, 1976). Although traditionally the social support has been generally provided by human beings, recent studies suggest that ICA could serve as a new source of social support (e.g., Wei, Willett, Qu, & Eschenfelder, 2019).

Epistemic Network Analysis (ENA) was originally developed to model theories of cognition, discourse, and culture which argue that the connections people make in discourse are a critical level of analysis (Shaffer et al., 2009). But the method is not limited to analyses of learning data. For example, ENA has been used to analyze communication among health care teams (Wooldridge, Carayon, Eagan, & Shaffer, 2018). ENA is an appropriate technique for any context in which the structure of connections is meaningful. ENA is thus a useful technique for modeling product review data because it can model the relationships among different types of social support perceived from ICA as they are expressed within the product reviews. In this study, Echo Dot (3rd Generation) review is chosen because of its diverse user population and the richness of the data.

With the product review data, current study tries to answer two research questions: (1) What are the differences in social support perceived by the elderly users of Alexa device and the non-elderly user group? (2) What are the differences in social support perceived by those who live in homes with Alexa-controlled smart devices and those live in homes with Alexa device only?

2. Method

2.1 Data Collection and discourse analysis

The author collected 4,001 review data of Echo Dot (3rd Generation) on Amazon.com with a web scrapper during March 2019. A regular expressions coding approach is used to automate coding for the 5 codes listed in table 1. Codes have been validated by comparing hand-coded data between independent human coders, and by comparing hand-coded data to the automated coding system. The author models the connection between three types of social support and compare the structure of the social support in the reviews of the elderly and non-elderly, as well as the structure of the social support between users living in a “connected” homes and those not.

Table 1. Discourse analysis codes definitions and examples.

Code	Definition	Exemplar reviews	kappa (κ)	rho (ρ)
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Informational support	Amazon Alexa provides information, guidance and suggestions to users.	“We use it for the latest news and the weather.”	1.00	0.00
Instrumental support	The provision instrumental services by Alexa.	“We have our lights controlled by Alexa.”	0.91	0.02
Companionship	Alexa serve as a companion to the users	“Alexa can be good when you need companionship.”	0.86	0.04
Connection	Other smart devices are controlled by Echo	“I use smart plugs to operate lamps”	0.96	0.01
The elderly	Reviews that talk about the user experience of the elderly.	“I’m a 65 year old ... woman”	1.00	0.00

3. Results

Fig. 1 shows that both elderly users and non-elderly users could perceive instrumental support and informational support, but only the elderly group perceive companionship from Alexa at the same time. Fig. 2 shows that the people living in “connected” homes perceive companionship from Alexa through the perception of instrumental support and informational support slightly more than those living in an “unconnected” home. Some examples of those reviews are presented in Table 2.

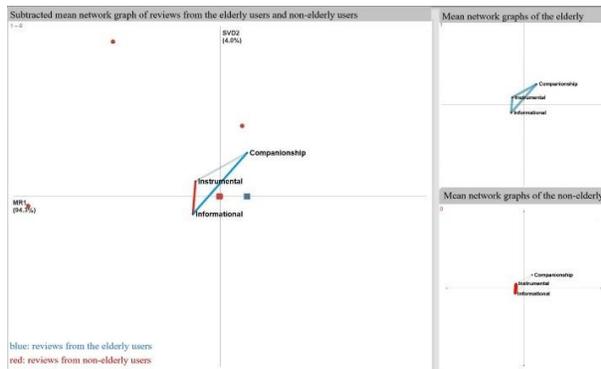


Figure 1. Mean network graphs for the elderly users (top-right) and non-elderly users (bottom-right), as well as the subtracted mean network graph for both groups (left).

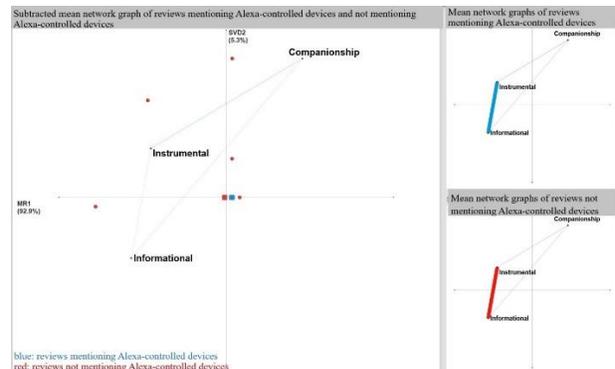


Figure 2. Mean network graphs for the Alexa-controlled device users (top-right) and Alexa only users (bottom-right), as well as the subtracted mean network graph for both groups (left).

Table 2. Review examples: elderly vs. non-elderly users and “connected” home vs. “un-connected” home.

Review type	Review content
The elderly user review	“Yeah, I am already in love with Alexa. And I told her so. She answered back, I am flattered! Ha, I am a lonely old shut in lady, wheelchair user, chronic health problems. I ask her to remind me ... to take my meds... She tells me jokes, helps me with my foreign languages.... She is my friend.”
Non-elderly user review	“...You can use it as ..., set alarms, add grocery list that will sync to your phone Alexa can answer most questions and has a decent amount of knowledge on most subjects. My child enjoys asking it to make fart noises. Very cool new toy!”
Review from user living in a “connected” home	“...Came with our Ring security system...a huge help. Thanks for including this, Amazon, greatly appreciated finding new uses, every day, Alexa is a new family member.”
Review from user living in a “non-connected” home	“OMG! It's like having a companion... She knows so much and can learn so much more. She may not understand me some times, but then no one else does either! ... I love it!!!”

4. Discussion

In a previous study, Wei et al. (2019) used an interview-based approach to learn if and how smart home users could perceive social support. They found that one senior (in her 70s) talked to her Alexa device to decrease her loneliness when her husband travelled abroad for a long time. However, limited by the sample size of that study, they could not conclude that Alexa is a companion for the elderly. In this study, however, with larger sample size, the author can more confidently conclude that the elderly could perceive

companionship via the use of Alexa (although the effect size is not very large). The ICA can hold natural voice-based conversations and users can do lots of stuff with the ICA. Senior citizens could benefit from using the devices, not only functionally, but also emotionally. Lonely senior citizens could talk to those ICA to fight against loneliness.

This study also provides more evidence to support the author's speculation that people living in a home multiple smart device are more likely to perceive companionship from Alexa through the instrumental support and informational support provided by the devices. In addition, this study indicates that ENA could be applied to the study of social and emotional aspects of HCI.

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Directive or facilitative tutor? The effect of tutoring styles on STEM learning design discussion

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Abstract. The present study aimed to shed light on learning performance and gains in two differently-tutored online discussion environment, directive tutoring and facilitative tutoring. 33 student-teachers enrolled in the teacher education program, and completed 11 online discussion activities with a directive tutor or facilitative tutor. We aligned epistemic network analysis method to analyze 15,567 discussion data and explore the structure of interaction and strength of connection among the groups with different tutoring style.

Keywords: Tutoring style, STEM learning design, Epistemic network analysis.

1 Objectives

Traditional teacher education often adopts lecture-based approach in which teacher educators delivering pedagogical knowledge to student-teachers. Besides, many teacher training programs consist of a collection of isolated course in which theory is presented without much connection to practice(Korthagen & Kessels, 1999). This emphasis on expert-knowledge have shown its failure to strongly influence the practices of graduates of programs(Gal & Society, 2005). To address these issues, this study adopts an instructional model, a type of “cognitive apprenticeship” (Dickey, 2007), in which student-teachers jointly develop STEM learning design competence through active participation, interaction and reflection under the guidance of a tutor. However, it remains unclear regarding how to scaffold learning design in a community of teaching practice. Previous research has shown that tutors of different styles perform differently when conducting online discussion (Chae & Shin, 2015; Foong, Nor, & Nolan, 2018). Therefore, this study aims to explore student-teachers’ learning performance and gains in two different tutoring styles, i.e., directive and facilitative tutoring. More specifically, this study contrasts tutoring network and STEM learning design competence network of the two groups led by different tutoring styles.

2 Theoretical Framework

2.1 Tutoring Style

With regard to tutoring in general, previous research has proposed various but related conceptions. For example, student-centered and teacher-centered, student-centered and content-centered, knowledge-building and knowledge-telling, etc. Despite the different terms used, there are fundamental differences between two tutoring styles. This study started from a main conceptualization of a facilitative tutoring style and a directive tutoring style (Berghmans, Michiels, Salmon, Dochy, & Struyven, 2014; Chae & Shin, 2015), both tutoring styles result in a unique and distinctive learning environment (Table 1). In the process of guiding student-teachers to conduct STEM instructional design, facilitative tutor stimulates active construction and deep learning of knowledge by asking questions and prompting, values the high-quality involvement of student-teachers and encourages student-teachers initiative. In contrast, in a directive tutoring group, the learning process is characterized by a rather explicit steering by the tutor. Directive tutor gives student-teachers explicit directions and provides specific and timely feedback to their questions, and student-teachers become somewhat passive participants in the learning process.

Table 1. The comparison of facilitative tutor and directive tutor in conducting online discussion.

Characteristic	Facilitative tutor	Directive tutor
Aims and main focus	Process-oriented, stimulating and challenging knowledge construction and active learning	Knowledge-oriented, transferring information and direct explaining content
Starting the task	Asks a student-teacher to demonstrate the course content and objectives by questioning	Demonstrates the course content and objectives
Feedback	Asks for feedback from themselves and/or their peers, while supporting this by questioning	Gives specific and immediate feedback
Reaction to arguments	Don't make a stand, guide themselves to clarify the point of view and decide the final plan by group	Participate in the discussion, state position, and proceed to the next step
Closing the task	Asks student-teachers to summarize the discussion content at the end of the task by letting them point out one or more things that they have learned	Summarizes the discussion content, points out important aspects, misconceptions, and the mistakes made by student-teachers at the end of the task

2.2 Community of Inquiry

The Community of Inquiry, proposed by Garrison, Anderson and Archer, is designed to develop critical thinking through online discussion in higher education. This model

believes that learning occurs in the interaction of three elements: cognitive presence, teaching presence, and social presence (Internet & Education, 1999). Indicators for each of the three elements emerged from the analysis of computer conferencing transcripts, and the indicators described represent a tool for researchers to analyze discourse. The initial classification of teaching presence proposed by the authors consisted of three characteristics: design and administration, facilitating discourse, and direct instruction. Considering the online discussion environment of this study, we combine the three elements of teaching presence and technical support as the coding dimension of the tutor's discourse. For the discourse coding dimension of the student-teachers, we refined it from the perspective of STEM instructional design based on cognitive presence (triggering event, exploration, integration and resolution) and social presence (emotion expression, open communication, group cohesion). It includes seven aspects: discipline foundation knowledge, technology and method, curriculum theme situation, learning activity design, product design and production, learning objective and evaluation, and social emotion.

3 Method and Data Source

In the STEM teacher education course, thirty-three student-teachers evenly divided into 8 groups, including 4 to 5 persons per group. Four groups were led by a facilitative tutor, and the remaining four were led by a directive tutor. All student-teachers participated in a STEM learning design program including 11 online discussion activities, and a total of 15,567 discussion data were collected. Beginning from a quantitative ethnographic perspective, data sets were compiled by using epistemic network analysis (ENA) to explore student-teacher development. ENA offers a strategy for “quantifying, visualizing and interpreting network data”. The set of procedures includes identifying and defining target codes, devising reliable and valid rules for categorizing discourses and using ENA for analysis. Ultimately, this process culminates in a thick description and inferential statistical conclusions about connection patterns between tutoring style and STEM learning design competence.

4 Expected Results

We propose the following hypothesis as our expected result:

(1) In the group guided by a facilitative tutor, the connections between facilitating discourse and the different cognitive dimensions of student-teachers was stronger; on the contrary, the design and administration and direct instruction of the directive tutor interacted more with the student-teachers in the group.

(2) The cognitive structure of the group with a facilitative tutor is closely related, while the connections among cognitive elements of the group with a directive tutor is loose and mainly depends on the teachers to deliver.

