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Edited by:
Golnaz Arastoopour Irgens, Simon Knight

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Preface

This volume represents the supplementary proceedings of the Fifth International Conference on Quantitative Ethnography (ICQE23). This year's event represents the first ICQE in Australasia, following 2022's inaugural European event (Copenhagen, ICQE22), two years online (ICQE20-21), and the ICQE launch in North America (Madison, ICQE19). As part of the spirit of open community, the conference has always included both a formal Springer published proceedings and these supplementary proceedings to provide a range of submission types, and thus ways for authors to disseminate their work.

The conference and wider community as fostered through the International Society for Quantitative Ethnography (ISQE) provides a forum for discussion regarding Quantitative Ethnography (QE), its data, methods, and applications, for returning and new scholars, across disciplines.

These supplementary proceedings comprise 10 Doctoral Consortium applications, 29 Posters, 2 Workshops, 2 Symposia, and 23 Research Agenda Development (RAD) proposals. These were presented alongside the 33 full papers accepted at the conference, published in the Springer Proceedings. The interdisciplinarity of the field can be seen across the submissions received, and in the authorship collaborations. The manuscripts also demonstrate the interest in this new methodology amongst emerging scholars and in developing research agendas. Of the full papers, 20 were 'student paper' submissions, with 10 Doctoral Consortia submissions and more among the wider submissions. The RADs – a new submission type this year – provide a forum at the conference for discussion regarding future research directions across the field, and its theoretical and methodological underpinnings, while facilitating international and interdisciplinary collaborations. As we describe in the Springer proceedings, and paralleled here, the submissions draw on a range of data types, from contexts that include formal education, workplace and online settings among others. The submissions reflect three core themes, often making contributions across them: learning and learners; society, culture, identity and justice; and advances in QA methodologies.

- Learning and Learners: These submissions focus on Modeling Learners' Perspectives and Knowledge, Behavior and Multi-Modal Analyses, and applications of QE in STEM Education and Games and Digital Spaces for learning.
- Society, Culture, Identity, and Justice: These submissions focus on Narratives and Identities in Education, as well as approaches to Modeling Identities and Narrative in wider context, and QE as a lens onto Speech and Culture, with a strand of papers investigating applications of QE in Equity and Social Justice.
- Advances in QE Methodologies: These submissions included Comparing and Combining Modeling Tools, Innovations in Coding Tools and Coding approaches, and Teaching QE, sometimes drawing on data from learning contexts in their investigations towards methodological advancement.

ICQE: CONFERENCE AND COMMUNITY

The QE community is developed through, and reflected in, the range of contributions at ICQE, in terms of the topics covered, sources and contexts of data, the core contributions made, and the submission types, with the community seeking to provide an inclusive space for both new and experienced QE researchers.

We would like to thank all authors across the ICQE submission types, and continue to invite researchers into the QE community, previous authors and new. We would also like to thank the reviewers, program committee members, and others in the QE community who have supported the conference. The program chairs would like to acknowledge support from ISQE and the National Science Foundation in the United States. We are particularly grateful to the local chairs and organizers for their work in planning the conference and welcoming ICQE to Melbourne.

September 2023

[Golnaz Arastoopour Irgens]
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Doctoral Consortium

Using Epistemic Network Analysis to Understand the Intersectional Experiences of Teachers of Color in a White-Dominated Education Institutions

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Abstract. The proposed study seeks to explore the experiences of preservice teachers of color completing teacher preparation in an elite, predominantly and historically white university through a holistic, intersectional lens. To visualize connections between participants' various social identities, their senses of belonging, and various programmatic elements and interactions, the proposed study seeks to use epistemic network analysis (ENA) to represent these connections in dynamic models, in service of thickly describing the intersectional experiences that preservice teachers of color have. ENA presents a unique opportunity to visually represent the connections between participants' experiences and multiple salient identities simultaneously, minimizing essentializing participants' identities and the subsequent risk of tokenization.

Keywords: Epistemic Network Analysis, Network Analysis, Teachers of Color, Preservice Teachers, Teacher Education

1 Goals of Research

Schools and districts nationwide have voiced calls for a teaching force that reflects the growing diversity of American public school students – more than half of whom identify as a racial or ethnic minority [1]. Academic research also supports these calls, finding that students of color tend to perform better academically in school when matched with teachers of color [2, 3, 4, 5]. Preparation programs focused on recruiting and training teachers of color have proliferated in response to these calls for workforce diversity, yet teachers of color still leave the profession at higher rates than white teachers [6, 7, 8]. Research finds that, on the whole, teachers of color experience teacher preparation as a marginalizing space and do not feel accepted or affirmed in their cultural identities while in teacher preparation [9].

The goal of this self-study is to better understand the experiences that preservice teachers of color have attending three teacher preparation programs housed within the same white-dominated education institution. While all three programs have committed to efforts in recent years to recruit and prepare more teachers of color, while making programmatic modifications to reflect this diversity, the experiences of preservice teachers of color in programs is relatively limited. By examining and better understanding the experiences of preservice teachers of color who have graduated from this predominantly white institution's (PWI's) teacher preparation programs, the institution

will be better prepared to support preservice teachers of color once they enroll. This study seeks to explore the following questions:

1) What are teachers of colors' experiences of belonging in their teacher education program?
2) How do teachers of colors' various social identities impact and influence their experiences in their teacher education program?

2 Methods

The proposed study will use epistemic network analysis in three distinct ways. First, the proposed study will use ENA to attempt to visualize connections between preservice teachers of colors' multiple salient social identities and their experiences in teacher preparation through the coding of interviews with teachers of color who have graduated from such programs. Data collection has been completed and consists of thirteen interviews with graduates of color across three teacher preparation programs all housed within one predominantly white education institution. Second the proposed study will use ordered network analysis (ONA) to visualize connections between salient social identities and preservice teachers of colors' positive and negative experiences in teacher preparation programs. Each experience coded in initial coding is assigned a valence of positive or negative. Third, the proposed study will contribute to the scholarly discourse on quantitative ethnography (QE) and ENA as methodology when used to model intersectionality.

3 Preliminary or Expected Findings

Preliminary findings use ENA to model connections between salient social identities and program experiences but do not account for positive or negative valence of those experiences. Additionally, preliminary findings are centered around racial identity, as the data was collected as part of another study that focused on racial identity. However, initial traditional qualitative coding revealed the relevance of multiple social identities that intersect with race, such as gender and socioeconomic status, amongst others which is where the interest in ENA initially arose. I anticipate that using ENA and ONA to model connections between salient social identities and the range of positive and negative experiences that preservice teachers of color had while in the program will reveal that preservice teachers of colors' experiences cannot be viewed through a racial lens alone and are most thickly described when intersectionality is foregrounded in analysis.

4 Expected Contributions

The current scholarly conversation about teacher preparation and teachers of color focuses largely on individual preservice teachers of colors' reflections on their experi-

ences. While this approach has played an incredibly important role in bringing preservice teachers of colors' experiences to light and the extent to which they have felt unsupported in teacher preparation programs, there have been far fewer inquiries that have sought to situate those reflections within the concrete, programmatic and pedagogical considerations that frame programs' approaches to preparing preservice teachers of color. As such, several scholars have voiced support for a more programmatic approach to research on teacher preparation and teachers of color [10]. These calls have highlighted the necessity of research that examines the supports and structures that guide preservice teachers of color through preparation in addition to the barriers that prevent successful matriculation through preparation [6]. The proposed study would use quantitative ethnographic approaches to both center the experiences of participants while also analyzing their experiences through a programmatic lens because of the inherent focus on connections between the two. Further, the proposed study will contribute to the broader quantitative ethnography field and its applications in studying identity, intersectionality, and education.

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An IoT-based Multimedia System for Fine-grained Multimodal Learning Analytics

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Abstract. Multimodal learning analytics (MMLA) assumes that human communication in collaborative learning is fundamentally multimodal in terms of language and nonverbal information such as gaze, body language, actions, facial expressions, speech, and writing and sketching. Computational approaches would provide new perspectives on cultural practices learners engage through their collaboration in different but complementary ways compared with the traditional qualitative approaches such as conversation analysis. This study proposes an Internet of Things (IoT)-based multimedia system including a video recorder, an audio recorder, and sensors for MMLA. The proposed system would support fine-grained multimodal analysis of collaborative learning owing to technological ingenuity of hardware and software.

Keywords: Collaborative learning · Multimodal learning analytics (MMLA) · Internet of Things (IoT) · Sensor networks · Time synchronization.

1 Goals of the Research

This study aims to develop an Internet of Things (IoT)-based multimedia system for multimodal learning analytics (MMLA). Figure 1 shows an overview of the proposed system. The system consists of devices like a video recorder, an audio recorder, and sensors for collecting fine-grained collaboration data, algorithms

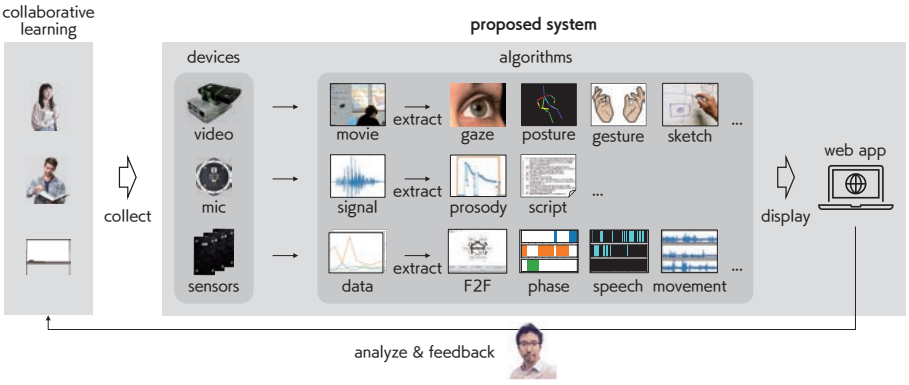

Fig. 1: Overview of the proposed study.

to multimodally extract collaboration with the acquired data from the devices, and a web application to display the acquired collaboration for learning analysts.

To realize a fine-grained IoT system, there are three system requirements: 1) easy installation of the system, 2) multimodal extraction of collaboration, and 3) precise data collection from devices. The first requirement is essential for installing the proposed system in an actual learning environment. The second requirement is necessary to extract collaboration for MMLA. The third requirement is for fine-grained collaboration analysis.

2 Background of the Project

The project is based on the potential of nonverbal information for collaborative learning analysis. Nonverbal information is exchanged among participants, and influences how the participants interpret discourse in collaborative discourse practices. In learning analytics, the issue has been discussed in the topic of MMLA. MMLA assumes that human communication in collaborative learning is fundamentally multimodal such as gaze, body language, actions, facial expressions, speech, and writing and sketching. The technological development to capture the modalities in the learning setting makes it possible for researchers to integrate the modal information for describing practices in more accurate ways.

3 Methodology

I designed and implemented sensor-based learning analysis on a web application. Each sensor collects fine-grained data owing to µs-level synchronization across the sensors. To make the system multimedia for MMLA, I am currently developing a novel video recorder to synchronize with the developed sensors for accurate data collection.

4 Preliminary or Expected Findings

I am in the preliminary stages of developing a prototype model of a video recorder. This recorder uses a Raspberry Pi 4 Model B and a Raspberry Pi Camera V2 as the video device, as shown in Fig 1. Although the model records video at a resolution of 640x480 pixels and a frame rate of 30 fps, it realizes unstable synchronization with sensors owing to hardware and software characteristics. To achieve stable synchronization, I plan to implement a video recorder with an application specific microcontroller mounting Mbed OS.

5 Expected Contributions

The proposed IoT-based multimedia system would provide new perspectives through fine-grained multimodal data for quantitative ethnography. The system also contributes to breaking the technological limit for range expansion of collaboration analysis.

Automated Expert Feedback in Co-Located Settings

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Abstract. This research project aims to investigate and implement automated expert feedback within co-located nursing education settings. Using Design-Based Research (DBR) and Quantitative Ethnography (QE), the project engages in a three-year, iterative, collaborative process with educators and researchers. The research gathers multimodal data and conducts student interviews, adhering to GDPR guidelines. Preliminary findings suggest that Epistemic Network Analysis (ENA) has the potential to guide the design of automated feedback systems effectively. The research is expected to yield transformative impacts on the delivery mechanisms of expert feedback in co-located settings and offer insights into complex educational processes.

Keywords: Expert Feedback, Co-located learning, Quantitative Ethnography

1 Research Goals

The principal objective is to investigate the complexities and possibilities of automated expert feedback in co-located settings, specifically in nursing education. The research seeks to:

- Understand how experts generate feedback.
- Explore ways to incorporate experts' feedback into automated systems.
- Examine how students interpret and use automated, expert-driven feedback.
- Identify the types of epistemic practices evidenced by nursing students during debriefing sessions that are supported by automated expert-driven feedback.