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Plan Backward to Move Forward: Exploring Preservice Teachers' Competence Trajectory Through Backward Design of STEM Curriculum

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Abstract: This proposal aims to explore the impact backward design has on the trajectory of competence development of STEM preservice teachers. Our approach to this exploration is to seek the interactions of competence levels within online discourse of preservice teachers in two groups. Topic modeling technique and epistemic network analysis were employed with an authentic learning environment, result with a comparative degree to which backward design brings a certain shift on the competence traces.

Objectives

STEM literacy and competence have become an essential part of integrated STEM curriculum in K-12 education, the different competence-oriented learning goal has enlightened us that it would be more straightforward to create learning activities that scaffold understanding to those outcomes, which has been clearly articulated as assessments. This proposal is therefore aimed at collecting learning evidence from behavior and outcome to justify the competence level, to seek the interrelations or connections among different levels during competence development.

Theoretical framework

Despite the increasing and urgent advocacy of integration of STEM disciplines, studies that address competencies requiring development appear scant with mixed findings and inadequate directions for STEM advancement in K-12 education (English, 2016). Recently, STEM Teachers' Competence Level Standard in China (hereinafter called The Standard for short) was issued, which provides guidance for STEM teachers in terms of professional knowledge, skills and practical operations from five dimensions: STEM education value understanding, STEM discipline basics, STEM interdisciplinary understanding and practice, STEM curriculum development and integration, STEM teaching implementation and evaluation (National Institute of Education Science, 2018). STEM literacy and 21st century competencies have now gone into elaborating aspects in the individual STEM disciplines (Honey, Pearson & Schweingruber, 2014), indicating that STEM lessons are competence-oriented rather than knowledge-oriented, which suggests it is of considerable significance to collect learning evidence from behaviors and outcomes to justify the competence levels. This different learning goal of STEM learning is rightly compatible with backward design approach, who shares a reversed planning sequence with traditional instructional design.

Traditional instructional design generally develops a curriculum by moving from design of teaching methods or learning activities, then to creation of concrete learning activities or techniques, and finally to the decision of learning outcomes (Richards, 2013). Such instruction is too often driven by textbooks, lectures, worksheets, and activities that fail to make learning relevant for students (Scruggs, Mastropieri, & McDuffie, 2007), in which case many students fail to develop understanding of key concepts within content. Contrariwise, backward design approach starts with a specification of learning outcomes and decisions on methodology, syllabus is thus developed from the learning outcomes. Wiggins and McTighe (2005) defined and illustrated three stages of backward design process namely: identify desired results, determine acceptable evidence, plan learning experiences and instruction. This process indicates the idea that teachers cannot plan how they are going to teach until they know exactly what they want their students to learn.

The Standard, on the basis of Chinese education, has suggested a framework for scaling STEM teachers' competence levels from a hierarchical perspective. However, how these five dimensions are interrelated and connected with each other during competence development remains a question. Therefore, the purpose of the current study is, to seek the impact backward design has on competence development by comparing two groups of preservice teachers applying different planning sequences for curriculums.

Method

According to the purpose of our study, 30 preservice teachers from two classes are randomly divided into 8 groups to design optional-theme STEM curriculums in cooperation. The whole process of the semester-long design was comprised of 10 sub tasks following a design route. Preservice teachers are required to prepare individual learning materials and discuss each sub task on weekly online meetings in an authentic learning system. A tutor is assigned to each group to monitor the whole design process and guide the discussions.

Experiment groups from class 1 are instructed to design in a main sequence of planning specifications of learning outcomes, identifying learning evidence, and creating learning activities, using backward design approach. And the control groups from class 2 design in the traditional sequence of mainly, creating learning activities, identifying learning evidence and learning outcomes, using forward design approach. 15825 rows of discourse data were collected from the chatroom of weekly online meetings. Topic modeling technique and epistemic network analysis were employed aiming to seek trajectories of competence development of preservice teachers from different classes. The process of our methods was thus developed with the following steps:

1. The Mallet topic model package is applied to connect words from the rich discourse data with similar meanings, and distinguish "topics" consist of clusters of words with specific quantities that frequently occur together;
2. An initial dictionary with dimensions and definitions is established by iterative manual work from the topic models and corpus;
3. nCoder is afterwards used to identify, define, classify and validate sets of codes to refine our coding scheme (see Table 1 in appendix) by automated coding;
4. The dictionary is thus updated through each round of coding under the supervision of rho and kappa values;
5. Epistemic network analysis is then applied to identify meaningful and quantifiable patterns in discourse, networks from four stages of two groups are superimposed, which aims to compare the degrees of closeness of each interaction at different competence levels;
6. Competence level trajectories of two groups are thus visualized by connecting the centroids of each network from different stages, in order for highlighting the impacts of different design sequence.

Hypothesized Results & Significance

Based on the review and coding scheme, we observed the two groups of preservice teachers using different curricular designing sequence on their competence level trajectories. Groups from class 1 applying backward design approach appear outperformed class 2 using forward design approach in developing STEM teacher competence. Namely, the impact of backward design approach that leverages varying interactions of different competence stages, calls on operationalizing STEM teachers' goals or standards in terms of assessment evidence as they begin to design a curriculum, and what they would accept as evidence that their students have attained the desired understandings and proficiencies before proceeding to plan teaching and learning experiences.

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Appendix

Table 1. Coding scheme applied to STEM preservice teachers' online discourse.

Dimension	Code	Description	Example
STEM discipline basics	STEM disciplinary basic knowledge	Disciplinary knowledge related to themes of STEM courses	"Whether size of wheels affects <u>thrust</u> , <u>friction</u> should be considered."
	Technology and method	Techniques and methods that teachers need to master when implementing STEM courses and students need to complete thematic tasks	"We build cars with <u>makeblock</u> ."
STEM curriculum development and integration	Thematic situation	Discussions of teachers' design on learning situation and interactions of students on thematic tasks	"Our physics class learns leverage principle by designing <u>seesaw</u> ."
	Learning activity design	Design, development and integration of learning activities	"We can let students conduct <u>experiments</u> after learning."
	Prototype or scheme design	Design, production and other activities around thematic tasks	"Test data should also be shown in <u>diagrams</u> ."
STEM teaching implementation and evaluation	Learning objectives and evaluation	Learning objectives of situational topics and corresponding evaluation rubrics	"I think the focus of the evaluation of products is <u>practicability</u> ."
Social presence	Performance of social emotions	Support for cognitive and emotional goals in discourse process, including emotional, interactive and cohesive response	" <u>Sorry</u> , there were some problems with my computers."

Epistemic Networks in Playful Assessment

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Abstract: Playful assessments are games that support formative assessment through epistemically meaningful gameplay. Playful assessments provide rich streams of student data for formative assessment, however this data can be difficult to interpret. We employ epistemic network analysis (ENA) on a playful assessment game to present a proof of concept of how quantitative ethnographic methods might assist in understanding and building playful assessment systems.

Introduction, Game Design, and Data Analysis

Playful assessment refers to the use of games and play as a means of formative assessment that present learners with opportunities to create personally relevant and epistemically meaningful artifacts through play (Holbert & Wilensky, 2018; Kim, 2018). Playful assessment environments provide rich data about player behavior, which in turn aids the instructor’s understanding of a learner’s current conception of a domain and allows that instructor to adapt teaching to meet the needs of individual students (Berland, Baker, & Bilkstein, 2014; Black & William, 1998). In this poster, we report on a playful assessment called *Beats Empire*, where learners engage with the domain of data science by taking on the gameplay role of a music studio manager. We employ ENA on preliminary data from *Beats Empire* in order to understand player behavior and visualize the connections between the epistemic actions that constitute practicing and performing meaningfully within the domain of data analysis (Shaffer, 2017). We ask the following research questions: RQ1: How can we understand player behavior within *Beats Empire*’s epistemic frame of data analysis? RQ2: How do player conceptions of their gameplay match onto the positionality of their projected points within the epistemic network of *Beats Empire*?

Beats Empire is set within a fictional city modeled on New York, consisting of five boroughs that have their own preferences on the mood, topic, and genre of a song. Gameplay is structured on the epistemic frame of data analysis, giving players realistic analytic tools to understand audience trends. Data for this analysis was collected in the winter of 2019 between two middle school classrooms with 39 total students. Our epistemic network graphs were constructed using log data from the game, and supplemented by qualitative data from play-aloud cognitive interviews. Two examples of actions in the epistemic frame are: RecordSong, which refers to constructing a song in terms of genre, mood, and topic for a specific borough; and CheckLine, which refers to using the line graph tool to visualize genre, mood, and topic popularity across boroughs. We used individual turns (that is, a single in-game week of time) as the conversation unit, with lines being defined as significant actions within the game. Since our research questions are concerned with behavior over a player’s entire session we used a whole conversation segmentation method to create our model.

Preliminary Findings and Discussion

We found that there was a general clustering around the most direct approach to the game: recording songs and advancing the in-game week in sequence. Jorge is a strong example of a player who explores other aspects of the game, but is largely using a core gameplay loop of recording songs and advancing weeks. In comparison, Alyssa makes heavy usage of two types of data representations: line graphs and heat maps. We can further triangulate these positions through post-game qualitative interviews, for example Alyssa describes her usage of data as such, “[the graphs] show how many people listen to [a topic] based on the ranking, like one week ago, two weeks ago.” By comparison, Jorge mentions taking a more informal experimental approach to the game, where he used a post-hoc analysis of audience reactions to songs to identify ‘nostalgia’ as a popular mood in one of the boroughs, “I used [data] by ... having half [my artists record] nostalgia, and the other having another [mood] to see which [the burrough] liked more.”

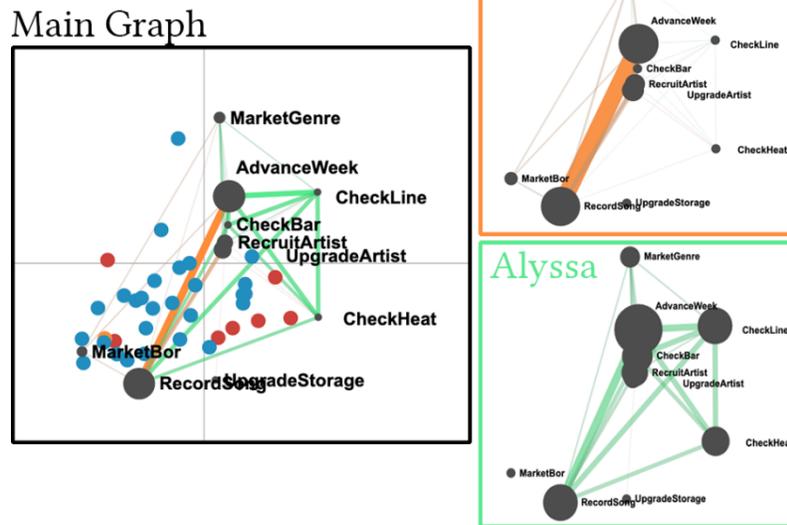


Figure 1. A graphic showing the entire epistemic network of our 39 students on the left, and then our two focal cases on the right, with Alyssa being represented in green and Jorge being represented in orange. Red and blue projected points refer to students in different classrooms.

Our poster will display our main ENA graph (see Figure 1), describe the codes that comprise the epistemic frame of the game, and present ego-centric graphs of our two focal cases triangulated with rich qualitative data excerpts from interviews and play-aloud sessions. We will also have a live demo of the game to help contextualize our work. In discussion of the poster we will present ENA as a tool for formative, playful assessment in classroom settings. We will also discuss future work that will synthesize qualitative and log data for ENA of *Beats Empire*. We hope to engage in active discussion with attendants about incorporating ENA as a live teacher tool in a classroom, possible approaches to future study design, and the role of ENA in understanding and designing playful assessments.

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Egypt: A Special Education Policy Discourse Analysis

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The purpose of this content and discourse analysis is to analyze the language used in special needs and disability policy in Egypt, specifically the relevant articles from Egypt's Child Law 12. First a brief content analysis will be completed, using the language in US federal law, IDEA, (US Department of Education, 2010) as well as that of the UN Convention on the Rights of Persons with Disabilities (United Nations, 1989) as the comparative frameworks. A closer discourse analysis of how the language used in Egypt's Child Law 12 influences and/or shapes student identity. More specifically this study looked at the use of deficiency-based language and a generalized outlook that does not differentiate between and among the different types of disabilities. These factors can directly affect students' academic outcomes, starting with their school experience.

Goals of Research

Due to the general nature of Egypt's Child Law 12, there is the potential for a lack of understanding and awareness in Egypt when it comes to disability. The language in this law can also impact the identity formation for individuals with disabilities. The purpose of this paper is to analyze the language used in special needs and disability policy in Egypt, specifically the relevant articles from Egypt's Child Law 12. This will be done through the use of a discourse analysis. This close analysis of tasks and tools as discussed by Gee (2011) will address the following research questions:

1. How does the discourse used in Egypt's Child Law 12 shape the identities of individuals with disabilities in Egypt?
2. How does the language used in Egypt's Child Law 12 communicate the identities of individuals with disabilities in Egypt?
3. How is the language used in Egypt's Child Law 12 contribute to the larger conversation about individuals with disabilities?

Background of the Project

Egypt's Child Law 12 was passed in 1996 and was amended in 2008 (The National Council for Childhood and Motherhood, 2008). It a broad law, but has a section dedicated to children who have been diagnosed with disabilities and special needs. It mandates that individuals with disabilities receive proper care based on their needs. This is detailed in the law's Articles 75-86. It is important to note that these articles cover issues relating individuals with disabilities in general, including but not limited to education, work, rehabilitation, and social integration. The law, officially known as Promulgating the Child Law, was put together by the cabinet of the National Council for Childhood and Motherhood. The 1996 law, as well as the 2008 amendments, were approved by former president Hosny Mubarak. With the 2008 amendments, however, the official documentation referred to it as: Law 12 of 1996 Promulgating the Child Law amended by Law 126 of 2008.

The Child Law has a generalized outlook about disability, however, there is a somewhat marked difference between and among those who have disabilities. It is important to note the title of the section in the Child Law that addresses the educational aspect of children who have been diagnosed with disabilities: Care and Rehabilitation of the Disabled Child. First, it implies that all

disabilities require rehabilitation and second, that the care that children with all disabilities require is remarkably different from the care required by their non-disabled peers

Methodology

The methodology used in this discourse analysis is that of Gee's building tasks. The task chosen is that of identities along with situated meanings, social languages, and Discourse as the tools of inquiry for further exploration. The first tool of inquiry is that of socially situated identities and Discourses, where statements pertaining to parental voices, accessibility, stigma, and identity are explored. For the second tool of inquiry, social languages and Discourse are utilized to examine the choices of language used by the government and how this influences the government's perceived role when it comes to students with disabilities and as well as how it shapes the identities of those students.

Preliminary Findings

The first cycle of coding utilized an a priori approach of coding, where the Child Law was coded for the overarching themes of accessibility, capability stigma, identity, parental voice, and missing elements from the law. The researchers found that disability seems to be viewed as a monolith. It was also found that identities are limited to those who are male and employment bound. It was also found that there is no space for females and that individuals with disability types with different strengths, needs, and life outcomes are not included or prioritized. Finally, through the use of a word frequency count, it was found that the most used words in the law are: disabled (36 counts), rehabilitation (20 counts), and employment (6 counts) whereas education (6 counts) and schools (3 counts) were amongst the least used.

Expected Contributions

This paper is expected to contribute to not just the gap in the literature when it comes to special education policy in Egypt (and potentially the region), but also to the understanding how the language used at the government level can influence the stigma, treatment of, and identities of students who have been diagnosed with special needs. More specifically, the role of language in policy for enabling opportunity and communicating possibility is a step in the right direction and how missing language constrains the identities of those with disabilities and places limits public consciousness.

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Big Data, Black Boxes and Bias: The Algorithmic Identity and Educational Practice.

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Abstract: Implications associated with predictive analytics is of growing interest in educational settings. Enabling the observation, identification and prediction of behavior via multiple and interconnected online surveillance systems, Australian K-12 teachers are only developing explicit knowledge of how platforms that use targeted online advertising and social learning analytics may impact their educational practice. Although arguably modulating educational practice, teacher capacities and innovation, such potential implications are lacking sufficient debate. Focusing on Australian K-12 teachers' negotiation of commercial and algorithmic bias, the research provides a survey snapshot of 'Apps in Australian Classrooms' (n=210) and teachers' sense making of predictive analytics via semi structured interviews (n=23). In July a quantitative analysis of select platforms' discourse on social media will occur followed by a second participant interview. The research aims to provide evidence that may be used to inform greater debate surrounding potential implications of predictive analytics in K-12 settings.

Goals of the research

1 The research aims to provide evidence in relation to how Australian K-12 teachers are aware of, understand and negotiate commercial platforms as part of their educational practice.

Background of the Project

2 The presence of Edtech platforms that claim to personalize learning and use analytics to either reach or engage Australian K-12 teachers, or provide insights on teaching and learning has dramatically grown in the last decade. However, according to multiple sources, including educational researchers (Hogan, Thompson, Sellar, & Lingard, 2018), commercial organizations (Müller-Eiselt & Rubin, 2018) the Australian Competition and Consumer Commission (ACCC, 2018) and the Australian Human Rights Commission (Human Rights and Technology Issues Paper, July, 2018) (Raul, 2018), the debate surrounding implications of these technologies has not been sufficient. The research aims to focus on commercial platforms and potential implications for teachers, such as the (1) modulation of control and (2) how they may be part of the perpetuation of commercial and algorithmic biases. With algorithmic systems lacking transparency, Australian legislation challenged to keep pace with advances in such technology and K-12 classrooms seen as a good source of profit, how teachers are negotiating these algorithmic systems is currently of significant interest.

Methodology

3 The research is underpinned by the conceptual relationship between Deleuze's 'Societies of Control', discourse in relation to 'assemblage' (Deleuze, 1992; Deleuze & Guattari, 1980) and Cheney-Lippold's 'Algorithmic Identity' (Cheney-Lippold, 2011). The method aims to explore how teachers negotiate the immanently ethical differences associated with commercial platforms that leverage or depend on predictive analytics. Recruitment occurred via a paid campaign on social media linked to an online survey. Participants who completed the survey were invited to participate in a one

hour phone interview. Data was collected from the online survey (n=210) and semi structured interviews (n=23) between November and April 2019. A thematic analysis accompanied the data collection and a social network analysis of platform discussed in the interviews will be completed in July. Second round interviews will occur in August 2019. The final analysis will be guided by ideas and knowledge garnered at the ICQE19 doctoral consortium.

Preliminary or expected findings

4 The survey provided a snapshot of platforms and potential influence of predictive analytics in Australian classrooms, including a sample of what platforms are widely used and how teachers became aware of them. The preliminary findings suggest that as the majority of platform policy state that cookies and other tracking devices are common, teachers using platforms are potentially being surveilled on an ongoing basis. Secondly, that platforms have the ability to share anonymized data for advertising purposes, thus completing a feedback loop teachers are largely unaware of. The thematic analysis performed concurrently with the collection of interview data, expanded on this and suggested that Australian K-12 teachers are savvy users of the internet, but lacking exposure to marketing principals such as targeted marketing and how this may shape or modulate their behavior and such educational practice. Secondly, notions of platform capitalism and commercial bias appeared to be poorly understood. Thirdly, the notion of algorithmic bias (algorithmic fairness) was widely unknown although evidence of platforms claiming to be ‘proactive, rather than reactive’ in relation to mental health and wellbeing was apparent. Although Edmodo, Duolingo and Clasdojo were initially planned to be analyzed, the interview participants provided a much greater scope of platforms being used than expected, including discourse surrounding market power. Therefore, the platforms to undergo social network analysis have yet to be decided and will be chosen in discussion with supervisors in the current weeks.

Expected contributions

5 The expected contribution to knowledge sits squarely with educating and informing Australian K-12 teachers. The goal of the research is to provide evidence so that K-12 teachers may engage in the greater debate and discussion regarding analytics in K-12 settings. I, as many others do, consider teachers on the whole, to be a collective group of savvy and discerning prosumers. However, making visible the invisible is an ongoing challenge. With recent advances in technology, bringing significant implications, enabling K-12 teachers a means to negotiate notions such as commercial and algorithmic bias impacts is expected to be a significant contribution to the knowledge. This is needed, as where teachers were able to discuss commercial bias, the majority could not discuss targeted advertising, nor could they discuss algorithmic bias. Therefore, commercial platforms potentially have privileged knowledge that is being leveraged for their financial gain (tactics of platform capitalism), which inadvertently perpetuate discrimination (algorithmic fairness) under the guise of trialing or adopting ‘innovative educational practice’. Therefore the contribution is expected to empower teachers with knowledge of such topics, so that they may engage with platforms and those designing algorithmic systems to a greater extent.

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Differentiating Quality of Upper Elementary Classroom Talk Using Epistemic Network Analysis

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Abstract: The aim of the current project is to test the usefulness of epistemic network analysis to differentiate the quality of classrooms' academically productive talk and detect changes across time. Sixteen Language art teachers' lessons will be observed during the school year. ENA analysis is expected to yield a two-dimensional network, with one axis ranging from simple to complex contributions and the other axis ranging from a fixed solution to more open and multi voice dialog.

Academically productive talk, APT hereafter, refers to a specific kind of classroom dialogue that promotes critical thinking and in-depth learning (Michaels & O'Connor, 2015). The teacher and students create and maintain an environment with accountability to knowledge, peers and rational thinking (Resnick et al, 2017). Different perspectives and ideas can be explored through talk (Mercer & Howe, 2012) and learning is constructed via mutual inquiry (Nystrand et al, 1997). Using dialogue, students identify a problem and aim to find a solution, by a collective examination of multiple ideas, identifying those with merit through evidence (Alexander, 2005; 2018). Empirical researches have shown that APT can lead to deeper understanding of content (Asterhan & Schwarz, 2009; Murphy et al 2018; Wilkinson et al, 2016), longer attainments and skill transfer (Adey & Shayer, 2016; Zhang et al, 2016) and even increase in general cognitive abilities (Gorard et al, 2015; Topping & Trickey, 2007).

Currently, the most commonly used method of quantitatively assessing the quality of classroom talk is frequency counting of coded elements in the dialogue to allow for statistical comparisons in larger data sets. However, one drawback of frequency counting-based comparisons in this context is that only discrete dialogue moves are considered, without connecting them to what happened before and after (Lefstein, Snell & Israeli, 2015) In other words, it does not give insight into the extent to which the different dialogue elements are (or are not) interconnected within a given conversation, which is an important characteristic of high quality APT. Moreover, some of the recent large-scale intervention efforts did not capture significance change in the quality of talk, and yet have shown increase in students' achievements (see for example Khun & Zillmer, 2015; Reznitskaya, Anderson & Kuo, 2007). This

discrepancy suggests that perhaps a more finely tuned measurement tool is needed to detect changes and growth in the quality of talk.

Epistemic network analysis, ENA hereafter, is a method of identifying and quantifying recurring connections among elements in coded data, and representing them in network models (Shaffer, 2017). Recent works have used the ENA framework to identify connections between concepts learned in different subject matters (Bruun & Evans, 2018; Csanadi et al, 2018). The rationale is that the increasing connectivity between concepts in a given theoretical framework reflects learning and understanding. The aim of the current project is to examine whether using ENA to detect changes in the quality of classroom dialogue is feasible and whether this provides insights into the relation between dialogue and learning outcomes.

The present study

The current project is a small part of a large-scale endeavor to embed APT in classrooms and test its' impact on the achievements, knowledge retainment and transfer of abilities across domains among upper elementary students in Israel. The data will be collected in three different, mid-sized towns from within the central district in Israel. The work described here will take place during the first implementation stage of the project. Sixteen teachers and their students will participate. Video-recorded classroom data will be collected at specific time periods (beginning of school year, middle and towards the end), as well as on one specific topic (narrative text comprehension) with adaptations to age and reading level. The observed lessons (three observations in 16 classes, 48 in total) will be transcribed in verbatim, parsed into episodes according to content and coded at the turn level.