2 Background

Higher education is undergoing a significant transformation, fueled by technological advancements that challenge traditional pedagogical paradigms. Yet, even within this evolving landscape, the principle of feedback remains integral to student development and performance [1], [2]. Logistical challenges such as expanding class sizes and limited availability of domain experts often impede effective feedback delivery [3]. In this context, expert feedback, characterized by incisive, constructive advice from individuals with specialized knowledge [4], becomes particularly valuable but is frequently elusive due to high demand and restricted accessibility [5]. To address these issues, the current research posits automated expert feedback as a scalable and sustainable solution, particularly in co-located settings. Innovations in learning analytics have enabled the development of automated feedback systems capable of offering timely, adaptive, and meaningful feedback [6], [7]. While technology acts as an enabler, it must be strategically aligned with pedagogical objectives to be effective [8]. Therefore, this research aims to examine the complexities and affordances of automated expert feedback and its potential to bolster collaborative learning in co-located settings.

3 Methodology

This research adopts a Design-Based Research (DBR) approach with a focus on simulation-based learning in nursing education. Over a span of three years, the project engages educators and researchers in a collaborative effort to create a multimodal analytics tool for automated student feedback. The work follows a structured, iterative three-stage process comprising analysis and exploration, design and construction, and evaluation and reflection [9], thus allowing for adaptive refinements tailored to the specific research context and emerging needs

The empirical core of the study is a simulation-team training course within nursing education, designed to emulate an Intensive Care Unit (ICU). In this controlled environment, registered nurses engage in activities that include iterative simulations and comprehensive debriefing sessions to enhance learning and reflection. The study has secured the necessary authorization for data collection, which includes teacher discussions, multimodal data

from simulations, and student interviews, in compliance with General Data Protection Regulation (GDPR) guidelines.

Data integration and analysis leverage Quantitative Ethnography (QE), utilizing Epistemic Network Analysis (ENA) as a key methodological tool. This allows for the visualization and examination of complex interaction patterns, offering a comprehensive understanding of the learning process and the experience of receiving feedback. ENA serves to elucidate relationships among different data elements, thereby enriching the interpretative rigor of the QE analytical approach.

4 Preliminary Findings

In the initial year of the project, observational studies within nursing education have yielded valuable insights into expert feedback, propelling the research into its design and construction phase for an automated feedback system. Planned activities for September 2023 involve testing sensors to combine multimodal data, including video, audio, and physiological markers, to enrich feedback generation. Preliminary work has successfully applied Epistemic Network Analysis (ENA) on a dataset to model students' collaborative skills. The findings support ENA's utility in identifying individual collaborative behaviors, serving as a precursor for targeted interventions. Future work aims to extend ENA application to simulated nursing scenarios, to refine the automated feedback design.

5 Expected Contribution

This research project primarily contributes to higher education by developing an automated feedback system for co-located learning in nursing education. It addresses expert feedback scarcity and inconsistency, potentially transforming feedback delivery. The project also enhances understanding of complex learning processes by integrating quantitative ethnography in multimodal data analysis. Its findings could benefit various educational contexts, advancing learning analytics and educational research. Success could improve teaching, learning, assessment practices, and student outcomes.

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Enhancing Analytical Reading Performance in Science News through Metacognitive Video Modeling

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Abstract. This project investigates the impact of metacognitive video modeling on the analytical reading performance of students when reading science news articles. The video modeling showcases experts explicitly demonstrating self-regulated learning (SRL) strategies and metacognitive processes during reading and analysis. Participants will acquire enhanced analytical reading skills and the ability to critically evaluate arguments by applying the observed processes. The study utilizes a quasi-experimental design with two experimental groups: science students and non-science students. The primary outcome measure is analytical reading performance, evaluated through posttests utilizing the Toulmin-argumentative pattern. Additionally, metacognitive awareness is assessed as a secondary measure, collected through a combination of transfer task, self-report questionnaires, and think-aloud protocols to gain a comprehensive understanding of participants' metacognitive awareness after engaging with the video modeling. It is hypothesized that the experimental groups will exhibit significant differences in analytical reading performance and metacognitive awareness after the intervention.

Epistemic Network Analysis (ENA) is employed to establish connections between participants' analytical reading performance, their metacognitive awareness of SRL strategies, and other relevant factors. Through network analysis, the most influential factors or strategies associated with higher analytical reading performance can be identified. Furthermore, researchers can explore the relationships between different factors within the network and identify potential pathways for improving analytical reading skills of science and non-science students.

Keywords: Video Modelling, Analytical Reading Performance, Metacognitive Awareness, Toulmin's Argumentative Pattern, Epistemic Network Analysis

1 Goal of the Research

The primary objectives of this research project are to investigate the impact of metacognitive video modeling on the analytical reading performance of science and non-science students when engaging with science news articles. Specifically, the study aims to explore the relationship between observed self-regulated learning strategies, metacognitive processes, and participants' ability to enhance their analytical reading skills and critically evaluate arguments.

To address these objectives, the following research questions have been formulated:

RQ1: Can metacognitive video modeling improve analytical reading performance?
To answer this question, pre- and post-tests will be conducted to assess participants' analytical reading performance before and after their engagement with the metacognitive video modeling. The tests will be based on the Toulmin-argumentative pattern.

RQ2: How does metacognitive awareness of self-regulated learning strategies moderate the effect?
This question aims to examine the role of metacognitive awareness and self-regulated learning strategies in moderating the impact of video modeling on participants' analytical reading performance. This will be measured by using the self-report questionnaire and the think aloud protocol.

RQ3: Can the effects of metacognitive video modeling transfer to a novel task?
In addition to the pre- and post-tests, a delayed test will be administered after a two-week interval to examine the sustainability and transferability of the effects of metacognitive video modeling. This delayed test will assess participants' performance on a different task to evaluate the generalization of their acquired skills.

By investigating these research questions, this study aims to contribute to the existing literature on metacognitive video modeling and its impact on analytical reading skills. The findings will provide insights into the effectiveness of this instructional approach and its potential for enhancing critical thinking and argumentation abilities in science and non-science students.

2 Background of the Research

The advent of online education has brought forth numerous benefits, allowing students to access a wealth of resources and engage in interactive learning experiences. However, online reading classes often encounter challenges, particularly in fostering higher-order thinking skills such as analytical reasoning. While language skills and strategies receive significant attention during lectures, the development of metacognitive abilities, including deep comprehension, self-monitoring, and effective learning strategies, may be overlooked. The absence of face-to-face interactions with teachers and peers in

online environments further compounds these challenges, hindering students' metacognitive skill development and potentially impacting their reading comprehension abilities and overall learning outcomes. To address this issue, innovative instructional approaches must be explored to effectively promote metacognition in online reading classes.

The utilization of video modeling examples draws upon the theories of example-based learning, which suggest that learners can acquire new skills by observing expert performance through examples. It is considered as a metacognitive tool to prompt students to reflect on their learning and it enhance the outlearning outcome [1] This approach combines the elements of modeling examples, typically showcasing a screen recording of a model's self-regulated learning strategies accompanied by verbal explanations [2, 3].

Research indicates video modeling examples have been utilized to train self-regulation skills like self-assessment and task selection, resulting in improved learning outcomes. However, it is important to note that the transferability of these outcomes to different domains has been limited [4].

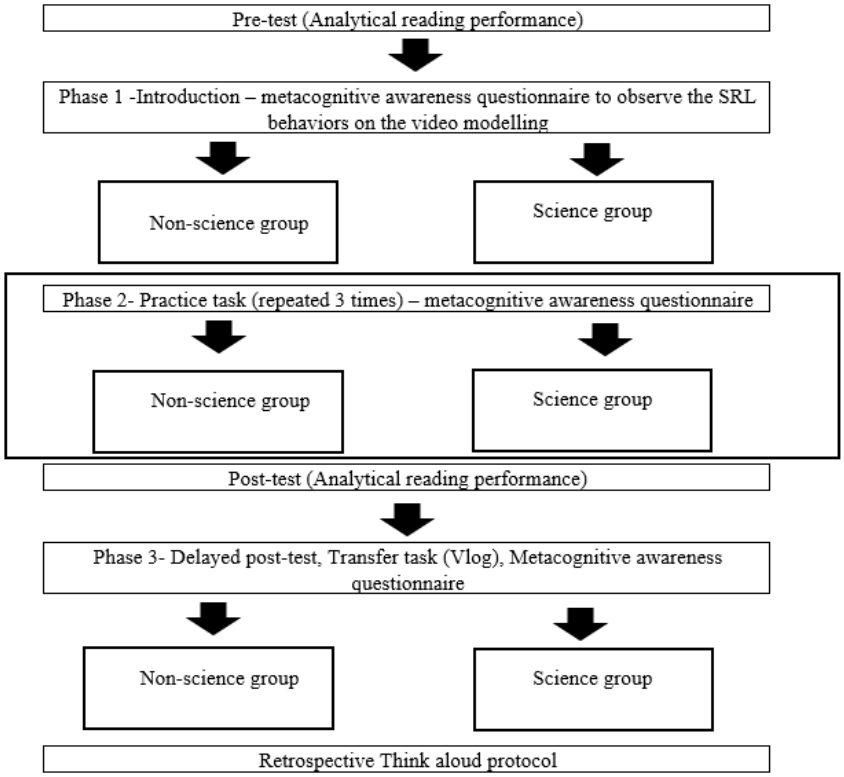
In this study, video modeling examples offer a suitable opportunity to integrate the teaching of self-regulated learning strategies and analytical thinking by demonstrating how to conduct analysis of the elements in the news correctly and providing verbal explanations of thought processes; the videos can incorporate both scientific reasoning principles and self-regulated learning strategies [5]. Furthermore, we examine how a video modeling intervention embedded with the thought process can moderate metacognitive awareness and the target skills of students on the transfer task.

3 Methodology

3.1 Participants and Design

The participants in this study were college students enrolled in the English for Teacher course at a university in Thailand during the first semester of the academic year 2023. They were divided into two groups: 40 science students and 40 non-science students, with a total of 80 students. All participants volunteered to take part in the experiment, and informed consent was obtained from each of them.

Fig.1 Procedure of the study



3.2 Material and Procedure

Phase 1: Introduction

During the instruction, both the science students and non-science students' groups were exposed to a video modeling session. The purpose of this session was to provide them with a visual demonstration of the desired metacognitive awareness behaviors. Following the video modeling, the participants engaged in practice activities using a metacognitive awareness questionnaire. This questionnaire was designed to observe and assess their self-regulated learning (SRL) behaviors exhibited during the video modeling session. The aim was to evaluate how effectively the participants monitored metacognitive strategies while engaging with the instructional material.

Phase2: Practice tasks

During phase 2 of the study, the practice tasks took place. Both the science students and non-science students' groups watched the video modeling session and then completed the reading tasks three times. After each iteration of the task, the participants were required to monitor the self-regulated learning (SRL) behaviors demonstrated in

the video by using the provided questionnaire. The purpose was to keep them focused on observing and evaluating the metacognitive strategies in video modelling.

Furthermore, following each completion of the task, the participants were asked to complete an exercise specific to that task. After this phase, an immediate post-test was administered to measure their performance. It provided insights into the participants' progress and improvement in analytical reading performance throughout the practice phase.

Phase3: Delayed post test, Transfer task (Vlog)
In phase 3 of the study, the participants were instructed to take a delayed post-test after a two-week interval following the practice phase. This test aimed to assess the retention and transfer of the analytical reading skills they had acquired during the previous phases. Following the delayed post-test, the participants were then required to create a vlog. They were given the freedom to choose a news topic of their interest and analyze the arguments presented in the chosen news article. The objective of this activity was for the participants to apply the metacognitive strategies they had perceived from the video modeling sessions into their vlog presentations. After completing their vlogs, the participants evaluated their own performances using the metacognitive awareness questionnaire. This allowed them to reflect on their use of metacognitive strategies during the vlog creation process. Additionally, the participants engaged in the think-aloud protocol, where they elaborated on their metacognitive strategies employed during the vlog creation. This protocol enabled researchers to gain insights into the participants' thought processes, decision-making, and metacognitive awareness while analyzing arguments and presenting their findings in the vlog format.

4 Expected Findings

The expected findings from the data collected during the experiment of the study may include:

Improved Analytical Reading Performance: Both the science students and non-science students are expected to show an improvement in their analytical reading performance from the pre-test to the post-test. This would indicate that the instructional interventions effectively enhanced their analytical reading skills.

Increased Metacognitive Awareness: The completion of the metacognitive awareness questionnaire during the video modeling sessions and practice tasks is expected to reveal an increase in participants' self-awareness and utilization of metacognitive strategies. This suggests that the instructional interventions successfully promoted the development of metacognitive skills among the participants.