Following decades of research, scholars have converged on the key dialogue moves that lay at the heart of APT (for comprehensive, recent reviews see Howe et al, 2019; Kim & Wilkinson, 2019). Statistical consideration of ENA given the planned data set size, constrained the number of dialogue move codes that could be included to six (six codes chose two, at least 15 units are needed for statistical fitness of the model). After several iterations of coding scheme development, we have landed on the following categories: 'Simple' is used to capture closed, test-like questions or a non-elaborated or short student response. 'Repeat' indicates a repetition of ideas and 'Evaluate' indicates an attempt to ascertain the sought-after answer. 'Reason' refers to attempts to explain the rationale behind an answer. 'Evidence' indicates use of facts. 'Challenge' refers to statements that express one's doubts about something.

The Dynamic Evolution of Membership in Teams with Blurred Boundaries

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Abstract: Multiteam systems (MTS) have become common in today's team-based organizations. Yet little is known about the fluidity of membership and identity-related issues. This paper aims to uncover how membership unfolds over time and how that affects various team processes. I use longitudinal ethnographic field-study methodology for an exploratory examination of this phenomenon. I expect that the lack of clarity about membership will vary within and across teams, creating spillover effects to team processes. The findings provide novel insights into key issues in understanding of membership in MTSs over time.

Goals of the Research

Modern organizations often operate in dynamic environments, which over the years have become more challenging and complex (Zaccaro et al., 2012). For many years, the majority of research assumed that a team is comprised of a bounded set of individuals (e.g. Alderfer, 1977; Hackman, 1987). However, due to the current needs of businesses, newer organizational forms, involving multiteam systems¹ (MTS), have emerged and started replacing the traditional ones. One of the issues particularly interesting in this context is the discussion about social identity and membership within these forms. It is both theoretically and practically interesting for several reasons. First, individuals are usually allocated to multiple teams at the same time. Second, each component team may consist of employees from different organizations. In addition, employees are often geographically distributed. As teams become more fluid, overlapping, and dispersed, team membership boundaries become less clear. Hence, shifting identities can be experienced in MTSs.

Several scholars have recognized the need of looking at the concept of teams in a new light. Following the line of reasoning of Mortensen and Haas (2018), I argue that team membership will be perceived differently in MTSs as compared to traditional teams. Furthermore, the ongoing fluidity and shifting boundaries will likely result in multiple spillover effects to team processes. Given these points, the following research question arises:

How is membership temporally constituted in multiteam systems and how do patterns of membership change differentially affect team processes?

Background of the Project

The data for this research has been collected in a large multinational organization in Denmark. Teams in this study work in two multiteam systems consisting of nine componential teams in total. The nature of their tasks concerns development, maintenance and deployment of the IT solutions to the whole company.

When making the final selection of the teams to focus on, it was particularly important for me to have a range of the teams, which are composed in different ways, so that various team dynamics become more salient. Table 1 presents an overview of the two MTSs.

¹ Multiteam systems (MTS) are "two or more teams that interface directly and interdependently (...) toward the accomplishment of collective goals. MTS boundaries are defined by virtue of the fact that all teams within the system, while pursuing different proximal goals, share at least one common distal goal; and in so doing exhibit input, process, and outcome interdependence with at least one other team in the system" (Marks et al., 2001).

Table 1. Overview of the MTSs.

	MTS 1	MTS 2
Length of the project	Time-constrained	Continuous, no time-constraint
Number of teams observed	8	1
Similarities	Self-managing teams, one leader per team, interdependence between teams on the same MTS	
Differences	Size of a team Geographic distribution of employees Cultural diversity Internal vs. external employees Percentage of allocation on the team Employee turnover Tool usage	

Methodology

I use ethnographic method to explore and capture the dynamics of team membership. I have collected data by use of participant observation, semi-structured interviews, videos, online communication exchanges between employees and numerous organizational documents and artifacts. To date (May 7th 2019), I have conducted three months of data collection, and I intend to end the process in February 2020. As one of the next steps, I plan to organize the collected data based on quantitative ethnography data organization guidelines. Next, I will apply epistemic network analysis (ENA) to map the way the codes from my data are connected to each other.

Expected Findings

I expect that collective disagreement about membership will be present despite the formal membership criteria within the organization. Furthermore, the lack of clarity about membership will vary within and across teams, creating spillover effects to team processes.

Expected Contributions

Teams do not operate in static environments, yet the majority of the literature on team dynamics treat teams as being homogeneous over time and provide little insight into temporal dynamics (Zaccaro et al., 2012). Theoretically, this study has responded to an important research void in “analyzing team member time allocation in a more dynamic way, examining how members engage and disengage with particular teams over time” (Cummings & Haas, 2012, p. 338). To my knowledge, this is one of the first longitudinal and ethnographic studies, which tracks changes in the evolution of team membership in MTSs.

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Leveraging Social Learning Analytics to Support and Evaluate Learning Designs and Adaptive Learning

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Abstract: This paper provides an overview and update on my PhD research. The proposed project suggests a technology-supported teacher-led approach that includes leveraging social learning analytics (SLA) to support data-informed learning design (LD) decisions and adaptive learning. The context of this study will be three to five blended bachelors' courses using the Canvas learning management system (LMS) at two large public universities in Norway. This is a design based research study, employing a quantitative ethnography approach. The primary source of data will be collaborative activities performed on the Canvas LMS (i.e. online discussions). Social network and discourse analysis tools such as NodeXL, Louvain, and Latent Dirichlet Allocation will be used for analysis.

Introduction and Background

Learning design (LD), which in this study encompasses “tasks, assessments, learning environments, and resources needed to promote effective interactions between teachers and students and students and students in order to support learning” (Rienties & Toetnel, 2016), plays an important role in creating an effective learning environment. Nonetheless, although LD has the potential to highlight pedagogical intentions, it does not always follow an iterative process, which is the hallmark of design and does not take into account how students are engaged in the current course at a fine grained level of analysis. It also fails to specify the amount of learning that takes place during and after the learning process as specified in the design (Lockyer et al., 2013). Consequently, teachers rely on summative assessments (coarse grained analysis) such as the end of term examinations, course evaluations/surveys, in-class observations, and their previous experience to retrospectively make decisions regarding how best to teach their subjects to the next cohort of students (Rienties & Toetnel, 2016). However, with such an approach, little support is given to current students, as changes within the course are only possible and relevant for the next cohort of students (Li, Marsh, Rienties, & Whitelock, 2017). Besides, such methods are prone to challenges such as personal bias, hence providing less objective results. One way to deal with this challenge is by using more objective and proactive methods to evaluate students' learning in real time and to enable teachers to make timely informed educational decisions. This brings me directly to the opportunities of social learning analytics (SLA) to support teaching and learning decisions. SLA is a subset of learning analytics, which is concerned with the collection, measurement and analysis of students' data in order to understand their activities in a social learning setting. SLA identifies ways in which analytics are leveraged to identify social behaviors and patterns that inform the learning and teaching process (Ferguson & Shum, 2012). In light of this, within the learning analytics community (LAK), and among other educational technology researchers and practitioners, there is an increasing interest in exploring the dynamics between LA, LD, and adaptive learning (Lockyer et al., 2013; Li et al., 2017).

However, my preliminary literature review shows that the amount of empirical studies on the subject is still limited. In particular, there is a dearth of evidence to explain how SLA are deployed iteratively by instructors to reflect and make informed decisions on their own course designs and to tailor individualized student support. Moreover, there are still limited previous studies that focus on the use of large sets of educational data generated during online interactions to understand students' social and cognitive learning processes. Moreover, Ferguson and Shum (2012) emphasised that SLA requires further research, with more emphasis on online social interaction and social construction of knowledge in order to optimize support for learners and teachers. Therefore, with the motivation to address these research gaps, this Ph.D.

project adopts a novel approach, which uses SLA (combining social network analytics and discourse analytics)(Gasevic, Joksimovic, Eagan, & Shaffer, 2019) to capture relevant insights from students' online activities, and share these with teachers to support them in making informed learning design and adaptive learning decisions.

Goals, Research Questions, Theoretical Framework & Methodology

The aim of this doctoral study is to explore how social learning analytics (SLA) can support informed learning design and adaptive learning decisions. The overall research question (RQ) is: To what extent does a technology-supported teacher-led approach that includes the use of SLA help higher education teachers to make data-informed learning design and adaptive learning decisions? This question will be investigated through the following specific research questions. (i) How can teachers refine, change or adapt the course design while the experience is being delivered using detailed data and representations captured by SLA techniques? (ii) Does an Epistemic Network Analysis of the content of online discussions provide actionable insights to teachers regarding individual students' learning processes which can be used to provide timely personalized support? (iii) How are the teachers' learning design decisions/formats associated with students' online social and cognitive learning behaviors and performance? The context of this study will be three to five blended Bachelors courses using the Canvas learning management system (LMS) at two large public universities in Norway. This is a design based research study, employing a quantitative ethnography approach (Shaffer, 2017). The primary source of data will be collaborative activities performed on the Canvas LMS (i.e. online discussions) and other Canvas analytics data (i.e. student logfile data). Social network tools such as NodeXL and Gephi will be employed for data analysis alongside sophisticated computational and statistical techniques such as Louvain and Latent Dirichlet Allocation (LDA) (Gasevic, Joksimovic, Eagan, & Shaffer, 2019). The epistemic frame theory and the communities of inquiry framework (Shaffer & Ruis, 2017) will guide the analysis, interpretation and conceptualization of learning processes, generated from collaborative online learning activities.

Preliminary Findings & Expected Contributions

In response to research question 2, preliminary findings from the analysis of 4 online discussion forums have revealed that the combination of social network analytics and discourse analytics can afford insight and richer understanding of the students' cognitive and social learning processes, thus, supporting informed and timely pedagogical decisions. This Ph.D. project will contribute conceptually (i.e. validating and suggesting a LA and LD conceptual framework), empirically (highlighting the potential of SLA toward informed LD and adaptive learning), and methodologically (using DBR, quantitative ethnography, and theoretically grounded computational tools and approaches such as SNA and epistemic analysis to monitor students' learning and enhance learning design). This is an important contribution, since rigorous qualitative and design based research is required to yield actionable insights, provide explanation for the identified patterns, but also spell out explicitly how LA approaches can be used in different phases of design based research.

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Examining Collaborative Creativity in Informal Global Online Learning Environments

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Abstract: This research seeks to explore the factors that affect collaboration and interaction in creative activities in informal global learning. In particular, the research will apply quantitative ethnography and epistemic network analysis to examine patterns of discourse in the comments shared among users in Scratch.

Goals of the Research

This research seeks to explore the factors that affect collaboration and interaction in creative activities in informal global learning environments for K-12 students. In particular, the research will apply quantitative ethnography and epistemic network analysis (ENA) to examine patterns of discourse in the comments shared among users in Scratch, an online programming environment for young users. The research will focus on the following research questions:

1. What key elements characterize the interaction and collaboration among users who participate in creative activities in informal online learning contexts? Are there any differences between groups?
2. What patterns of discourse is demonstrated when interacting with one another in informal global learning environments? What changes can be observed in the patterns of individual users over time?

Background of the Project

Scratch is an online programming environment and community designed for young learners to create and share interactive digital projects, such as animations and video games (Hill & Monroy Hernandez, 2017). Scratch applies a visual approach to programming, which is also known as block-based coding. Launched by the MIT Media Lab in 2007, Scratch had more than 34 million registered users and over 36 million shared projects as of October 2018. The interactions and collaborations of users on the Scratch platform—captured in the comments and other actions—constitute key elements in the construction of not only the digital artifacts but also of the knowledge or meaning that is experienced by the students. Through the analysis of this process, it becomes possible to examine students' learning in situ, moving beyond simply measuring their mastery of distinct pieces of knowledge or skills (Shaffer et al., 2009).

Methodology

The longitudinal dataset of the public online activity on the Scratch platform—containing data on users, projects and comments—from 2007 to 2012 will be utilized for this analysis. The dataset includes information on over 1 million users and about 2 million projects as well as more than 10 million user-generated comments. The research will focus on comments that capture interactions between users, particularly those from projects that are reflective of creative content development (i.e. original projects).

ENA will be the main analytic technique used to visualize and identify meaningful patterns in the discourse data. It is grounded in epistemic frames theory, which posits that “learning can be characterized by the structure of connections that students make among elements of authentic practice” (Shaffer & Ruis, 2017, p. 182). ENA operationalizes this theoretical approach by modeling the connections between salient constructs—or codes—in the data, particularly by examining the co-occurrences of codes within

conversations (Shaffer, 2017). Due to the large size of the dataset, the research will also require the automation of the coding process.

Preliminary Findings

Preliminary analysis of the data focused on user comments related one project, which was selected because of its high number of comments. In order to examine the interactions between users, the data was filtered to only include groups of comments that were linked together by at least 4 responses. Such “conversations” containing 5 or more lines of data comprised 265 comments of the 5206 total. Grounded analysis was carried out on the select comments to identify eight constructs, including positive and negative assessment of the project as well as question, observation and social disposition. Following the coding of the 256 lines, the data was analyzed in the ENA Web Tool. Figure 1 presents the discourse patterns in the comments for two groups of users categorized by country. The ENA network for users from the U.S. is displayed on the left, while the right depicts the network for those from other countries. Some differences can be observed between the two groups, especially a stronger tendency for social disposition and observation among users from outside the U.S.

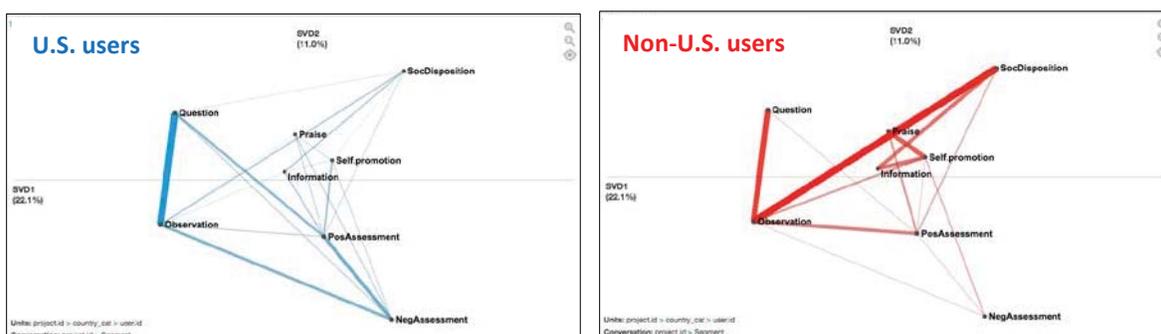


Figure 1. ENA networks of Scratch comments by users from the U.S. and other countries.

Expected Contributions

This study aims to contribute to the current literature by exploring the interaction and collaboration between users while engaged in creative activities in an informal online learning environment. The Scratch dataset will permit the extraction of the comments and responses in the form conversations, which were previously unavailable to researchers. Earlier studies investigating the comments from Scratch were based on de-contextualized text data, as only data “scraped” from the Scratch website was available for their analysis.

The longitudinal nature of the dataset will allow for the analysis of user activity and comments to identify significant changes in discourse patterns over time. In addition, the application of ENA on such a large dataset will require automated coding of the data. Automation carried out as part of this study may provide insights for further developing tools and procedures to facilitate the coding process.

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The Potential of Learning Analytics for Supporting Peer Assessment

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Abstract: In this research, Learning Analytics (LA) methods are used to explore different aspects of peer assessment (PA) in four case studies. The main dataset in every study come from a PA facilitating online platform, Peergrade. The first study focuses only on a big dataset and no context data is used. The remaining three studies, however, add context data to their big datasets. The second study explores the relationship between student grades and their performance. The third study focuses on comparing student's drafts of assignments and the final submissions. The fourth study investigates how student peer assessment skills change over time. All datasets include both numerical and text data and are analyzed using various machine learning techniques and Epistemic Network Analysis.

Background

Learning analytics promises insights into learning processes through the analysis of educational big data. Trying to measure learning with data points, however, comes with many challenges. Three of these are as follows. First, having access to “good quality” datasets, meaning datasets from which we can infer something about learning. Second, selecting the correct methods to analyze the data, so that we do not just tune the algorithms to get expected patterns from the data. Third, assigning pedagogical meaning to the results of the data analysis.

Peer assessment (PA) is “a process-oriented pedagogical activity in higher education during which students both provide feedback reviews on peers’ work and receive feedback on their own work” (Zhang et al. 2018, p. 1). It is often used in big classrooms, where the teacher is not able to give individual feedback to each student. Ferguson et al. (2016, p. 37) calls for aligning “analytics with assessment practices” as LA has the potential to change assessment practices and support “the holistic process of learning”. Aligning LA and PA is the main goal of this PhD project.

In order to determine the potential of LA for understanding learning processes, this PhD project aims to examine the following main research questions:

RQ1: How can we use LA to better understand learning processes and assessment for learning in particular, in the context of higher education?

RQ2: Which LA methods are useful in various assessment learning situations, such as peer assessment? How are they useful?

RQ3: What are the challenges and opportunities in applying LA methods, especially in the area of higher education?

Case Studies

My PhD project comprises 4 case studies that use learning analytics to explore different aspects of peer assessment (three of which involve data collected at one of two Norwegian University Colleges).

The main source of data for each case study is collected by an online platform called Peergrade that facilitates peer assessment. Peergrade can be integrated with the most popular LMS platforms such as Moodle and Canvas. The platform not only enables giving feedback to the other students, but also creates a feedback loop, in which the feedback is evaluated by the person who was assessed. The agreement between the graders is calculated, so that the teacher can intervene in the case of a high discrepancies

between the grades. There is also data on how much time students spent on giving feedback. Many kinds of files can be uploaded for grading including PDFs, videos, etc. The assignments can be weighted, and it is possible to give feedback anonymously.

Peergrade data is supplemented by additional sources, such as focus group interviews, or student grades. My datasets include both numerical and text data, and are analyzed using various Machine Learning techniques, such as natural language processing, clustering, and classification. Moreover, I experiment with using Epistemic Network Analysis method in order to try to explore the relationships between various variables.

The first study focuses only on a big dataset from 10,000+ students from many higher education institutions and high schools. The main goal of this study is to explore the data analysis possibilities without any contextual data (e.g., hand-in artefacts, detailed information about the peer assessment intervention). By using machine learning algorithms, we are trying to determine a good quality feedback, and how we can measure it on scale.

The second study explores the relationship between student grades and their performance. Peergrade data from 4,200 students in an undergraduate course at the BI Norwegian Business School is compared with students' performance data and supplemented by focus group interviews. Also, the hand-ins artefacts are collected.

The third study focuses on comparing student's drafts of assignments and their final submissions. The data is collected from 1,200 students in an undergraduate course on the Organizational Theory on a Norwegian University.

The fourth study investigates how student peer assessment skills change over time. A graduate class in Graphic Design course participates in a PA activity in their 1st and 3rd semester.

Preliminary findings

The results from the first exploratory study suggest that if students find the feedback, they received to their work useful, they are more likely to express gratitude, praise, intention of revision, or error acknowledgment. However, if they did not consider the feedback from the other students useful, they express confusion, criticism, or disagreement in their comments. Even though, this finding seems to be evident at first, it poses an interesting question: is the process of disagreeing with the feedback, and trying to defend own work useful from the pedagogical perspective, even if the students do not perceive it as such? And if so, how would such a conclusion influence the teacher's development of PA rubrics and students' preparation to the PA activity?

Expected contributions

The main contribution of this PhD project is to explore LA methods, and how they can help in gaining insights into the learning processes of PA activities. Particularly, if and how is it possible to automatically detect characteristics of useful or good quality peer feedback in student comments. Integrating various data types and data sources into one PA model is another methodological contribution of this research. The broader scope of this project is to inform teacher's practice, especially in the fields of learning design of PA activities and developing PA rubrics.

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Science Identity Development, Transformative Experiences, and Reflection in Undergraduate Anatomy and Physiology Classrooms

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Abstract: Little research examines effective pedagogical practices or student success in Anatomy and Physiology (A&P) courses. Science identity is a marker of persistence in STEM fields, and transformative experience theory informs the design of learning environments that support identity development. We aim to capture A&P students' changing perspectives on how they view themselves and the world in light of learning course content through students' written reflections, which we will analyze using epistemic network analysis.

Project Goals

The purpose of this study is to investigate how students connect science identity and transformative experiences (i.e., experiences in which students use curricular content to see their everyday lives in new, meaningful ways; Pugh, 2011) in an undergraduate Anatomy and Physiology (A&P) course. We will use a quantitative ethnography approach to analyze students' written reflections to answer the research question: how do the connections that undergraduate Anatomy and Physiology (A&P) students make between course content, transformative experiences, and science identity change over time?

Background

Undergraduate Anatomy and Physiology (A&P) courses are gateway prerequisite biology courses for students wishing to enter allied health fields, such as nursing, nutrition, or occupational therapy. Due to a high nationwide failure rate of these courses (Gultice et al., 2015), students are precluded from progressing through their educational programs. Research literature offers no consensus on factors that influence this phenomena or what best pedagogical factors support student success in this context, leaving educators with a dilemma when designing learning environments for these students. We propose that supporting student science identity through pedagogical design that encourages students to have transformative experiences could be a viable strategy to improve student engagement, and by extension, outcomes.

Gee (2000) categorizes science identity as a Discourse identity, described as how one relates to and participates in a disciplinary community. Science identity has been identified as a driving factor of persistence in STEM education and careers (e.g., Hazari, Sonnert, Sadler, & Shanahan, 2010), and supporting science identity can be accomplished by instruction designed to promote relevance and to scaffold exploration of identity (Kaplan, Sinai, & Flum, 2014). A student with a strong sense of science identity may feel more connected in a science classroom, though a student having transformative experiences will see the world around them as more compelling, making both science identity and transformative experiences desirable attributes for student success. Transformative experience theory offers additional pedagogical design principles to help students see content in a way that enriches their lives (e.g., Pugh, Bergstrom, Heddy, & Krob, 2017). Combining design principles that support identity development with those that support transformative experiences creates a model for learning environments that *re-frame* curricular content as interesting ideas, within which students can *re-see* this content as personally relevant in the classroom and *re-enact* their re-seeing in their everyday lives (Garner, Kaplan, & Pugh, 2016). By intentionally designing and practicing a pedagogical approach using this model, we hope to help facilitate transformative experiences and encourage student science identity development during an A&P course.

Methodology

Participants will be consenting students enrolled in an introductory Anatomy and Physiology (A&P) course at a mid-sized university in the western United States during a single semester. We anticipate a sample size of 120 students representing many allied health degree programs. The pedagogical design of the course will include re-framing, re-seeing, and re-enacting course content as relevant to the lives of students. As a formative assessment, students will be assigned five written reflections over the course of the semester with the prompt: “How does what you learned this week relate to your life?” These written student reflections will be coded for instances of expressed science identity development and transformative experience by two members of the research team. As over 500 written reflections will be collected, qualitative coding can be further explored using epistemic network analysis; using this method, we will be able to assess the strength and directionality of connections students make between facets of course content, transformative experience, and science identity, and how those connections change over the course of the semester (Shaffer, Collier, & Ruis, 2016).

Expected Findings and Contributions

Research in medical school contexts suggests that in written reflections, students will reflect on their own identity development (Wong & Trollope-Kumar, 2016). We also anticipate that as the instructor scaffolds how to re-see course content as relevant to students’ lives, students will notice and reflect on experiences they have outside the classroom. As the semester progresses and students have more opportunities to practice re-seeing and re-enacting the content, the structure and strength of the connections between transformative experiences, science identity, and course content may change.