Retention and Transfer of Skills: The delayed post-test conducted after a two-week interval following the practice phase will provide insights into participants' retention and transfer of the acquired analytical reading skills. A positive outcome would indicate

that the participants were able to apply their learning to new situations and maintain their skills over time.

Effective Application of Metacognitive Strategies in the Vlogs: Analysis of the participants' vlogs and the evaluation using the metacognitive awareness questionnaire are expected to demonstrate their ability to apply metacognitive strategies while analyzing arguments in self-selected news articles. This indicates their understanding and application of metacognitive awareness in real-life contexts.

Elaboration of Metacognitive Strategies through Think-Aloud Protocol: The think-aloud protocol will provide detailed insights into the participants' thought processes and the specific metacognitive strategies they employ during vlog creation. This qualitative data contributes to a deeper understanding of how participants apply metacognitive awareness in their analytical reading tasks.

The findings obtained from the study can be effectively analyzed and interpreted using Epistemic Network Analysis (ENA). It can help identify important epistemic nodes such as analytical reading skills, metacognitive strategies, and metacognitive awareness. It also offers a unique opportunity to explore connections between various epistemic nodes, thereby enabling researchers to gain insights into the underlying cognitive processes and the interplay between analytical reading skills, metacognitive strategies, Through the examination of these nodes interact each other, researchers can uncover valuable information about the relationships and connections within the system.

Additionally, ENA provides a means to investigate the transfer and retention of acquired analytical reading skills and metacognitive strategies. By analyzing the connections between nodes in the delayed post-test and vlog creation, researchers can assess the extent to which participants successfully apply their learning to new contexts and retain their skills over time. This analysis offers valuable insights into the effectiveness and long-term impact of the learning interventions.

By leveraging the power of ENA, researchers can gain a comprehensive understanding of how participants integrate their analytical reading skills and metacognitive strategies, transfer and retain their knowledge, this analysis offers valuable insights into the participants' learning processes and knowledge construction in real-life contexts.

5 Expected Contribution

The anticipated outcomes of this study have the potential to make significant contributions to the field of quantitative ethnography research in several ways:

The expected results of the study will provide valuable insights into how participants acquire and apply analytical reading skills and metacognitive strategies in real-life situations. By utilizing quantitative analysis techniques to examine the networks of knowledge, the study will deepen our understanding of the cognitive processes involved in learning and knowledge construction. This contribution adds to the expanding body of knowledge in quantitative ethnography by shedding light on the connections between cognitive factors, learning outcomes, and real-world application.

The expected outcomes of this study will enhance the validity and generalizability of quantitative ethnography research. Using rigorous quantitative analysis methods like Epistemic Network Analysis (ENA), the study will provide robust evidence regarding the relationships between analytical reading skills, metacognitive strategies, and learning outcomes. This will bolster the reliability of the findings and support the advancement of evidence-based practices in educational research.

The integration of qualitative elements, such as the think-aloud protocol and vlog analysis, with quantitative analysis techniques represents a valuable contribution to the field of quantitative ethnography research. This interdisciplinary approach bridges the divide between qualitative and quantitative methodologies, offering a more comprehensive understanding of the complex phenomena under investigation.

In summary, the expected results of this study in the realm of quantitative ethnography research contribute to a deeper understanding of learning processes, enhance research validity, and promote the integration of qualitative and quantitative approaches. These contributions support the growth and development of the community of researchers working in quantitative ethnography, fostering a more comprehensive and rigorous approach to the study of educational phenomena.

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Well-Connected Science Educators

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Abstract. By framing the connectivity of science educators through Communities of Practice, this study looks to identify salient areas of belonging and identity pertinent to becoming a well-connected educator. Implications include supporting periphery educators in professional learning to increase their network connections.

Keywords: Science Educators, Identity, Community of Practice

1 Goals

This study aims to construct a deep understanding of the qualities well-connected science educators possess within the same school district. Within this study, a well-connected educator is defined as an actor (individual) in a Social Network Analysis (SNA) model with the highest degree of centrality. The school district serves as the Community of Practice (CoP) the science educator participates [1]. Wenger [2], describes members of a CoP creating belonging in three levels: engagement, imagination, and alignment. Furthermore, he describes dimensions of identity through connectedness, expansiveness, and effectiveness within the CoP [2]. Using CoPs as a theoretical framework [1], the research questions that guide this study are: What modes of belonging, if any, are evident in well-connected science educators within the same district? What identity qualities, if any, are evident in well-connected science educators within the same district? How are the relationships and connections of well-connected science educators within the same district similar or different?

2 Background

CoPs are found in classrooms, sports teams, and business groups [1]. These groups negotiate mutual engagement, joint enterprise, and shared repertoire to facilitate forward learning and profound understanding as a group [1]. Among these groups, SNA can show the network of relationships between CoP participants and identifies well-connected individuals [3]. In science education, the networks of district-wide science educators have yet to be determined. The author is currently collecting data to create SNA models of science educators within several districts in the United States.

The central participants of one CoP may be peripheral participants of another [1]. This study focuses on how a well-connected educator's identity, as defined by Wenger [2], is captured in context of their space in the district-wide network. These aspects will create a unique conceptual framework and allow the gathering of thick ethnographic descriptions from participants.

3 Methodology

In this study, the CoP is represented by an actor's school district: two to four participants from each district will be asked to participate. The study will identify participants from an SNA model that show a high centrality and low betweenness centrality. Two factors investigated in the SNA survey (seeking out advice and support to succeed) support better understanding of the modes of belonging and dimensions of identity the participants possess within their district/CoP. Participants who demonstrate a high centrality and low betweenness centrality via the SNA survey will be invited to participate in individual 60-90 minute semi-structured interviews. Interviews will be transcribed using both web-based and manual transcription.

This study will use a quantitative ethnographic (QE) approach [4] to understand each participant's modes of belonging and identity qualities [2]. QE uses the emic data collected to create etic codes that describe critical factors of being a well-connected educator within the culture, in this case, a school district. The data will be arranged by turns of talk using guidelines for well-formed data within an Excel spreadsheet [4]. Data analysis begins with reading transcripts to check for clarity, again to identify inductive codes [5], and finally to explore relationships and to revise between deductive and inductive codes [6] based on the theoretical framework [1, 2] until theoretical saturation is reached. Each turn of the talk will be independently coded by two researchers, who will meet for social moderation to reach an agreement [4].

Epistemic Network Analysis (ENA) web tool [7] will be used to visualize the binary-coded data and connections between codes. In ENA, researchers can see a visual representation of connections between the Discourse in the data [4]. For this ENA, there will not be a moving stanza window, as the turns of talk may relate to each other, and creating a stanza window would cut off that connection [8]. Comparative network models may be used to statistically compare participants to discern how qualities may change based on the demographics of each district.

4 Expected Findings & Contribution

Results from this study will be reported as both qualitative and quantitative findings. The qualitative findings will reflect deductive codes grounded in the data and inductive codes drawn from the conceptual framework [5]. Quantitative results are presented in ENA models. Through quantifying the qualitative codes, connections between codes will show qualities in identity and belonging in a CoP of well-connected members [2].

Using QE and ENA will open a new line of methodology in science education that remains untapped. Furthermore, uncovering most central science educators within

a district and their interpretation of identity and belonging within a CoP has yet to be studied. Findings can influence how district leadership distributes policy, professional learning, standards implementation, and teacher leader initiatives.

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Modeling expertise as a continuum through epistemic network analysis of multichannel data.

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Abstract. In my thesis, I am investigating expert-novice differences as well as expertise acquisition in basic electrical circuits in the domain of electrical engineering. Specifically, I am looking into (1) establishing the continuum nature of expertise by sampling subjects of different levels of expertise. And (2) creating a generalizable process model of expertise, as opposed to a purely learning outcome model. To achieve these two goals ENA will be a very useful tool to understand the connections between cognitive, affective and metacognitive processes that expertise acquisition is expected to modulate. I will use eye-tracking data along with think-aloud data to track the changes in such processes. By collating eye-tracking data, which provides valuable insights into visual attention and cognitive load, along with think-aloud data, which captures participants' verbalized thoughts, a more nuanced and comprehensive analysis can be conducted within the ENA framework. However, the collation of these two different data types to create a single ENA is not straightforward due to the complication arising out of the mixing of multimodal data. Therefore, an additional focus of my thesis is to further the methodological base of ENA to include analysis of multichannel data. The outcomes of this thesis are expected to significantly contribute to the fields of educational research and instructional design by providing a comprehensive understanding of the differences between experts and novices in electrical engineering.

Keywords: Expert-Novice Continuum, Epistemic network analysis, Multimodal data, Eye-tracking data, Think-aloud data

1 Background and Goals of the research

Through the analysis of multiple domains in expert and novice studies, it has been observed that these studies commonly regarded experts and novices as binary categories, focusing only on differences between them. However, expertise development is more suitably represented as a continuum. Hence, one of the goals of this thesis is to model the expert-novice relation as a continuum. To effectively demonstrate this continuum, epistemic network analysis (ENA) can serve as a valuable tool as it can help track the trajectory of groups (in this case novices becoming experts) as they evolve over time [1]. ENA has thus far been primarily applied to learning sciences data, such as online discussions [2], interviews [3], and learners' interactions [4]. However, emerging data

sources such as online log data, eye tracking [5], and think-aloud protocols have gathered significant attention in recent times. Despite the diverse range of data sources employed, ENA has traditionally been generated using a single data type. In order to extract more profound and meaningful insights from ENA, it is vital to incorporate diverse types of data. Therefore, the second objective of this research is to establish a methodology for integrating multiple modalities of data.

2 Methodology

My research will involve the participation of a group of experts, comprising college teachers with significant experience in the field, as well as novices represented by second-year students enrolled in the electrical engineering program. Data collection for this study will be conducted utilizing an eye-tracking system in conjunction with the implementation of the think-aloud protocol. For eye tracking data, we will employ a high-frequency eye tracker (>60Hz). Verbal data can be gathered through one of three methods, namely, concurrent think-aloud, retrospective think-aloud, or stimulated retrospective think-aloud. Subsequently, the collected data will be subjected to analysis using Epistemic Network Analysis (ENA). Two distinct types of data will be acquired: eye-tracking data and verbal think-aloud data. To seamlessly integrate data from these distinct sources, we will strategically employ either time or context as stanzas for the ENA, depending on the type of think-aloud employed, such as concurrent, retrospective, or stimulated retrospective. Fig. 2 depicts the ENA generated through the integration of eye tracking and verbal think-aloud data from a previous study for a circuit.

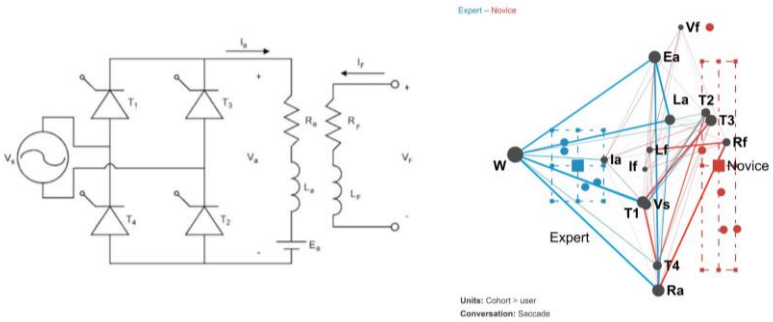

Fig. 1. Electrical circuit (left) and corresponding ENA (right)

3 Expectations from the thesis

My current state of the thesis indicates substantial confirmation of previously identified differences between experts and novices. Experts employed the working forward method, exhibited a better profound conceptual understanding of the domain, and utilized various heuristics to solve problems. Novices demonstrated a means-ends approach toward problem-solving, possessed limited and fragmented domain knowledge

and employed a limited range of problem-solving methods. We would conduct similar studies in the future to better understand the progression of novices toward expertise with multimodal data. As expertise is most likely to be a continuum, we envisage a better characterization of this continuum with multimodal data than unimodal data. ENA will help us to track the nuanced changes on several fronts, like cognitive, affective and metacognitive and change incrementally as a person moves from the novice end to the expertise end. This goal will in turn contribute to the methodological base of ENA as we would like to create networks with multiple data.

4 Expected Contribution of Thesis

Benchmarking of expertise is critical for assessing performance, setting goals, and promoting continuous learning. It also helps to analyze the gap between expert and novice levels, allowing for the introduction of additional courses to enhance skills. After establishing the benchmark, it becomes possible to examine the progress of students in local colleges with respect to the defined processes. One of my thesis contributions will be to propose benchmarking of expertise with the large volume of data (Yellow Square in Fig. 3). Students in college classrooms will be tracked throughout a course, aiming to achieve trajectories as illustrated in Fig. 3, where the red squares represent the mean values of the ENAs created with data over the length of a course, college year or a suitable time unit. The yellow square represents the mean of expert ENAs. The novices are expected to 'walk toward' the experts if true expertise is being acquired. Such insights will inform strategies to narrow the gap in expertise between the two groups.