This work will leverage novel pedagogy strategies in the context of understudied undergraduate A&P classrooms, and through epistemic network analysis, will contribute a novel analysis of transformative experiences and science identity development. Both factors have secure theoretical frameworks, but examining the reflections of students and the connections they make will allow for a deeper description of the relationship between the two constructs in this context. After this pilot study we may have justification to further explore, refine, and assess pedagogical methods that support students’ science identity and transformative experiences using quantitative ethnography methods, such as epistemic network analysis.

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Discovering Informal Learning Cultures of Blind Individuals Pursuing STEM Disciplines: A Quantitative Ethnography Using Listserv Archives

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Abstract: This study is proposed to discover the collective knowledge sharing patterns and informal learning cultures of blind individuals pursuing Science, Technology, Engineering, and Mathematics (STEM) disciplines captured through computer-mediated mailing listservs. Using the world largest online mailing lists for the blind, this research will conduct longitudinal quantitative ethnography for the three STEM-oriented listserv archives between December 2008 and December 2018, to develop a comprehensive understanding of learning experiences voiced by blind individuals.

Goals of the Research

The purpose of this quantitative ethnography is to discover the collective knowledge sharing patterns and informal learning cultures of blind individuals pursuing STEM disciplines, as captured through computer-mediated mailing listservs. More specifically, the following three research questions are proposed to achieve this goal: (1) What are the commonly challenging issues of blind learners that provoked distributed expertise depending on each subject of STEM found in the blind mailing lists? (2) What is the culture sharing pattern of solving problems regarding STEM accessibility issues among blind mentees and mentors on the mailing listserv? And (3) How do blind individuals exchange accessible ways of learning software and hardware engineering collaboratively in the STEM-related mailing lists?

Background

Over the past decade, the importance of Science, Technology, Engineering, and Mathematics (STEM) subjects has received a lot of research attention in formal and informal learning settings. Despite its growing importance and positive effect on learning, many blind students who are increasingly integrated into regular classrooms are often left without accessible resources and instructions (Beck-Winchatz & Riccobono, 2008; Jones, Minogue, Oppewal, Cook, & Broadwell, 2006). For instance, STEM content relies heavily on visual models, and the majority of STEM teachers and college instructors have little experience in teaching blind students (Jones et al., 2006). Hence, having other blind peers who share similar learning experiences and blind mentors who can serve as role models is critical for blind learners to address their unique challenges and succeed in STEM subjects (Beck-Winchatz & Riccobono, 2008). With the support of the Internet and assistive technology (e.g., screen reading software and refreshable braille display), blind individuals all over the world have increasingly become connected to each other, and the mailing list is one of the widely used accessible media among blind people to communicate and share tips with others. In other words, much informal learning and knowledge sharing among blind individuals have been accumulated through computer-mediated mailing list archives, which provide great investigative value in addressing the proposed research questions.

Methodology

Data Collection

The target community of this quantitative ethnography is the National Federation of the Blind (NFB), which is one of the world largest blind communities. Longitudinal text data that contains members' communication between December 2008 and December 2018 will be obtained by the publicly downloadable mailing list archives on their website (<https://www.nfbnet.org/mailman/listinfo>). Among 257 mailing lists, only the following three archives will be included in this study: (1) Science and Engineering; (2) Computer Science; and (3) BlindMath. To clearly address any ethical issues regardless of the openness

of the mailing archives, the data collection will be carried out with appropriate procedures from the ethical code of research approved by the Penn State institutional review board. All personally identifiable information (e.g., names; email addresses; email signature lines; and other sensitive or private portions) will be systematically either removed or replaced with pseudonyms for the data analyses and report procedures. In any event where the researcher feels the need to include a specific case of certain individuals' characteristics or their words at any stage of this research, he will ask permissions of each individual beforehand, following the Penn State IRB informed consent process.

Data Analysis

The overall research procedure will follow the five steps of “Knowledge discovery in databases (KDD)” proposed by Fayyad, Piatetsky-Shapiro, and Smyth (1996), as follows: (1) data selection; (2) data cleaning; (3) data transformation; (4) data mining, and (5) results evaluation and interpretation. Table 1 illustrates what the tidy data structure would look like after going through steps 1 through 3. In the data mining phase, I will perform the following three analyses: First, structural topic modeling (Roberts, Stewart, Tingley, Airoidi, & others, 2013) – which is one of the natural language processing algorithms that probabilistically discovers latent structural topics within a large corpus of documents – will be employed to identify common themes within the three mailing list archives. Second, descriptive statistics (i.e., counting and central tendency analysis) will be performed to systematically capture the frequency and variation of message exchange patterns within each listserv over time. Last but not least, directional network analysis will be carried out to elicit the communication patterns among subscribers within each listserv. All of these computational results, moreover, will be repeatedly triangulated with the researcher’s interpretive reflexivity as one of the blind members of the listserv.

Table 1. Sample data structure.

From	To	CC	Subject	Content
Sender’s name along with email address (will be changed when reporting)	Recipient’s name along with email address (will be changed when reporting)	Copied members along with their email addresses (will be replaced with pseudonyms)	Message subject	Message body

Expected Finding

The expected findings will include all answers to the set of proposed research questions concerning the informal learning experiences of blind individuals pursuing STEM subjects.

Expected Contributions

Combining computational results quantified by structural topic modeling, descriptive statistics, and network analysis with qualitative observation driven by the author’s insights as a lifelong blind learner, this research will contribute to a comprehensive understanding of how blind people learn STEM in general; and what challenges and solutions have been discussed among blind people to engage them in STEM education specifically.

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Co-Learning in an Intercultural Community-University Research Partnership

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Abstract: Co-learning is a central, but understudied, element of partnership-based health research. This study builds on situated and sociocultural learning theory, using discourse analysis and quantitative ethnographic techniques to examine meeting transcripts from nine years' of meetings between Yup'ik (Alaska Native) community members and university-based health researchers.

Goals of the Research

The aims of this study are to (1) trace changes in communication practice within the partnership over time, (2) identify and describe their implications for co-learning, and (3) offer insights into best practices for university-based researchers who wish to conduct responsive, ethical health research with community partners.

Background of the Project

The impetus for this research was a question from a Yup'ik elder. In the closing circle at the end of one of our meetings, a university-based researcher asked that the meeting participants – a mix of Yup'ik community members and university researchers – go around and each share what we had learned. Before anyone else spoke, he responded, “I want to hear what *you guys* [the university researchers] learned.” It was not an easy question to answer.

Although co-learning has been posited as an essential element of community-engaged health research (Israel, Shulz, Parker, & Becker, 1998; Israel et al., 2003), it remains an underexplored phenomenon. In particular, despite a substantial literature in the education domain pointing to the importance of communication in learning and the formation of viable communities of practice (e.g., Holland, Lachiotte, Skinner & Cain, 1998; Lave & Wenger, 1991), as well as the particular challenges that intercultural differences can pose (Heath, 1982), its role in co-learning has received little attention.

This study is grounded in a longstanding research partnership in southwest Alaska established by the [university 1, regional Alaska Native health corporation] and Yup'ik research participants and community members (Boyer et al., 2011; Trinidad et al., 2015). It focuses on the interactions of the Community Planning Group (CPG, comprising 10 Yup'ik study participants), the Ciuliat (a group of 5 Yup'ik bi-cultural liaisons), and 9 researchers from [university 1] and [university 2]. The general purpose of the meetings was to elicit the CPG and Ciuliat's advice about ongoing research and – for one project – to learn how best to share complex, but not clinically actionable, genomic research findings with the community. Meetings were held at least twice per year as needed and feasible.

Methodology

The study will center around analysis of transcripts created over nine years of meetings between the CPG, the Ciuliat, and the university-based research team. Each meeting lasted at least 1.5 days; a minimum of 3 transcripts will be included in the analysis. Transcripts include conversation translated from Yup'ik by a member of the Ciuliat and a mix of presentation-talk from the research team and full-group discussions on various topics. Specific transcripts will be purposively selected to capture changes in communication over time. Coding will focus on talk hypothesized to be relevant to co-learning (e.g. didactic teaching-talk,

storytelling, analogies, use of Yup'ik words, displays of emotion). ENA will allow comparison of talk patterns across timepoints, across groups, within groups, and at the individual level, identifying connections that discourse analysis alone may miss. Analysis will combine discourse analysis (Gee, 2005) and quantitative ethnography approaches (Shaffer, 2017). Both Yup'ik and university-based participants have given permission for the transcripts to be used in this way. The study has received approval from the UW Institutional Review Board and is undergoing review by the [tribal health corporation]'s Human Studies Committee. A series of individual interviews may be added later if needed.

Expected Findings

This study will identify changes in communication patterns within the partnership over time and how these may contribute to, or serve as markers for, co-learning (e.g., researchers using Yup'ik words or CPG members using scientific terminology). It is expected that co-learning will increase over time. Because ENA supports analysis at the level of individual participants as well as groups of participants, this study also has the potential to elucidate how specific individuals' engagement in the partnership influences co-learning between individuals and groups (e.g., individuals serving a "broker" function within the partnership may not be limited to the Ciuliat members).

Expected Contributions

This work is expected to (1) provide a thick description of communication as it relates to co-learning in an intercultural community-university research partnership; (2) identify markers of co-learning; (3) identify communication practices that support and impede co-learning; and (4) highlight opportunities for researcher self-reflection and assessment toward the development of responsive, ethical, culturally sensitive research practice.

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Differences in Group Communication between Game and Non-Game Collaborations

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Abstract: *School Scene Investigators: The Case of the Mystery Powder* was designed to foster collaborative learning and group communication. A previous qualitative study determined that game teams had more positive group communication than control teams. In this study, epistemic network analysis was used to investigate whether a significant difference existed between the network models representing group communication of game and control teams.

Goals

In this study, we will investigate the network connections between language style and communication responses for three groups playing *School Scene Investigators: The Case of the Mystery Powder* and three groups participating in a control activity. To assess the differences in group dynamics based on elements of collaborative discourse, epistemic network analysis (ENA) was used. ENA is a novel method for analyzing elements in coded data and then representing the connections as dynamic network models (Shaffer, Collier, & Ruis, 2016). Specifically, this study examined these questions: *Where are the strongest connections for game teams? What are the strongest connections for control teams? Does a significant difference exist between the network models for game teams and control teams?*

Background

Research shows that effective group communication is a key predictor of group success (Barron, 2003). *School Scene Investigators* was designed to promote collaborative problem solving; pilot research revealed that the game design built better relationships among players (Bressler & Bodzin, 2013). In fact, a qualitative study comparing the content of utterances from game and control teams demonstrated that game team discourse had higher levels of engaged responses and higher levels of communal language (Bressler, 2014). However, the content of utterances may not be most important when analyzing collaborative discourse. To truly analyze the mechanisms of collaborative learning interactions, researchers argue there is a need to investigate the connections students make *across* turns of talk (Siebert-Evenstone et al. 2016).

Methodology

Players were 8th grade science students from a diverse, urban middle school in northeast USA. Two teachers each taught 5 classes; full classes were randomly assigned to control and game conditions. The intervention took place over several class periods. Selected teams were audio recorded during the intervention. All collaborative discourse was transcribed to clearly delineate conversational turn-taking. When students agreed with or supported the speaker, it was coded as *Accept*. When students questioned, challenged, or asked for clarification from the speaker, the dialogue was coded as *Discuss*. When students ignored or rejected a proposal from the speaker, the dialogue was coded as *Reject*. When students addressed the group collectively, it was coded as *Communal*. When the group made demands of each other, it was coded as *Command*. In total, 2700 utterances were coded for language style and communication responses.

Findings and Analysis

To understand the basis for the research questions, earlier qualitative findings are included in Table 1. The table is conceptually ordered: the top team had the most effective group communication and the bottom team had the least effective. In the display, all game teams are at the top and all control teams are at the

bottom. The analysis concluded that game teams had higher levels of accept, discuss, and communal with lower levels of reject which led to more effective communication. In contrast, control teams had higher levels of reject and command with lower levels of communal which led to less effective communication.