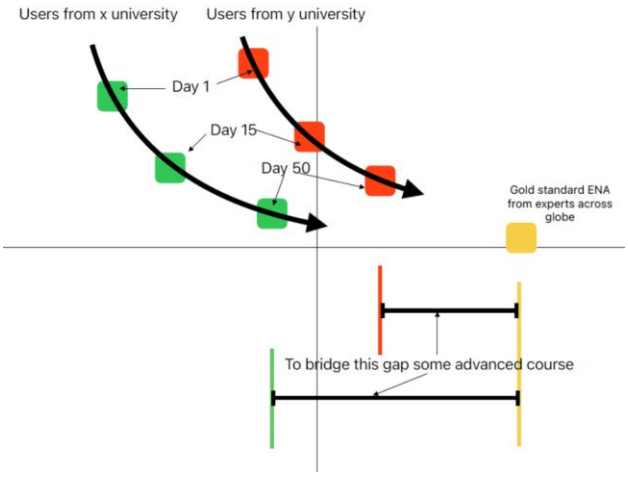

Fig. 2. Expert data will be collected through eye tracking and think-aloud data and a continuum of Students.

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Examining the Role of Cultural Capital in Access and Equity for Female Computer Science Learners of Color

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Abstract. This study aims to explore the impact of cultural capital (derived from Bourdieu & Passerson, [1]) upon the equity and access of female learners in computer science (CS) education and related fields. Cultural capital is examined under the following tenets of Yosso's [2] Community Cultural Wealth (CCW) model: aspirational, familial, social, navigational, resistant, and linguistic capital. This quantitative ethnographic research study aims to explore the impact of cultural capital in the CS learning experience of female learners of color as it relates to perceived access and equity in their field studies. Participants consist of approximately fifteen female-identifying individuals with degrees in computer science and closely related fields such as engineering, mathematics, and physics. Participants will participate in sixty (60) minute interviews via the Zoom video conferencing platform. Interview data will be analyzed utilizing the Epistemic Network Analysis (ENA) system to determine network connections between various tenets of the CCW model.

Keywords: Computer Science, Access, Equity, Cultural Capital, Community Cultural Wealth.

Summary

1.1 Goals of the Research

Study participants' work is connected to fields in the broader technology sector. Representation in the technology workforce, particularly regarding minoritized groups such as female employees of color, is a concern due to a deficit in reflecting the diversity of technology users. With this concern in mind, a goal of the research will be to inform Diversity, Equity, Inclusion, and Belonging (DEIB) practices in education and the technology workforce. Specific to higher education institutions, departments supporting related disciplines such as computer science, engineering, and related degree programs will be highlighted in the study's implications. Additionally, DEIB practices specific to early outreach programs and recruiting employees will be central to the study implications for employers of technology jobs.

1.2 Background of the Project

This study highlights a CS educational pipeline issue in which disparities in the United States K-16 educational system can impact employment equity in the technology. Learners' early exposure to technology and related STEM topics is vital as it can support independence with utilizing technology and have a lasting impact on their mathematics skills [3]. Furthermore, early engagement with CS curriculum encourages students to explore technology career options during their higher education studies [4]. Thus, establishing technological identity is vital to equity and access in CS education and corresponding fields of study.

It may be assumed that in science, technology, engineering, mathematics, and computing (STEM+C) curriculum and educational pathways, female learners of color should assimilate to mainstream culture to develop the skills necessary to advance through their CS education in high school to university level schooling and on through their career. Though emphasizing the cultural capital of these students in CS and connected classroom environments provide an opportunity to promote their unique cultural contributions, which may closely mirror the diverse group of global technology users that they will represent in their work.

The CCW model [2] utilized in this study provides an opportunity to explore various areas of the population's capital to celebrate the rich backgrounds of this group of learners and how they can contribute to our rapidly globalized society. Approaching this opportunity from the lived experiences of women of color can contribute to research in which CS education is examined retrospectively.

1.3 Methodology

This study will utilize Quantitative Ethnography (QE) to produce qualitative research exploring the phenomenon of how female learners of color use community cultural wealth to navigate access and equity throughout their STEM+C learning journeys.

1.4 Preliminary or Expected Findings

It is anticipated that network connections will be identified between the four elements of capital examined in the study: aspirational, navigational, familial, and social. Based on the interviews conducted to date (nine out of fifteen approximated by the end of the study), participants' responses to interview questions have indicated a strong (expected) emphasis on navigational capital as connected to familial and social capital. Additionally, similar patterns in capital (i.e., roles of family and community; challenges in navigation) have been observed among each racial group indicating that network connections between certain areas of capital may vary by racial background.

1.5 Expected Contributions

Contributions of this study are expected to enhance the K-12 educational curriculum and practices associated with early exposure to CS and related disciplines for female learners of color. Likewise, it is intended that the study will support higher education efforts toward exclusionary practices which support the population in related degree programs. It is also anticipated that this body of research will inform the early outreach and employee recruiting departments of technology companies seeking diverse graduates in the fields identified in the study.

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Transforming the Design Landscape: Unveiling the Critical Dimensions of Elementary Teachers' Approaches to Problem Scoping in Engineering Design

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Abstract. This exploratory, design-based research study will use constructivism as a learning theory and critical pedagogy as a theory of social justice, to develop, implement, and evaluate a critical, engineering-focused professional development (PD) program for elementary educators. The overarching goal of this study is to explore the influence of this PD intervention on the formation of teachers' critical consciousness, as evidenced by the ways in which participants conceptualize problem scoping and actively scope engineering problems and potential solutions using engineering practices and dimensions of care. This study will contribute to the literature by adopting a critical approach to engineering-focused professional development that explicitly addresses issues of power and inequality, harm, and ecological stability in engineering design through ill-structured problems grounded in socio-historical and socio-political contexts. Data will be collected through: (1) semi-structured interviews; (2) concurrent think aloud protocols; (3) video observations; (4) field notes and researcher memos; and (5) teacher-generated artifacts. Data will be analyzed using epistemic network analysis and findings will be articulated through a combination of visual models and thick, rich descriptions.

Keywords: Engineering, Professional Development, Critical Consciousness, Dimensions of Care.

1 Introduction

Although the formation and adoption of the *Framework for K-12 Science Education* [1] and *Next Generation Science Standards* [2] has increased the visibility of engineering education in K-12 spaces, the professional development (PD) field has not kept pace. To address this gap, educational institutions, such as school districts and universities, have designed, implemented, and assessed various forms of engineering-focused PD for elementary educators. These studies have demonstrated that engineering-focused PD can positively impact elementary teachers' confidence for teaching engineering [3,4], skills in and attitudes toward design thinking [5], engineering pedagogical content knowledge [6], understanding of the work of engineers [7,8], and the ability to recognize and understand engineering in the world around them [9].

Despite these achievements in the field, existing PD programs, as well as mainstream engineering curricula, standards, and frameworks, fail to detach from the hegemonic view of engineering and its neoliberal and technocratic roots [10]. This is problematic as engineers create systematic and material designs that have lasting

impact on both people and the planet. To work towards a more equitable, responsible, and sustainable future, PD programs must approach engineering as a profession that has liberatory potential.

Grounded in social constructivism [11] and critical pedagogy [12], this study employs design-based research [13], an often-unused methodology in engineering-focused PD research, and quantitative ethnographic methods [14] to enact and evaluate a critical, engineering-focused PD intervention. The overarching goal of this study is to explore the influence of the PD intervention on the formation of teachers' critical consciousness, as evidenced by the ways in which they conceptualize problem scoping and actively scope engineering problems and potential solutions using various dimensions of care.

2 Methodology

2.1 Intervention and Participants

The critical, engineering-focused professional PD serves as the intervention in this study. The 16-hour PD program adheres to a blended, flipped classroom approach and includes three main participation structures inspired by Rodriguez's sociotransformative constructivism framework [15]: (1) dialogic conversation, (2) authentic activity, and (3) reflection and reflexivity. The participants in this PD program include six elementary teachers from a Montessori school in the Northeastern United States. All six participants are White females who range in age from Generation Z (born mid-1990 to 2010) to Baby Boomers (born 1946-1964). Each holds a bachelor's degree and has completed or is in the process of completing an American Montessori Society teacher education program at the ELI, ELII, and/or Adolescent level.

2.2 Data Collection and Analysis

For this study, the following data will be collected: (1) semi-structured interviews; (2) concurrent think aloud protocols; (3) video observations; (4) field notes and researcher memos; and (5) teacher-generated artifacts. Epistemic Network Analysis (ENA), a technique used to model the "weighted structure of connections in discourse data, or in any kind of stanza-based interaction data" [16], will be used to answer the following research questions:

1. *How does participation in a critical, engineering-focused professional development program influence elementary teachers' conceptualization of the problem scoping phase of the engineering design process?*
2. *How does participation in a critical, engineering-focused professional development program influence elementary teachers' application of engineering practices and dimensions of care throughout the problem scoping phase of the engineering design process?*

In this study, ENA will be used to compare the composition and strength of connections [14] teachers make between engineering practices and various dimensions of care before, during, and after their engagement in the PD program. All of the collected data will be coded deductively in Nvivo using sixteen codes derived from the NGSS's

Science and Engineering practices [2] and Gunckel and Tolbert's dimensions of care [10]. In addition to the deductive codes, the researcher will remain open to additional inductive codes.

Once the data has been coded, ENA will be applied using the ENA 1.7.0 web tool [17]. The ENA web tool, under the direction of the researcher, will create a series of models illustrating elementary teachers' individual conceptualizations of problem scoping and their problem scoping practices before, during, and after participating in the PD program [18]. In addition to a visual comparison of the models produced, Mann-Whitney U Tests will be used to determine whether a statistically significant difference exists between each teacher's conceptualization of and approach to problem scoping over the course of the PD program. Along with an individual analysis of each teachers' problem scoping practices, ENA will be used to analyze teachers' collaborative problem scoping practices over time.

3 Expected Findings and Contributions

Previous studies in the area of engineering-focused PD have found success in their efforts to positively influence elementary teachers understanding of the engineering design process, engineering, and the work of engineers, as well as teachers' abilities to develop and implement integrated engineering lessons in their classrooms [3, 4, 5, 6, 7, 8, 9]. The PD intervention described in this study will utilize many effective participation structures from the existing literature such as explicit instruction, engineering design challenges, opportunities for collaboration, and models of problem scoping tools, in addition to less commonly explored strategies such as dialogic conversation and reflection. Based on the success of previous programs, I expect teachers' conceptualizations of problem scoping and problem scoping practices to expand and strengthen as the PD intervention progresses. What is less predictable, however, is how teachers' critical consciousness will develop as a result of their engagement. I expect that teachers' critical consciousness will develop to some degree, as evidenced by an increase in the number of dimensions they consider (i.e. political, social, environmental, etc.) and a shift in their engineering practices.

This study expects to contribute to the literature by addressing three primary gaps in the design, implementation, and evaluation of engineering focused PD for elementary educators. First, unlike existing PD programs, this PD intervention utilizes critical pedagogy to challenge hegemonic views of engineering and develop teachers' critical consciousness. Second, this engineering-focused PD intervention focuses on just one phase of the engineering design process, contrasting existing programs that address engineering broadly. Finally, this study utilizes DBR, in combination with QE and ENA, which to the best of my knowledge, is an approach that has not yet been used to investigate engineering-focused PD interventions at any level.

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Envisioning Latinx Narratives in Philadelphia: Exploring Immigrant Perspectives Using Epistemic Networks by Geospatial Location

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Abstract. The focus of this research is the forthcoming demographic evolution in the United States, whereby by the year 2050, Latinx immigrants are estimated to constitute approximately 29% of the country's overall population. This study pays particular attention to the socioeconomic influence of this demographic on the city of Philadelphia. Using a combination of ethnographic semi-structured interviews, this research engages Latinx participants who are either entrepreneurs or employees within the food and factory sectors to ascertain their self-perception of their contributions to this urban community. A confluence of geographic information system (GIS) mapping and other spatial analytical tools, supplemented by epistemic network analysis, is employed to visually encapsulate the nuanced interactions and experiences of these immigrants, exceeding the confines of conventional mapping methodologies. The primary objective of this investigation is to illuminate the multifaceted ways in which Latinx immigrants, predominantly from Mexico and Northern Central America, contribute to the dynamism of Philadelphia through their spatial, network, social, and economic involvements. The cardinal query the study aims to address is: In what ways do Latinx immigrants articulate their roles in enhancing the vitality of Philadelphia as a receiving community?