	Command	Communal	Communication Responses
Team E1	Low	High	High discuss; High accept; Low reject
Team E2	Moderate	High	Very high discuss; Moderate-high accept; Moderate reject
Team E3	Moderate	High	Very high discuss; Moderate-low accept; Low reject
Team C1	Moderate	Moderate	Moderate discuss; Moderate accept; Moderate reject
Team C3	High	Low	Moderate-high discuss; Moderate accept; Moderate-high reject
Team C2	High	Low	Moderate discuss; Moderate-low accept; High reject

Table 1. Conceptually-Ordered Summary of Communication Responses and Language Style for All Cases

To understand how these variables connect across turns of talk, we created an ENA model. Connections between language style and communication responses for each game team were compared. Figure 1 shows the network diagrams for Game Team 1 (red), Team 2 (blue), and Team 3 (purple). There were no statistical differences between the means along either the X axis or the Y axis. The strongest connection across all teams was between *accept* and *discuss*. My hypothesis is that control teams will have a strong connection between *command* and *reject* and this will create a significant difference between game and control teams. Full analysis of control teams and model comparison statistics will be included in final paper.

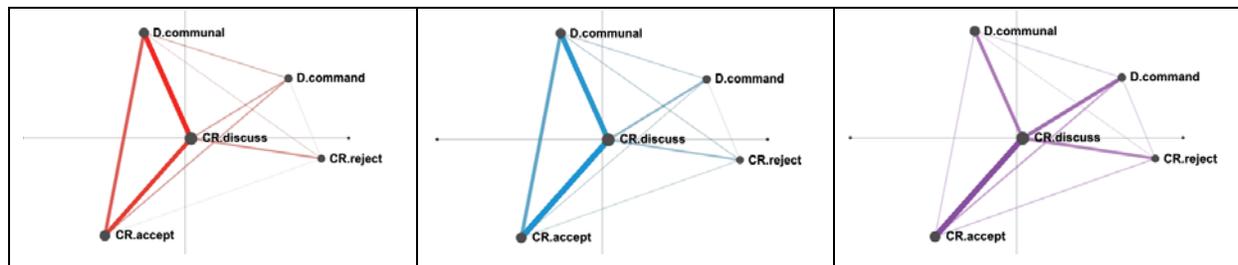


Figure 1. Network diagrams for all three game teams.

Contribution

Barron (2003) termed *accept* and *discuss* as engaged responses; she termed *reject* as a non-engaged response. Her research demonstrated that successful teams produce a high level of engaged responses in comparison to non-engaged responses. Using ENA, this study expanded on Barron's (2003) findings by demonstrating that engaged responses co-occur frequently in successful teams and often co-occur with communal language. The study shows that ENA offers an alternative method for analyzing qualitative data.

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Construction of Epistemic Cognition about Social Knowledge through Democratic Small-Group Discussions

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Abstract: This research aims to unpack the process by which young students construct and use social knowledge. The collective construction of epistemic cognition and its cognitive impacts are investigated with 136 fifth-grade students who participated in small-group discussions about complicated social-moral issues. Student discussions, essays, interviews, and questionnaires will be investigated to provide insights into the underlying psychological mechanisms of early adolescents' reasoning and decision making related to social-moral issues.

Background and Goals of the Project

My research centers on early adolescents' epistemic cognition about social knowledge. Social knowledge, in this research, is defined as the knowledge that individuals rely on to reflect on, evaluate, and understand the social world. Epistemic cognition (EC) related to social knowledge is a higher-order mental process that occurs when individuals think about the knowledge and knowing (e.g., the limits, certainty, and criteria about knowledge and knowing) about the social world. Social knowledge is fundamental to students' adaptive adjustment to school experiences with others. Students rely on social knowledge, for example, to reason about bullying and peer victimization.

To this end, the major research gap in this field is the lack of scholarly understanding about the nature and development of EC about social knowledge. Compared to epistemic cognition about academic knowledge such as science concepts, social knowledge is more contingent on human subjectivity and value judgment (Kuhn, 2009) and develops through personal experiences, social observations, and cultural transmission (Crick & Dodge, 1994; Frith & Frith, 2006). Additionally, although the importance of meaningful learning strategies (e.g., argumentation, inquiry-based learning) in higher-level knowledge construction has been well documented across multiple contexts, research about instructional practices that cogently engage students in reflective and critical thinking about social knowledge remains unclear.

The overarching aim of my research is to unpack the process by which people develop EC about social knowledge. The context of the proposed research is a democratic small group discussion in which 10-year-old children engage in various forms of reasoning about complex social exclusion issues. The corpus of data contains videotaped discussions collected from six fifth-grade classrooms throughout six weeks.

Research Questions

1. What is the nature of epistemic cognition about social knowledge?
 - a. What are the epistemic components of early adolescents' understanding about social exclusion issues?
 - b. How are these components related to different social knowledge schemas?
2. How does epistemic cognition about social knowledge change over time?
 - a. Does early adolescents' epistemic cognition about social knowledge develop through recurring small dialogic reasoning?

Method

Data Source

The dataset used in this project comes from a project sponsored by NAEEd/Spencer Foundation, “Promoting Early Adolescents’ Interpersonal Competencies and Academic Achievement through Collaborative Social Reasoning” (P.I: Dr. Tzu-Jung Lin). Participants were 136 fifth grade students from two public schools in a Midwest city in the United States. Each student participated in one discussion per week for six consecutive weeks. I will analyze 144 videos of small-group discussions on stories about provocative social issues (e.g., friendships, social exclusion, bullying and victimization), individual social reasoning essays and interviews, and questionnaires that tap into social competence (i.e., harmonious relationship, group working, and communication skills), academic competence, and EC concerning the source, certainty, development, and justification of social knowledge.

Data Analysis

The videos of small group discussions and student interviews will be segmented into meaningful units (i.e., sequences with a consistent topical focus) and coded based on the epistemic informed by two existing theoretical models of epistemic cognition—AIR(Chinn et al., 2014) and TIDE (Muis et al., 2006). The preliminary video data will be revisited for multiple times, along with the constant refinement of the codes until all the codes could account for the entire data set. The coded data will be analyzed by the Epistemic Network Analysis (ENA; Shaffer et al., 2009) method. ENA provides graphical projections of the relationships among epistemic components (i.e., codes), which allows the characterization of EC of the group of people in a specific context (e.g., small group discussions on racial discrimination).

To address research question 2, Latent Growth Curve Modeling (LGM; Duncan, Duncan, & Strycker, 2006) within a structural equation modeling (SEM) framework will be used to statistically model the changes of EC across the six weeks of discussions. Four major indices will be derived from the coding and the ENA results: the number of utterances reflecting social knowledge, the number of utterances reflecting EC, the density of connections (i.e., number of connections with respect to the weights of the links) among the EC codes, and the density of connections among social knowledge and EC codes.

Expected Contributions

This proposed research will contribute to the research and practice in cognitive, developmental, and educational psychology by 1) bridging the gaps in the understanding of social knowledge development, 2) providing a pioneering empirical research on EC about social knowledge, and 3) suggesting the potential mechanism of supporting students’ social knowledge and epistemic cognition development.

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Generating Visual-Form Learning Analytics from Quiz Usage Data

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Abstract: This paper briefly described a multi-year research study that used visual-form learning analytics (LA) to allow students to reflect about their study behaviors related to retrieval practice activities implemented as quizzes. The visual-form LA were built using the U-Behavior App, that collects quiz usage data from Canvas Learning Management System. Initial findings include students' understanding of well-established learning practices, the realization of intended study behaviors versus engrained behaviors, high score orientation, and a focus on comparisons.

Goals of the Research

This project aims to use visual-form learning analytics (LA) to help students to be aware and reflect on their study behaviors as well as to change their behaviors when they think it is beneficial for their learning process. Visual-form LA consist of the process of representing learner usage data as a visualization (McKenna, Folkestad, & Moraes, 2019). To produce the visual-form LA, we developed an application, the U-Behavior App, that collects quiz usage data from Canvas Learning Management System.

Background of the Project

The project was a multi-year study initialized in an online master's level class in the fall 2017 and fall 2018 semesters. The class had as main purpose to teach well-stablished learning strategies, such as retrieval, spacing, and interleaving (Brown, Roediger, & McDaniel, 2014), and apply those strategies in course assignments. The idea was to prepare future instructors to experience those learning strategies as students and provide them with the opportunity to reflect about their learning study behaviors regarding course assignments, specially retrieval practice activities (RPAs), implemented as quizzes. Although several other learning behaviors could be considered, such as, forums interactions, and number of times and ordering in which students have accessed the online materials, this research focused on RPAs because we had the intention to observe how learners were behaving after learning about retrieval, spacing, and interleaving.

Methodology

During Fall 2017, learners were given the opportunity to practice RPAs as learning-based quizzes which they had the option to take the RPAs up to ten times and retains their highest score. These RPAs consisted of multiple-choice questions and were randomized in question selection. Eight RPAs were offered as part of the early weeks of the course, but not all students attempted all eight RPAs. After the eighth RPA was offered, learners were then presented with their visual-form LA and prompted with reflection questions about the visualizations as a course assignment. Their usage study behaviors were collected using the application U-Behavior. For this study, we used an explanatory sequential design (Creswell & Plano Clark, 2018). One example of a visual-form LA from a fall 2017 student is presented in figure 1.

The X-axis reflects the RPA submission times composed of date and time of each attempt and the Y-axis represents the score obtained in each attempt. Each attempt is represented by a colored node and each color signifies one of the RPAs offered during the class. The RPAs taken in chronological succession were connected by trend lines. A node that is isolated (see the point labeled "7" in figure 1) can indicate that the student completed the RPA once or it may indicate that the student was interleaving their practice if they choose to test their knowledge by intermixing the RPAs across time.

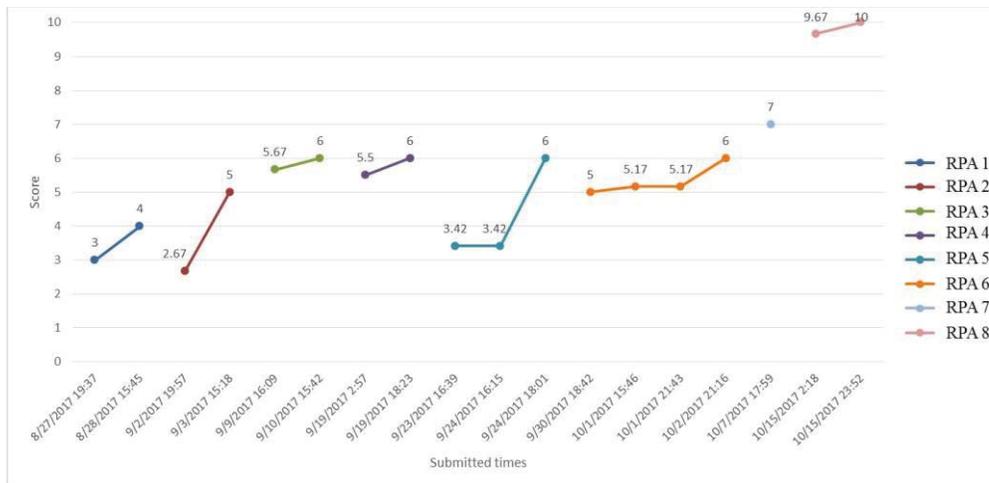


Figure 1. Example of a student’s visual-form LA

Considering the initial findings (described in the next section), we included an intervention reflective assignment on Fall 2018 study. This intervention consisted in presenting learners’ study behaviors (visual-form LA) from the previous year (fall 2017) and asking students to reflect about them. The intervention was done one month after the beginning of classes, allowing students to start building their knowledge about testing, space, retrieval and interleaving learning strategies.

Preliminary Findings

Data (visual-form LA and reflective assignment responses) from fall 2017 study were analyzed by three researchers using a common protocol. Nineteen learners completed 124 RPAs with 284 total attempts. Of all the RPAs completed, 146 (59%) had multiple attempts. A total of 10 learners attempted spacing, two attempted interleaving and 18 practiced retaking. From the qualitative analysis, we conclude that: most of the students engaged in behaviors that were oriented toward getting the highest score on each quiz. Reflecting on their behaviors, students understood the benefits of SRP but did not engage in that behavior. Interestingly, students wanted to compare their work and effort with their classmates to advance their understanding.