Keywords: Immigration, Urban Planning, Transnationalism, Epistemic Network Analysis, Geographic Information Systems

1 Goals of the Research

By 2050, the Latinx population will reach 128 million, or 29 percent of the U.S. population, with “new immigrants and their descendants” accounting for seventy-four percent of the projected growth, which will eclipse the White population and Mexican immigrants, along with Northern Central American immigrants, are the largest immigrant group in the 21st century to inhabit Philadelphia. The impacts of these demographic changes can be understood through an examination of the physical presence and the economic development Latinx immigrants generate in Philadelphia. In urban planning, a map can display the geographical positions of participants within a city, but it falls short of expressing the significant links and relationships that are crucial in

representing the real-life experiences of immigrants. To address this need, this project consists of ethnographic semi-structured interviews with Latinx immigrants who work as entrepreneurs, in the food industry, or factory workers. By combining ethnographic interviews with epistemic network analysis (ENA), a geographic information system, and other spatial analyses, this study explores the network, spatial, social, and economic impacts of Latinx-driven economic development and population growth in Philadelphia. In summary, this project seeks to answer the following research question: How do Latinx immigrants describe their actions and impacts on the vitality of Philadelphia, PA, as a receiving community?

2 Methodology

The participants in the dataset are Latinx immigrants or individuals who have a close connection to the Philadelphia small business community and have self-selected whether they were interested in being interviewed with the intervention consisting of semi-structured interviews held for approximately one hour. Inductive codes were defined and connected to existing theoretical concepts in relevant disciplines, such as urban planning literature, to create the overarching theoretical framework for understanding the richness of Latinx immigrant discussions in the context of the study

3 Preliminary Findings

Connecting ENA to the city and regional planning topics of immigration, transnationalism, and entrepreneurship has been invaluable in visualizing cultural nuances that are understood but are not spatially visible. While a map may illustrate participants' physical locations in a city, a map is limited in communicating connections, which prove impactful when documenting immigrants' lived experiences. Additionally, ENA was used to communicate data collected in Spanish, effectively broadening public awareness about Latinx immigrant issues and increasing visibility for the growing Latinx population in Philadelphia and across the U.S.

4 Expected Contributions

In conclusion, ENA demonstrates how immigrants, such as Mexican and Honduran newcomers, have disproportionately affected Philadelphia by fostering an emerging and thriving entrepreneurial community and supporting the arrival of new immigrants to the area. Acknowledging that immigrants possess a high level of motivation and desire to succeed can help reframe the negative narratives about immigrants and create a supportive community for all to thrive despite their economic limitations. Thus, an urban planning recommendation is to intentionally foster an inclusive and welcoming small-business community that increases access to capital and develops a mechanism for easily facilitating the sharing of information across all industries.

Sense of Belonging: A Quantitative Ethnographic Study of African Diaspora Women in Undergraduate General Chemistry

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Abstract. This research will explore sense of belonging of African Diaspora undergraduate women in general chemistry courses. Epistemic Network Analysis (ENA) will examine the connections between factors that influence sense of belonging. This work can be used to develop a framework for improving sense of belonging for women of the African Diaspora in undergraduate general chemistry studies which may have implications in science, technology, engineering and mathematics (STEM) career trajectories.
Keywords: STEM, African Diaspora, Women, General Chemistry

1 Research Goals

This study examines sense of belonging of African Diaspora undergraduate women enrolled in general chemistry at a public university in California, USA. Primary research questions are:

1. What is the relationship between sense of belonging and related factors for African Diaspora women while enrolled in undergraduate general chemistry courses?
2. How does sense of belonging in the course influence their sense of belonging in the field to pursue careers in science, technology, engineering and mathematics (STEM)?

2 Background

General chemistry is often a college course used to "weed-out" students from large majors that prepare students for careers in STEM, the medical and veterinary fields. The "weed-out effect" has been reported to impact the sense of belonging for underrepresented minority (URM) students in STEM majors [1]. Recent studies present sense of belonging in general chemistry courses as a predictor of performance and attrition for first year undergraduates [2]. In the United States, at a national level there has been a clear directive to create a more diverse, equitable and inclusive STEM workforce [3]. The study draws upon the Expectancy-Value Theory where self-efficacy

beliefs and task value have impacts on motivation and sense of belonging [4]. Aspects of identity like race and gender have been found to impact sense of belonging and influence student decisions to choose STEM majors [5].

3 Methodology

This study will focus on the experiences of women undergraduate students of the African Diaspora, who identify as Black, African-American, Afro-Caribbean, or from the continent of Africa. The participants will be enrolled in general chemistry as a degree requirement. Students will participate in pre and post semi-structured interviews. In addition, they will submit video journal entries at five time points during the course. This will allow for a trajectory analysis to examine how sense of belonging changes during the general chemistry course. Participant narratives will be paired with metadata that will include student age, geographic origin, self-described race demographic, highest degree attained by parent(s), college major, end of course grade, chemistry preparation and career objective. Epistemic Network Analysis (ENA) will be used to model the connections between major themes in the data or codes, particularly by examining the co-occurrences of codes within conversations [6].

4 Expected Findings and Contributions

Possible findings will highlight the connections between belonging and related factors such as, academic performance, socio-emotional responses and professor/peer interactions as well as their evolution over time. The findings of this study can be used to inform how universities and other organizations support women of the African Diaspora as they pursue both STEM majors and careers.

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Research Agenda Development

Online Social Annotation: Breaking Down Barriers to Distance Learning for Offshore English as an Additional Language (EAL) Students in a Hybrid Course

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Abstract. The purpose of this research is to investigate how offshore online students and onshore face-to-face students interact in social annotation activities during pre-class learning in a postgraduate hybrid course. The data has been collected. I would like to learn how to model and visualize interactions between student online annotations. I would also like to discuss the optimal methods to code the annotations and configure ENA tools for QE analysis.

Keywords: Educational Technology, Social Annotation, EAL Student, Online Learning, Community of Inquiry (CoI)

1 Area and Domain of Research

This proposed research is in the domain of Learning Sciences and Educational Technology.

2 Background

Educators have increasingly utilized collaborative annotation systems for reading tasks to foster social learning communities [1]. Researchers have found that those systems facilitate co-construction of knowledge and scaffolding of learning during reading and annotation activities [2] [3]. However, few studies have explored how students interact and exchange information in social annotation activities in online courses.

The Community of Inquiry (CoI) framework has been developed to describe critical community inquiry in online courses [4]. It includes three interdependent dimensions of presence: cognitive presence, teaching presence, and social presence [4]. Cognitive presence refers to students' ability to construct meaning through critical discussion and reflection in a community of inquiry [5]. And social presence is related to students' communication and relationships with others in the course [5]. Both are significant for student learning [6]. The researchers plan to use the CoI framework to explore the student interaction in the online social annotation activities.

3 Research Objectives

This study aims to investigate how offshore English as an Additional Language (EAL) students and onshore face-to-face students interacted and engaged in the discussions in the pre-class reading and collaborative annotation activities. The students were all enrolled in a postgraduate taxation law course delivered by the same chief examiner in an Australia university. The research questions are: (1) Do offshore online students and onshore face-to-face students participate and perform differently in the social annotation activities and other assessments? (2) How do the students interact and engage in the discussion during social annotation activities? and (3) How do students construct knowledge in collaborative annotations? With a university ethics approval, data including deidentified student demographic information, annotation logs and assessment results has been collected.

4 Prior Experience and Expectations

I have read some QE resources and attend one workshop. Based on what I have learnt, I feel that QE might be an effective method for analyzing the student annotations to answer the research questions. In the RAD session, I would like to learn how to model and visualize interactions among student online annotations, which are often short and isolated. And I would like to discuss how to best code the annotations to organize data and configure ENA tools for QE analysis.

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The Role of Neighbourhood In-between Spaces in Combating Social Isolation among Older Adults in Asian High-density Urban Context

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Abstract. This research investigates the role of built-environment design in mitigating social isolation and loneliness among older adults in Hong Kong, a high-density sub-tropical city in Asia. The study adopts a qualitative approach and is currently in the conceptualization and design phase. Additionally, a pilot project on the same topic is underway, with data collection scheduled for completion by the conference date. This research aims to utilize quantitative ethnography (QE) techniques to analyze the interplay between environmental and social factors that either promote or hinder social activities among older adults within the neighbourhood.

Keywords: Age-friendly Environment, Social Isolation and Loneliness, Neighbourhood Planning and Design, Urban Studies

1 Area and Domain of Research

With the lens of built-environment design and planning, this proposed research study is in the domain of Urban Studies under the Social and Behavioral Sciences.

2 Background

Older adults' social isolation and loneliness are widely observed around the world. Numerous studies have demonstrated the significant impact of built-environment features on social interaction (Gehl, 2011; Jacobs, 2016). Shared spaces that offer diversity can support various types and levels of social connections (Yarker, 2019), while factors like walkability, access to green spaces, transportation alternatives, and mixed-use design have been found to reduce older adults' loneliness (Lyu & Forsyth, 2022). However, most of these studies have been conducted in low-density western contexts, and it is crucial to explore the empirical links in the high-density Asian context, considering the influence of culture and perceived density on social interaction (Lawson, 2009).

In Hong Kong, dwelling units often suffer from limited space and congestion. In-between spaces within neighbourhood, such as lobbies, circulation areas, and platforms, have been designed or utilized as venues for residents' activities, allowing the spillover

of domestic life. According to the Theory of Affordance (Gibson, 1977), the perception of the environment can drive actions, and these links vary among different individuals. Therefore, apart from the environmental features on the planning level, such as accessibility and land-use mix, spatial features on the design level that can be perceived by people hold potential to either hinder or encourage social interactions among older adults.

3 Research Objectives

This research investigates the relationship between the environment, social interaction, and social isolation among elderly residents in high-density neighborhoods in Hong Kong. The objective is to provide insights for urban planning, design, and management to promote healthy aging-in-place and social inclusion. The central research question is: What environmental features (both perceived and structural) can mitigate social isolation among the elderly by fostering social interaction? Data collection methods include on-site behavior mapping, interviews, and diary studies. A pilot study has been conducted, with data collection scheduled for completion by September 2023.

4 Prior Experience and Expectations

My introduction to the QE technique began with a workshop, which left a lasting impression so I read the book 'Quantitative Ethnography' (Chinese version). I believe that this technique has the potential to enhance my data analysis. Particularly, I am intrigued by the quantitative interpretation of qualitative data using the 'data structuration' approach within QE. As there is limited research in my field utilizing QE, I anticipate that my project will bring innovation and contribute to the existing knowledge.

Currently, I have developed a preliminary coding framework for analyzing my interview data, but I recognize the need for improvement. I aspire to gain further insights on organizing and visualizing data, enabling me to explore and present the intricate relationships that emerge in my research.

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The Use of Quantitative Ethnography to Facilitate Cultural Integration in Global Organizations

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Abstract. This research aims to explore cultural integration in global organizations and the development of a framework to enable integration within culturally diverse teams. This study is in the conceptualization and design phase and no data has been collected. I would like to explore the use of QE techniques to analyze the complex factors that contribute to cultural integration in the global work environment.

Keywords: Quantitative Ethnography, Cultural Integration, Global Organizations

1 Area and Domain of Research

The proposed research study is in the domain of Social and Behavioral Science.

2 Background

Poor cross-cultural interactions often result in an inability to collaborate successfully across boundaries and borders. This frequently results in inconsistent global business results and poor financial performance. The significance of this problem is confirmed by the Economist Intelligence Unit (2016), indicating that 90% of executives from 68 countries report poor cross-cultural interactions to be a top issue in global operations. In addition, according to a survey conducted for *Trends in Global Virtual Teams* (Soloman, 2016), with respondents from 80 countries, 68% reported that cultural challenges are the biggest hurdle to global team productivity. These statistics indicate there is a substantial, ongoing challenge working across cultures which frequently results in profoundly suboptimal outcomes for the individual, the team, and the company. Empirical evidence suggests the need to better understand why the global workforce is failing to generate sustainable results and what may be done to improve the ability to successfully work in the global business environment. This study proposes to use quantitative ethnography to leverage monologic, semi-structured interviews with global leaders in corporations to both qualify and quantify the need for cultural integration to improve business outcomes on a global basis. It will specifically seek to leverage epistemic network analysis (ENA) to explore the critical components of an emerging framework to facilitate cultural integration in global organizations.

3 Objectives

The aim of the proposed research is to better understand the drivers behind the ongoing cultural challenges in global organizations, using epistemic network analysis to gauge the strength of relationship between critical concepts (data points) to facilitate the development of a multidisciplinary framework to enable cultural integration within and across global organizations. The proposed population for this study will be leaders in global organizations that engage across multiple cultures simultaneously to drive global team effectiveness. Potential research questions include: (1) To what extent do multicultural challenges inhibit the achievement of desired business outcomes? (2) How is *cultural readiness* defined and understood in global organizations? (3) What are the critical components of a cultural integration framework?

This research is in support of an application for the NSF Grant, Science of Organization (SoO). NSF funds this type of research because organizations are critical to the well-being of nations and their citizens globally. This research fits the profile of the SoO grant because it uses quantitative ethnography to develop and refine theories contributing to cultural integration, as well as to develop new measures and methods in the development of a cultural integration framework to improve conditions in global organizations. The goal is aimed at yielding new insights and information that is of value to organizations and research communities. This study is a continuation of the research done in a dissertation study exploring the need for cultural integration in global organizations. The research questions reflect the next stage in this research, identifying the core challenges and exploring what may done to begin to solve the ongoing challenge of poor cultural integration on a global basis. For the purpose of this research, data will originate from semi-structured, monologic interviews, which will be used to analyze the ethnographic data, while also being coded for use in epistemic network analysis.

4 Prior Experience and Expectations

I used Quantitative Ethnography as the core methodology for my dissertation. Although I have utilized QE previously, it is important to continue to gain insight and expertise through more experienced researchers. The expectations for participating in the discussion-based sessions are to continue to broaden my knowledge and think deeply about new and innovative ways to leverage QE. Simultaneously, the purpose is also to explore partnership opportunities for grant funding involving QE.

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Analysis of Information Ethics Classes by Using QFT, which Simultaneously Aims at the Goals of Moral Education and Information Literacy

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Abstract. This study aims to develop moral education and information ethics lessons for students, consequently allowing them to think from multiple perspectives. The information ethics class was developed using the Question Formulation Technique and a research lesson was conducted. The text data of the questions formulated and selected in groups by the students was collected, following which it was analyzed using the Epistemic Network Analysis.

Keywords: Question Formulation Technique , Information Ethics, Moral Education, Information Literacy, Educational method.

1 Area and Domain of Research

Educational technology.

2 Background

This study examined whether elementary school students could learn information literacy and moral education using the Question Formulation Technique (QFT).1
The QFT required the students to ask and answer their own questions instead of seeking guidance from a teacher.
This method was utilized as it encourages the following:
1) Student-centered rather than teacher-led learning.
2) Students to think from multiple perspectives about the problems related to internet use.

Moral education, which has 22 content items such as “honesty” and “moderation and temperance,” is a special subject taught in the Japanese elementary and junior high school curriculum. Additionally, the contents of information literacy, including information ethics, are also mandatory.

The data from three questions selected by the students through group discussions was analyzed using Epistemic Network Analysis (ENA) to determine whether the students had effectively used the QFT to learn both information literacy and moral education without any direct teaching.

3 Research Objectives

This study developed an information ethics lesson for a moral education course that could simultaneously achieve the elementary and junior high school moral education and information ethics goals.
The text data on the questions that the students had formulated and selected in groups was analyzed and categorized using the moral education content items and the information literacy goals.

4 Prior Experience and Expectations

The first author learned about the Quantitative Ethnography (QE) for the first time when they took part in the LS Japan Seminar 2023-02 held in Osaka, Japan, on May 28, 2023. The text data on the questions formulated and selected in groups by the students in a research class was collected; however, this data is yet to be analyzed2. Advice can be expected from QE scholars on the data analysis process by participating in discussion-based sessions.

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Improving Inclusive Classroom Practices through Virtual Reality Immersion for Pre-Service Teachers

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Abstract. Providing in-situ experiences for pre-service teachers on how to support, teach and engage diverse learners has traditionally been challenging and ethically fraught. In this study, the use of Virtual Reality seeks to bring these learning experiences to pre-service teachers through a sensitive, growth-focused approach. Using VR technology, pre-service teachers will learn in a shared environment, by viewing pre-recorded 360-degree videos of classrooms in action. Over a semester of a graduate teaching course, pre-service teachers will experience virtual classrooms and will be led to explore inclusive classroom practices through virtual reality headsets and synchronous software.

Keywords: pre-service teachers, virtual reality, professional experience, inclusive education, initial teacher education,

1 Area and Domain of Research

- Educational Technology for teacher training
- Initial Teacher Education & professional experience
- Virtual Reality in Education

2 Background

In 2020, the UNESCO Global Education Monitoring [1] report noted that there continue to be marked inequities for learners in classrooms around the world and across Australia. Indeed, 25% of teachers in 48 countries identified a need for professional learning to support diverse learning needs [1]. In Australia, there continues to be a lack of understanding of what is meant by 'inclusive education' despite definitions emerging from numerous states, territories, and regulatory bodies [2].

Numerous themes were identified in UNESCO's ongoing global monitoring [1], one of which is of major concern to initial teacher education: Teachers continue to believe that inclusive classroom practices are neither possible nor desirable. This acknowledged deficit in teacher skills informs the current study, which focuses on learners with intellectual disabilities in mainstream schools taught by non-specialised teachers [3].

In Australia, teachers have identified that inclusive classroom practices are beyond their abilities; Instead, initial teacher education is charged with addressing this deficit at the beginning of a teacher's career [4]. By using virtual spaces to develop these skills, we can provide in-the-moment experiences of inclusive classroom practices to demonstrate both the reality and feasibility of creating and maintaining a diverse and inclusive classroom. VR also offers the ability to share videos of 'classrooms in action', and enable pre-service teachers to pause, reflect, question and review what they are seeing. Pre-service teachers need more opportunities to observe inclusive teaching and learning in a way that enables point-of-need interactions with educational experts. Spending time in the classroom, however, is a highly valued commodity for pre-service teachers, yet increasingly difficult to organise [5]. Professional experience can also be costly, time-limited, and difficult to control.

Pre-service teachers report vastly different experiences from school placements, and these experiences can be positive or negative depending on the context [6].

From an emergent data analysis perspective, grounded theory is considered appropriate for this study as there is a clear lack of current research in synchronous VR and inclusive classroom practices. Codes, categories and themes will be iteratively identified, refined, searched for and validated, as a key component of the grounded theory process [8]. Through this iterative and reflective process, emergent theories will be challenged and refined at each research stage. However, the study may be redesigned with a QE focus after attending the RAD program.

3 Research Objectives

The purpose of the study is to understand if the use of Virtual Reality, in initial teacher education, has a positive impact on preservice teachers' knowledge and understanding of inclusive teaching practices. The research question to be addressed is: *How might synchronous VR experiences enable pre-service teachers to identify, evaluate and plan for inclusive classroom practices?*

This research employs a mixed-method design and will engage Masters students from the Master of Teaching program in their second and final year of study. Three VR experiences will be run for each of two core units in a Master of Teaching program. With 6 tutorial groups across the core units, totalling 36 VR classes. Data will be generated from observational notes, student journal reflections, focus groups and online surveys. This study is currently underway with some data already collected.

4 Prior Experience and Expectations

This is my first independent study using QE. I have, however, worked with Professor Mike Phillips on his research projects and in 2023 I attended an ENA workshop. I am seeking support to learn about designing a study to leverage QE, particularly ENA. I hope to gain connections with my peers and expertise for future research.

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The Relationship Between Mindfulness Practices and Effective Global Leadership

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Abstract. This research aims to explore how mindfulness practices contribute to effective leadership in an international setting. As this study is in the conceptualization and design phases, there is presently no data collected. QE techniques shall be used to analyze the factors of mindfulness that lend to more effective leadership practices.

Keywords: Mindfulness, Global Leadership, Quantitative Ethnography.

1 Area and Domain of Research

This proposed research study is in the domain of Mindfulness Practices and Global Leadership.

2 Background

Mindfulness practices have gained recognition for their positive effects on well-being and performance [1]. The application of mindfulness in the realm of leadership has garnered interest, particularly in the context of global leadership. Global leaders face complex challenges that necessitate effective navigation of diverse cultures and contexts [2]. Mindfulness practices, with their focus on self-awareness, emotional regulation, and cognitive flexibility, offer potential benefits for enhancing leadership effectiveness in the global arena [3]. However, further research is needed to understand the specific application and impact of mindfulness in global leadership contexts.

3 Objectives

The objective of this research is to examine how the implementation of mindfulness practices contributes to the effectiveness of global leaders in an international setting. The study will explore the impact of mindfulness on leadership behaviors, decision-making processes, and overall leadership effectiveness. Data collection will include observations, interviews, and surveys to gather insights from global leaders who have incorporated mindfulness practices into their leadership approach in crisis situations. Research questions will consider the influence of mindfulness techniques on global leadership. The collected data will be coded, categorized, and analyzed for themes through QE methods and connections visualized through ENA software [4].

4 Prior Experience and Expectations

I have limited experience in using Quantitative Ethnography in a research setting, although I have had exposure to epistemicnetwork.org, which is a platform that facilitates the visualization and modeling of connections between complex factors in research through an ENA program. I have briefly experimented with the software to create visual representations of relationships and networks among variables, concepts, or themes within a dataset about female leadership. Furthermore, I have had some experience in working with the OSF online platform, which is designed to support open and collaborative research. As OSF provides features for project management, data storage, and sharing, I may utilize this platform to promote transparency and facilitate the sharing of research materials and findings, enabling collaboration and reproducibility in my research. I am interested in learning more about how QE tools can be applied to studying mindfulness practices as used by global leaders in crisis situations as they relate to enhanced leadership effectiveness, particularly with regard to modeling the connections using ENA software.

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A Case Study of Teaching Assistants' Support Methods in Group Discussions in an Active Learning Class

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Abstract. This research aims to explore how Teaching Assistants(TAs) support students during group discussions in an active learning class. The results showed that beginner's TAs emphasized for the students finished tasks of group discussions in time and decided whether to intervene or not. On the other hand, experienced TAs recognized "flow of the class" and "role of the TA", and decided whether to intervene or not. The results can be used as a reference when designing training programs for TAs on how to support in group discussions and when teachers utilize TAs in active learning classes.

Keywords: Higher Education, Teaching Assistant, Active Learning, Group Discussion.

1 Area and Domain of Research

This proposed research study is in the domain of Higher Education.

2 Background

Teaching Assistants(TAs) play a role in supporting active learning classes in Japanese universities. The role of TAs include teaching, participating in discussions, and providing support outside of classes [1].

The TAs in active classes are expected to have the ability to respond flexibly to the needs of both students and teachers. Students demand "skills to provide appropriate support according to the situation" [2], and teachers demand abilities and experiences unique to students that teachers cannot provide, such as "empathizing and thinking together with students" and "acting as a bridge between instructors and students [3].

However, there is a lack of accumulated practical research on how to train TAs and how teachers utilize TAs in active learning classes [4]. It is necessary to clarify how TAs support students in order to consider how to train TAs.

3 Objectives

The aim of this proposed research is to explore how TAs support students during group discussions in an Active Learning Class. Potential research questions include:

(1) What do TAs pay attention to and think about while supporting students in group discussions? and (2) How do TAs with experience and inexperienced TAs differ in their support methods?

This study targets TAs on information media education in a university. The class was conducted in a flipped classroom, and students were instructed to watch a preparatory video before the class. In the class, first, the teacher provided feedback on the questions on the review sheet submitted by the students. Next, the teacher talked about knowledge of the class, group discussions were held. The content discussed in the group discussion was compiled into a Google Slide for each group. All groups then gave a one-minute presentation on what they had discussed, and the instructor provided feedback on the presentations. The class ended with a final administrative contact.

Data collection would include observations and interviews from April to July 2023. During observation, TAs wear wearable cameras to collect date. After that, check the movie and interview TAs through play videos and ask TAs what they are thinking at the time.

4 Prior Experience and Expectations

An interview was conducted as preliminary data in May. As a results, experienced TAs have grasped the "flow of the class," considered the "role of the TA," and made a "decision of intervention or not". On the other hand, the inexperienced TAs have checked the students to finish discussions in time and "check the progress" by looking at "how the students are talking" and "tools for organizing group discussions" before "deciding whether to intervene or not. These results allow us to determine what information TAs need when supporting in group discussions such as "the flow of the class", "the role of the TAs" and "tools for organizing group discussions".

Based on the above results, we plan to use ENA to clarify the process of decision to intervene of TAs. In additions, we plan to refer to the literature of teacher noticing [5]. The results can be used as a reference when designing training programs for TAs on how to support in group discussions and when teachers utilize TAs.

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The Transformation of First-Year Students' Views of Research in Undergraduate Research Focused on the Relationship with Communities of Practice

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Abstract. The purpose of this study is to explore how communities of practice in undergraduate research contribute to the transformation of first-year students' views of research. This study is in the conceptualization and design stages; data have not yet been collected. We would like to explore the use of QE techniques to analyze the complex factors that contribute to the transformation of first-year students' views of research.

Keywords: Higher Education, Undergraduate Research, Views of Research, Communities of Practice.

1 Area and Domain of Research

This proposed research study is in the domain of Learning Sciences and Educational Technology.

2 Background

Undergraduate research (UR) has attracted attention as a high impact educational practice in higher education. Undergraduate research is an investigation or study conducted by undergraduate students that makes an original intellectual or creative contribution to the discipline. For example, U.S. biology programs actively employ course-based undergraduate research, known as Curriculum-based Undergraduate Research Experiences (CUREs). All students in a class participate in a collaborative research project. In the area of education, UR may benefit university students. However, few studies have investigated how UR contributes to first-year students' views of research.