We are still analyzing the data obtained from fall 2018 study, but we observed that some students did change their study behavior after the intervention and started to practice spacing and interleaving.

Expected Contributions

We expect to make contributions for both students and instructors. Helping students to better understand how they behave, and how that behavior is related to learning may lead to improved learning strategies. Presenting learners with visual-form LA creates opportunities for them to reflect on and understand their practices; changing and improving their learning strategies when they think it could be beneficial for them. Instructors can use visual-form LA to identify students’ strengths and areas that need to be improved, allowing the construction of personalized feedback to the learner.

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Tracing Change in Informal Educators' Role Identity for Facilitating Learning by Making

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Abstract: This summary is situated in Invent with Environment (IwE)- a design-based research study that involved supporting three informal educators to facilitate 32 middle and high school Latinx students' exploration of role possible selves in environmental science (ES) through 4 to 7-week maker courses. Projective Reflection guided informal educators' exploration of role identity for facilitating learning by making through three phases: *starting self* (co-design of maker curriculum in Fall 2018), *exploration of role-possible selves* (implementation and refinement of curriculum in Winter 2019), and *new self* (re-enactment of curriculum and reflection in Spring 2019). During these phases, informal educators were prompted to articulate their *knowledge, interest and valuing, self-perception and self-definition, and self-organization and self-control* for adopting maker-centered learning as a novel approach to support students' engagement in ES. Quantitative Ethnographic techniques will be used to chronologically organize, examine, and trace change in informal educators' role identity for facilitating learning by making.

Goals of the Research

Educational researchers argue that learning by making (e.g. working with ideas and constructing with materials and tools such as Makey Makey, 3D Doodler) can facilitate new ways of understanding concepts, supporting identities and dispositions, and triggering future trajectories in academic domains and careers (Bevan, 2017). However, educational research is nascent in terms of how the introduction of interdisciplinary and interactive technological-pedagogical innovations (making, in this study) in formal and informal learning settings can stimulate dynamic shifts in teachers' pedagogical roles in orchestrating student learning (Bevan, 2017; Shaffer, Nash, & Ruis, 2015). Even fewer studies have paid attention to how we can educate teachers to reconstruct themselves in a time where the praxis of teaching is becoming increasingly decentralized and re-professionalized in digitally-evolving learning ecologies (Brennan, 2014; Cohen, 2017). Addressing this gap is inextricably tied to the dearth of empirical investigations that can support the democratization of making for K-12 aged students in formal and informal settings. This study, Invent with Environment focused on examining how educators can be supported in cultivating methodological skills to adopt learning by making in a systematic manner, to facilitate nuanced forms of learning with making, and to intentionally reflect on their beliefs, their goals, and purposes, and self-perceptions as they facilitate learning by making. Thus, in this paper, the following research question is examined, *"To what extent does an environmental science educator experience change in his role identity over time as it relates to facilitating learning by making as a result of co-designing, implementing and maker courses for middle and high school students?"*

Background of the Project

Invent with Environment is an exploratory concurrent mixed-methods study funded by DU-SOE (a) to co-design, implement, refine maker courses with informal environmental science educators, (b) to engage middle and high school students' identity exploration in environmental science, and (c) to scaffold informal educators' exploration of role identity for facilitating learning by making. Analytical, pedagogical and theoretical approaches that have been successfully applied to educate pre- and in-service teachers in adopting game-based learning, and engage students across K-12 in game-based courses to support their interest and knowledge in

STEM (Foster, 2014; Foster & Shah, 2015) were co-opted. In addition, theoretical approaches that focus on tracing change in teachers' motivations and actions in a specific role identity (learning by making, in this study) by elucidating the harmony (or lack of it) between the cognitive, social and affective aspects that impact teachers' adoption of the role identity were adopted (Kaplan & Garner, 2018; Shah & Foster, 2018).

Methodology

A design-based research approach was used (Cobb et al., 2003) to co-design (2-weeks in Fall 2018), implement (4 weeks in Winter 2019), refine (Winter 2019), and re-enact (7-weeks in Spring 2019) maker courses for middle and high school Latinx students. All the activities were carried out at Riverside Center Environmental Education (pseudonym). This one of the first urban environmental education centers in the country and has four core program areas: environmental education, environmental art, land stewardship, and wildlife rehabilitation. Participants included three in-service environmental science educators (Ashley-a Caucasian female, Austin-a Caucasian male, Edmond-a Latinx male) who are currently working at the environmental education center. During each phase, informal educators were prompted to articulate their *knowledge, interest and valuing, self-perception and self-definition, and self-organization and self-control* for adopting maker-centered learning as a novel approach to support students' engagement in environmental science using surveys, artefacts, reflective journals, co-teaching of the course, and reflection meetings.

Expected Outcomes and Contributions

Initial inductive and deductive data analysis has involved ascertaining findings from each data source individually and triangulating them. For instance, qualitative data from reflective journals from the professional development have been analyzed using the guidelines by Kaplan & Garner (2018). These have been triangulated with t-test findings from a survey (Shah & Foster, 2015). However, in the future, Quantitative Ethnographic (QE) techniques will be used to synthesize data from all sources chronologically, and to visualize and interpret change in informal educators' role identity for facilitating learning by making. The application of QE to study the changes in educators' role identity as a result of participating in the study activities can potentially set the foundation for building a scalable model that characterizes (i) what it means to be an educator who is committed to enhancing his/her STEM practice with technology (professional identity), and (ii) educators' actions for facilitating students' knowledge and interest in STEM by leveraging technology-mediated experiences (practice).

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Keynotes

Individuals and Discourses

Jim Gee

Abstract: When anyone speaks or writes there are always two “authors”. One “author” is an individual who always speaks or writes as part of a social network of other individuals. This fact follows from the fact that there can be no “private languages” (following Wittgenstein). The other author is a (“big D”) Discourse that speaks and writes as an historical entity using human individuals as “carriers”. Discourses give (transformable) meaning to what individuals say, write, and do and individuals continually produce, reproduce, and transform Discourses.

Epistemic Network Analysis (ENA) can be seen as operating at three interacting levels: (a) the ways in which individual contributions gain meaning in an interactive social network of individuals; (b) the ways in which Discourses gain meaning in an interactive network of Discourses; and (c) how the two levels reciprocally interact to produce “specific universals”. What ties these three levels together are processes of “mind/society” recognition of socially situated identities and activities mediated by grammar (code) and situation (context).

Quantitative Ethnography Across Domains: Where We Are and Where We Are Going

Golnaz Arastoopour Irgens

Abstract: In the last decade, researchers in a variety of domains have used Quantitative Ethnography (QE) in their work. With an initial following in learning sciences and learning analytics, QE is now being used by researchers in fields such as political science, neuroscience, computer human interaction, and anthropology. The main reason for this wide-spread application is because QE leverages the power of human interpretation and computational efficiency such that researchers can create “thick descriptions” of large datasets. In this keynote, I will review how researchers across domains are using QE in different ways, focusing on how QE can be an inclusive research method. After reviewing the current state of the field, I will propose future directions for the QE community.

Nurturing the Connections: The Role of Quantitative Ethnography in Learning Analytics

Dragan Gašević

Abstract: This talk will explore connections between two emerging fields focused on harnessing the potential of data – learning analytics and quantitative ethnography. Learning analytics is focused on the analysis of data collected from user interactions with technology with the goal of advancing our understanding of and enhancing human learning. Despite some early success stories and widespread interest, producing meaningful and actionable results is still a top open research challenge for learning analytics. The talk will first explore how quantitative ethnography can offer promising approaches that can address this open challenge in learning analytics. The talk will next discuss how progress in learning analytics can be used to accelerate the development of the field of quantitative ethnography. The talk will finally outline promising directions for future research at the intersection of learning analytics and quantitative ethnography.

Invited Symposium

Invited Symposium

Chair: Simon Buckingham Shum (University of Technology Sydney, Australia)

Panel: Karin Frey (University of Washington, USA), Jun Oshima (Shizuoka University, Japan), Adam Lefstein (Ben Gurion University of the Negev, Israel), and David Williamson Shaffer (University of Wisconsin-Madison, USA)

Join the panellists in conversation reflecting on the topic of Quantitative Ethnography, when they'll consider questions such as... What shape is QE's DNA? What can we learn from other emerging fields? How do we build the QE community, and bridges to other communities? Delegates will have the chance to propose questions in advance, and to contribute their own thoughts in the session.

Workshops

Introduction to Epistemic Network Analysis

Kamila Misiejuk and Brendan Eagan

Abstract: This workshop introduces the participants to the basics of the Epistemic Network Analysis (ENA) by analyzing two Shakespeare plays: Romeo and Juliet, and Hamlet. The goal of the workshop is to learn how to use the ENA web tool independently, and how to develop and interpret ENA graphs. The workshop consists of three parts: 1) theory, 2) step-by-step tutorial, and 3) group work. The topics of the first part are the differences between social network analysis and ENA, and data coding challenges. In the second part, the participants are introduced to the ENA web tool in order to compare the discourse between Romeo and Juliet, and Hamlet. Finally, the participants put their newly acquired skills into practice in the group work exercises.

Introduction to Automated Coding and nCoder

Amanda Siebert-Evenstone and Seung Bok Lee

Abstract: This workshop will introduce methods for valid and reliable automated coding of text data using the nCoder webtool and R package. During the workshop, participants will work individually and in teams to step through the process of creating an automated and validated code. In this interactive workshop, participants will learn how to (1) combine qualitative and quantitative perspectives for text analysis, (2) create codebooks for code validation and publication, (3) develop and test automated classifiers to code text data, and (4) validate automated coding schemes. We will also provide an R script for participants who wish to use the R package version of this technique.

Advanced Epistemic Network Analysis

Zach Swiecki and Cody Marquart

Abstract: In this workshop, we will introduce participants to advanced features of epistemic network analysis (ENA) available in the webtool and the rENA package for R, including weighted models, projection, masking, and trajectories. Participants will work in groups to apply these features on one of several sample datasets. Our emphasis be on how to implement the features, as well as how to determine whether they should be used. The workshop will culminate with an rENA analysis using ENA outputs in a subsequent technique, such as regression. Familiarity with ENA theory, the webtool, and rENA is preferred; however, we will provide brief overviews of each. We will also provide an R script for participants to use as a reference during and after the workshop.

Special Sessions

Further Fields: Introducing Quantitative Ethnography to New Academic Disciplines and Research Areas

Andrew Ruis, Abigail Wooldridge, Szilvia Zörgő and Vitaliy Popov

Abstract: This session brings together four scholars with experience introducing quantitative ethnographic methods to new domains or research areas. It can be challenging for junior scholars—especially graduate students, post-doctoral researchers, and assistant professors—to use approaches unknown in their field, as to do so can make mentorship, publication, research program development, and tenure review more difficult. The members of the panel will talk about their experiences applying quantitative ethnography in novel contexts in order to foster a broader discussion on quantitative ethnography as a domain-general research methodology.

Fostering Quantitative Ethnography Enculturation in Research Teams

Eric Hamilton, Golnaz Arastoopour Irgens, Karin Frey and Hee Soo Jung

Abstract: This panel will focus on approaches to developing QE culture within a research team/lab. Representatives from four institutions will discuss experiences in adapting ENA into their research efforts, including ways to foster support for using ENA among peers, working through challenges, and offering insights for others on lessons learned and QE community.

Teaching Quantitative Ethnography

Brendan Eagan, Eric Hamilton and Kamila Misiejuk

Abstract: This panel will focus on approaches to teaching Quantitative Ethnography. QE instructors from three institutions will discuss their experiences in teaching ENA, nCoder, and rho among other topics. They will discuss adopting, adapting, and creating QE instructional materials, as well as sharing challenges, lessons learned and advice for aspiring QE instructors.