Participation in undergraduate research involves the acquisition of academic research skills in addition to the development of one's own research interests and concerns [1]. First-year students have a naive view of research, as if research is a solitary activity [2], while Faculty members teaching undergraduate research courses have already established their own view of research. As a result, faculty and students' perceptions of research do not match, making it difficult for faculty to involve students in research activities [3]. Therefore, research is needed to explore how teaching assistants, who serve as bridges between faculty and students in undergraduate research, and the

community of practice [4] among faculty, TAs, and students that is constituted there, contribute to the transformation of first-year students' views of research.

3 Objectives

The purpose of this study is to explore how engagement with communities of practice in undergraduate research contributes to the transformation of first-year students' views of research in higher education. The intervention will involve the introduction of trained teaching assistants into first-year seminar classes in interdisciplinary undergraduate courses at a research-based university. The course content will practice simple human science research. Potential research questions include: How do teachers and teaching assistants as members of a community of practice affect the transformation of first-year students' views of research?

Data collection will include speech logs and observations, during group activities. Once the data are obtained, the concepts and themes that emerge from the speech logs and observations will be analyzed with a focus on the interaction between TA/faculty and students. This study is in the conceptualization and design phase; no data has been collected.

4 Prior Experience and Expectations

In a workshop, I've used Quantitative Ethnography (QE) and believe it can enhance my study by analyzing individual speech log contributions. I aim to visualize and model how complex factors transform first-year students' perceptions of research within undergraduate research communities. Based on previous research [1], we categorize codes as: (1) Content, (2) Method, and (3) Epistemology. Data collection hasn't begun as targeted classes start in the fall, but preliminary analysis can be done during a senior college graduate research seminar, the results of which I would like to discuss.

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An Approach to Quantitative Ethnography with SCAT: the Use of Qualitative Data Analysis Method

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Abstract. This study aims to improve transparency by developing a method to visualize the process of code generation in quantitative ethnography (QE). We use the qualitative data analysis method called "SCAT" (Steps for Coding and Theorization) to analyze interview data and generate a codebook from the results. At the conference, we hope to discuss the meaning and role of Codes, as well as how to improve the coding process for capturing culture better.

Keywords: Quantitative Ethnography, Code, Coding Process, Qualitative Research, SCAT

1 Area and Domain of Research

The research areas and domains of this study are related to methodology, particularly quantitate ethnography (QE) and qualitative research.

2 Background

In QE, the manner in which the data is coded is an important factor. Researchers interpret the culture under analysis by demonstrating the relationship between Codes in the Discourse [1]. However, how those Codes were generated is not always clear. Particularly in qualitative research, the researcher's subjectivity is not eliminated, and the researcher himself/herself is the measure for the research. Therefore, "transparency" must be demonstrated by clearly indicating the process of interpretation.

3 Research Objectives

The purpose of this study is to develop a method for visualizing the code generation process. For this purpose, we used the qualitative data analysis method "SCAT" (Steps for Coding and Theorization) to analyze interview data (two interviews, open to the public) of examinees for certification examinations, etc., and generated a code book for Epistemic Network Analysis (ENA) from the results. We attempted to make the process of code generation explicit.

SCAT has an explicit, step-by-step analysis procedure that can be applied to relatively small data sets and is easily accessible to beginners. The first procedure is "four steps coding," where the segmented data are listed on the leftmost side of the SCAT matrix, and the codes are considered and attached based on the following steps. Step 1: Noteworthy words or phrases from the text. Step 2: Words outside of the text that paraphrases Step 1. Step 3: Concepts outside of the text that accounts for Step 2. Step 4: Themes/concepts that emerge from them.

The second procedure is to describe the storyline using the results of Step 4, and to describe the theory based on the storyline [2]. Figure 1 shows part of the SCAT analysis results.

ID	Speaker	Text (English)	<1>Remarkable words and phrases in the text	<2>Words or phrases outside of the text that paraphrase it	<3>Concepts outside of the text that would explain the left	<4>Themes and organizing concepts (considering the context before, after, throughout)
1	INT	Hello! It's nice to meet you, my name is Int.	Hello/ nice to meet you		First Greeting	
2	A	Hello, it's nice to meet you, too.	Hello/ nice to meet you		Reply to Greetings	
3	INT	Thank you for taking the time to see me today. I am greatly appreciated!	Thank you/ greatly appreciated	acknowledgment/ joyful	Positive words/ emotional outbursts	Forming rapport by expressing feelings with positive words
4	A	Thank you very much.	Thank you			
5	INT	Please excuse me. What would you like me to call you?	like me to call you	confirmation of the name	Transfer of the right to decide the name	Interviewee's perception of discretion
6	A	You can call me A.				
7	INT	Mr. A, right? Thank you very much. Have you ever had a user interview like this before?	Mr. A, right?/ have you ever had	confirmation of past experience	Closed questions/ eliciting experience	Eliciting interview experience through closed questions
8	A	No, I have not.				
		(snip)				

Storyline	INT conducted [forming rapport by expressing feelings with positive words] at the beginning of the interview with A, and shared [recognition of interviewee's discretion] such as how to call her by name. Regarding the interview, the interviewer first [elicited the interview experience through closed questions], followed by... (snip)
Theory	・At the beginning of the interview, the interviewer shares [recognition of the interviewee's discretion], such as how to call the interviewee by name, and [forming rapport by expressing feelings with positive words and phrases]. ・In the [informed consent at the beginning of the interview], first [eliciting the interview experience through closed questions], [sharing the purpose of the... (snip)

Fig. 1. Part of the SCAT analysis results

4 Prior Experience and Expectations

Kaneko, the first author, is a qualitative researcher with no prior experience in QE. While discussing QE with the second author, Ohsaki, and analyzing data using ENA, Kaneko considered that the sense of what the "code" refers to may differ between interpreters. Therefore, we will examine not only the meaning and role of Codes in QE, but also the process by which they are generated.

Furthermore, we perceive that the results analyzed by SCAT are not always completely scooped up when analyzed in QE. Our pragmatic goal is to determine the disparity between the results revealed by SCAT results and the QE results. In addition, we would like to discuss how to improve the coding process by visualizing the process and what type of codes "better captures culture."

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Research to verify the effectiveness of LTD's reading comprehension and collaboration skills training

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Abstract. This research aims to develop a new standard for educational methods in Japan, based on educational methodology and educational technology. With the transformation of educational policies in Japan, educational methods and tools are evolving. On the other hand, the reform of the examination system has not yet been realized, leading to the use of education methods with ambiguous evaluations. The purpose of this research is to elucidate the impact on learners of Learning Through Discussion (LTD), a type of active learning. LTD is a method that includes preparation and small group discussions. Prior research and practice have shown that LTD deepens learners' understanding of texts, improves test scores, and enhances the quality of reports. This study quantitatively analyzes these effects and clarifies the impact of LTD on learners.

Keywords: Collaborative Learning, Active Learning, Learning Through Discussion, Learning Analysis

1 Area and Domain of Research

This research is in the area of educational methodology and educational technology.

2 Background

We want to develop a new standard for educational methods in Japan. The Ministry of Education(MEXT) in Japan, advocated "proactive, interactive, and deep learning" in Courses of Study released in 2017. The project began in earnest in 2020. This is based on a reflection on the "cramming education" that had been provided up to that point and the intention to prepare for the information society that is coming in the future. This shift in policy direction has resulted in schools practicing active learning in the classroom and in a new subject called "Time for Integrated Inquiry. And from 2019, the Ministry of Education(MEXT) started the "GIGA School Initiative " to distribute one digital terminal per child and student and to develop a high-speed, large-capacity communication environment. These deployments were completed in March 2023. In other words, Japanese schools have now simultaneously transformed both the concept and the tools of their teaching methods.

However, the practice of "proactive, interactive, and deep learning" has only been transformed at the level of each teacher. This is because one of the exits of education, the university entrance examination system, has not been transformed, and we are still unable to break away from education for examinations. Hence, no learning methods and systems to evaluate the quality of learning outcomes have been developed to replace the examination system. Therefore, teachers are teaching without knowing how to conduct their classes and whether their teaching methods are effective. In this phase when the Internet has been developed, digital terminals have been distributed to all students, and it has become easier to log all kinds of learning, we believe it is important to analyze and evaluate Japanese educational methods qualitatively and quantitatively, and to create a new standard for educational methods.

3 Research Objectives

The purpose of this study is to determine the impact of Learning Through Discussion (LTD), an active learning and cooperative learning program, on learners' collaboration and reading comprehension skills. LTD is one of the strategies for active learning-based teaching developed by William Fawcett Hill of the University of Idaho, USA, in 1962. This method consists of a single set of activities,from the learner's self-preparation of a single text through to small group discussions, the flow of which is described below.

STEP1. understanding the whole text
STEP2. understanding the language
STEP3. understanding the claim
STEP4. understanding the topic
STEP5. making connections with existing knowledge
STEP6. relating to self
STEP7. evaluation of assigned texts
STEP8. rehearsal / meeting evaluation

Through this series of learning processes, we will measure and analyze how learners' (individual and group) reading comprehension and collaboration skills change.

4 Prior Experience and Expectations

The purpose of the LTD is to gain a deeper understanding of the text. Since preparation is a prerequisite, students must necessarily be proactive in their learning. If students do sufficient preparation, they will naturally be eager to discuss the subject matter in class. Discussions will improve both the ability to interact and to understand. As a result, it directly leads to the realization of "proactive, interactive, and deep learning".

For these reasons, Mori and Suzuki have been introducing LTD in both lecture and seminar courses at Fukuoka Women's University since 2016. The effects include improved exam scores, improved quality of reports and graduation theses, improved pass rates for employment examinations (both written and interview), and high evaluation after employment (for example, if the individual becomes a junior or

senior high school teacher, he/she can gain trust from students, parents, fellow teachers, and administrators, and can contribute to society while also enjoying himself/herself). The following are some of the benefits of the program.

Nishida and Nakano have been practicing LTD since 2019 in after-school in high schools, as part of one of the projects of OCES(Organization for Career Education & Support). In addition, we have developed a web service that allows students to save the contents of their LTD preparation in the cloud. By using this service, not only can tutors easily check the contents of the preparation, but also they can verify the effectiveness of the ENA more effectively.

Through this research, we aim to clarify the effectiveness of LTD, to have LTD flourish in classrooms throughout Japan and around the world, and to develop reading comprehension and collaboration skills even further through lessons.

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Drivers and barriers to technology adoption in Uruguayan teachers

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Abstract. Ceibal is Uruguay's digital technology center for innovation at the service of public educational policies. It serves as an essential partner for educational research, innovation, and technology. Ceibal identifies teachers as a key ally to improve students' welfare and learning through technology, as they are the ones who decide to integrate these resources into their daily practices. Through this project, we aim to gain empirical knowledge about teachers' decision-making process of integrating technology into their teaching. Specifically, we want to gain a deeper understanding of barriers or opportunities that drive their behaviors in relation to currently available resources.

Keywords: Teacher decision making, Teacher training, Ed-tech adoption.

1 Area and Domain of Research

Teaching Sciences and Educational Technology, Pedagogical reasoning for technology integration, Quantitative Ethnography.

2 Background

Ceibal is Uruguay's digital technology center for education innovation at the service of public education policies. As a one-to-one digital education program, Ceibal provides each student and teacher with a personal device - laptop or tablet - along with access to robust digital platforms. With its extensive outreach, Ceibal covers 100% of public schools and reaches 87% of the Uruguayan school-aged population.

One of the main challenges for the Uruguayan education system is improving the quality of education throughout the country. Teaching the right learning abilities at scale has been identified as a critical factor in student-centred learning, and technology could help achieve this [1, 2]. Historically, students' usage rate of Ceibal's ed-tech offer depends, primarily, on whether teachers integrate the non-mandatory available resources into their planning or not. Since the last few years, one of the biggest challenges for Ceibal is promoting the adoption of technology in teachers' regular practices. Most of the teachers know and use technology, but only sporadically and/or as a gamified activity for their students.

Through this project, we aim to gain empirical knowledge about why and how teachers decide to integrate technology into their lessons. The results could be key for Ceibal's present and future strategies, allowing for thoughtful and empirically based efforts to redesign programmes and products, as well as design new interventions aiming to overcome the issues that could be preventing technology adoption. We propose the use of Epistemic Network Analysis as an analytical framework, aiming to explore how different dimensions relate and contribute to teacher's decisions to consider technology as part of their toolbox.

3 Research Objectives

The aim of the proposed research is to gain empirical knowledge about Uruguayan teachers' decision-making process of integrating technology into their practices. Our primary research questions are: What shapes the decision of teachers to incorporate technology into their regular teaching? What are the barriers preventing them from doing so? We are particularly interested in understanding to what extent professional training and the user experience with Ceibal's current offer operate as drivers or barriers.

This research project is at an initial stage. We are planning on conducting fieldwork to obtain qualitative raw data suitable for QE analysis, as well as exploring other sources of available data that could be integrated.

4 Prior Experience and Expectations

This project would be our first experience with QE on an institutional and professional level. Over the next few months, we will be experimenting with the methodology using raw data from existing research in order to gain practice and understanding of the tools. Our goal is to be able to develop a project that contributes to understanding how Ceibal's main user of interest interacts with its current offer, which is what we are proposing in this application. We expect the sessions will help us visualise whether the sources of information we are planning to develop are suitable to answer the questions we stated, as well as how to make the most of QE methods to learn from already available sets of information. In addition, we hope to generate potential new lines of research collaboratively.

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Multimodal Rule Explanation in Children

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Abstract. We conducted a study across four French classrooms (CE2, CM1, CM2, and 5e) of different age groups (approximately 8-9, 9-10, 10-11, 12-13 years old respectively). Groups of four play a game where one student is instructor and the other three are players. The instructor explains the rules to the others. We investigate verbal and non-verbal behaviors of rule explanation and intercomprehension checking across age groups, using Transmodal Ordered Network Analysis (T/ONA).

Keywords: T/ONA, Multimodality, Psycholinguistics, Language development

1 Area and Domain of Research

This study is in the domain of learning sciences, linguistics and psycholinguistics.

2 Background

The process of constructing cohesive and coherent discourse varies with a child's age [1]. Many studies explore this by focusing on children's explanation from a multimodal perspective [2]. A recent study [3] reported that: (1) children rely on gestures to construct their message and introduce information, and do more so as they age, and (2) children also better manage interactional constraints during a game explanation task by increasingly checking intercomprehension or by responding more to peers' requests.

Due to interdependency across multimodalities (e.g. dialogue, gaze, and gesture), we will adopt Transmodal Ordered Network Analysis (T/ONA) to represent patterns of connection-making in children's intercomprehension. Thus, we specify a unique window length for each modality (dialogue, gaze, and gesture) based on their temporal influence projecting to future learning events during children's intercomprehension.

3 Research Objectives and Preliminary Exploration

We observed and recorded 114 children during 28 games. We analyzed rule explanation within groups of 4-5 children. The "instructor" of each group explained the rules to other players. During explanations, players engaged with gaze, dialogue, and gestures to show understanding. We asked: R1) What are patterns of intercomprehension during rule explanations across modalities? R2) How do patterns differ across age groups?

We coded intercomprehension behaviors using ELAN software. Each turn of talk or behavior had four parts: 1) whether the action was only dialogue or multimodal (dialogue with gestures); 2) whether the explanation was correct or incorrect; 3) whether the explanation was complete or incomplete; 4) whether the instructor conducted intercomprehension checking with other players verbally or with gaze. To answer R1 and R2, we formed a grand mean T/ONA model using 9 codes based on these four dimensions.

We constructed a grand mean T/ONA model using these codes to answer R1. We observed strong bidirectional connections between correct and complete explanations for both verbal relevance and multimodal relevance. This indicates that to make a correct explanation of game rules with thorough details, children usually engaged with both dialogues and gestures. We constructed T/ONA subplots for different age groups to answer R2. Based on the means rotation to maximize the variance explained by age, T/ONA shows different patterns for the youngest and eldest groups: while young children made more connections within verbally relevant expressions and gestures with details, older children tended to skip the details in their gestures and dialogues. Also, older children did more intercomprehension checks both individually and collectively. Based on this initial work, we discovered patterns of rule explanation using multimodalities across different age groups. Now, we 1) fine-tune Temporal Influence Functionss for different modalities; 2) add phatic gaze behaviors to understand the impact of nonverbal behaviors contributing to intercomprehension among children of different ages.

Acknowledgments

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Educators Support to Advancing Project-Based Learning In High School

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Abstract. The objective of this investigation is to delve into the foundational pillars aiding educators in advancing project-based pedagogy within secondary educational institutions. I aspire to investigate the application of Quantitative Ethnography methodologies to scrutinize instructors' cognitive construals of impediments in the realm of project-based erudition.

Keywords: Educational Technology, Project-Based Learning.

1 Area and Domain of Research

This proposed research study is in the domain of Learning Sciences and Educational Technology. Deals with project-based learning in high school.

2 Background

Within the domain of educational sciences, project-based learning is perceived to facilitate efficacious cognition. Its pedagogical milieu embodies six characteristics: driving questions, focus on learning goals, engaging in scientific practices, collaborations, using technology tools to support learning, and creation of artifacts. In practical pedagogical contexts, however, a dissonance arises. Instead of nurturing heightened engagement and cultivating profound comprehension of pivotal concepts, students are often imparted superficial knowledge (Joseph, Namsoo 2014).

In the Japanese educational landscape, specifically under the aegis of the revised 2022 curriculum guidelines for secondary education, a conspicuous extension in temporal allocation for collaborative learning has been observed. Anticipations are rife that educators will integrate project-based learning, a pedagogical approach scrutinized within the ambit of educational sciences. Nonetheless, a dearth of institutions actively embracing this paradigm and an inadequacy of opportunities for instructors to acquaint themselves with its nuances pose formidable challenges in the dissemination of this methodology.

3 Research Objectives

The objective of this investigation is to delve into the requisites that educators require to advance project-based learning. Within the scope of this inquiry, educators will be subjected to initial surveys and subsequently categorized into two cohorts, each consisting of 3 to 5 instructors. This categorization will be based on their implementation of project-based learning and the extent to which they advocate for it.
Subsequent to categorization, each group will engage in deliberations concerning pedagogical challenges, the desired attributes of the learning environment, and related facets. The ensuing discourse transcripts will be subjected to QE methodology, thereby facilitating the extraction of disparities between the two cohorts and enabling a comprehensive exploration of pivotal focal points warranting pedagogical support.

4 Prior Experience and Expectations

In the course of my interviews with multiple educators, it has come to light that a deficiency exists in their capacity to architect project-based learning frameworks. Alternatively, some educators opine that their students lack the requisite acumen to attain substantive strides within their investigative pursuits. I am inclined to undertake a quantitative juxtaposition and examination of the challenges experienced by educators who are actively advancing project-based learning against those who are not.
Furthermore, it is my intention to ascertain whether the discourse among educators facilitating project-based learning encapsulates elements congruent with the six characteristics emblematic of a project-based learning milieu.
Given my lack of familiarity with QE methodologies and tools, the impending analytical outcomes remain an enigma. Nonetheless, I am enthusiastic about acquainting myself with the quantitative analysis of discourse transcripts. Additionally, I would also like to know how to best collect and organize data such that it is appropriate for QE analyses.

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Mathematics Teaching Identity and Teachers' Instructional Enactment

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Abstract. This research aims to explore how QE techniques can be used to analyze the complex factors of that influence teachers' mathematics instruction. Building on prior research looking at mathematics teaching identity, I would like to design future studies that examine how individual factors relate to teachers' instructional enactment. To do this, I would like to explore the utility of using different rubrics to evaluate teachers' instructional decision-making, thus providing opportunities to evaluate the efficacy of professional learning opportunities while taking into consideration the complexity of individual teachers' identity and experience.

Keywords: Teacher Learning, Teacher Evaluation, Mathematics Teaching Identity, Elementary Education.

1 Area and Domain of Research

This proposed research study is in the domain of Teacher Learning and Instructional Evaluation.

2 Background

As mathematics continues to be viewed as a "gatekeeper" to many careers and opportunities, research puts a great deal of focus on improving mathematics instruction and addressing inequities in access to high-quality mathematics learning experiences. This research often examines what makes instruction high-quality [1] or how to prepare pre-service teachers to support student learning through responsive teaching practices and implementing student-based learning opportunities [2]. How teachers view mathematics and their role in teaching mathematics to students constitutes a distinct *mathematics teaching identity* (MTI).

Based on the wide range of research on teachers' professional identity [3] and the mathematics identity development of early career teachers [4], the primary components that seemingly comprise MTI are one's own *math identity, mathematical knowledge for and in teaching (MKT), mathematics teaching self-efficacy* and *visions of high-quality math instruction.* Each of these components of mathematics teaching identity influence and are influenced by one another, creating a complex dynamic system [5] that drives how an individual acts in their role as a mathematics teacher. Additionally, the

individual's emotion intersects across all components and serves as another mechanism that determines action in a given context. This action includes instructional practices within the classroom, as well as the decisions teachers make in relation to what professional learning opportunities they pursue related to their mathematics teaching. Research is needed to explore the validity of this conceptualization as it relates to teachers' instructional enactment.

3 Objectives

The aim of this proposed research is to explore how the potential of adopting a dynamic systems model of mathematics teaching identity can help support strategies for teacher learning. Rather than taking an objective stance on how a single dimension of teachers' influences instruction, looking at how those elements of individuals guide their decision-making and action can help researchers and practitioners to seek appropriate supports for learning both in teacher education and professional learning environments. Further, being cognizant of how different school environments support or constrain an individual's mathematics teaching identity can help teachers to select appropriate environments in which to work, or to take actions to develop and change their own learning community to better support their mathematics teaching identity. Based on this, potential research questions include: (1) How do elementary educators' mathematics teaching identities relate to their approaches to mathematics instruction? and (2) How does organizational context impact teachers' ability to enact their mathematics teaching identity? Though this study is still in the conceptualization phase, data collection would include teacher interviews and video data of classroom instruction.

4 Prior Experience and Expectations

Over the last year, my initial exploration into quantitative ethnography and epistemic network analysis has helped me to further see how the affordances of a quantitative ethnographic approach can support this work in mapping the complexities of mathematics teaching identity in early career teachers. I feel my research could benefit from learning more about visualizing and modeling connections between the mathematics teaching identity and classroom instruction. To do this, I would like to know how to best collect and analyze classroom observation data in a way that is appropriate for QE analyses, as well as to discuss ways to look for alignments and misalignments across individuals' mathematics teaching identity and classroom instruction.

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Mother-Daughter Communication and Decision-Making Regarding HPV Vaccination

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Abstract. The aim of this study is to explore the extent to which the opinions of mothers and daughters and the parent-child relationship contribute to their intention to vaccinate against HPV. This is currently in the conceptual stage and data has not yet been collected. I would like to try to quantitatively visualize the changes that occur in mother-daughter conversations regarding their attitudes toward vaccines using QE.

Keywords: HPV Vaccine, Mother-daughter Communication, Decision-making, Vaccination Intent

1 Area and Domain of Research

This proposed research study is the domain of Communication Studies and Preventive Medicine.

2 Background

The HPV vaccine has been widely recommended by governments in various countries for about 20 years. While many nations have high vaccination rates, some are now also advocating vaccination for males. In contrast, in Japan, safety concerns were raised due to media reports on post-vaccination adverse reactions, resulting in the suspension of active promotion from June 2013 to March 2022. Even after resuming vaccinations in April 2022, Japan still faces the challenge of low vaccination rates. The vaccine is considered most effective when administered to girls aged 11 to 16 before sexual activity, with mothers often making the vaccination decision. Existing research indicates that maternal risk perception is a significant factor affecting vaccination intent [1]. Common concerns include cost, doubts about vaccine effectiveness and safety, inadequate vaccination information, and limited awareness of HPV and the vaccine [2]. While it is clear that some mothers hold such concerns, there is limited research on how they communicate their perspectives to their daughters and how these interactions influence final vaccination decisions. Investigating the communication and decision-making methods between parents and children regarding HPV vaccination is essential. Additionally, studies suggest that younger individuals have higher knowledge and awareness of the HPV vaccine [3]. This suggests potential differences in vaccination perspectives between mothers and daughters, with cases where either may compromise

during the decision-making process. Understanding these dynamics is vital for future awareness efforts.

3 Research Objectives

The purpose of this proposed study is to focus on the conversations between mothers and daughters regarding HPV vaccine administration, aiming to explore the process leading to the final decision on vaccination based on the tendencies of their respective opinions and the parent-child relationship. In this study, we will observe the conversations about impressions and intentions regarding HPV vaccination between mothers and their unvaccinated daughters aged 11 to 16. The anticipated research questions are as follows: (1) To what extent do mothers' and daughters' opinions contribute as determining factors in the decision-making process for vaccine administration? (2) Does the parent-child conversation and their relationship influence the final decision on vaccine administration? For data collection, we will utilize speech data obtained through conversation between mothers and daughters, as well as pre- and post-conversation depth interviews. After acquiring the data, we will compare and analyze any differences or changes in the impressions and values regarding the vaccine between the two parties before and after the conversation. At the conceptualization and research design stages, this study builds upon previous survey results, and data collection has not yet been conducted.

4 Prior Experience and Expectations

Although I have no prior experience with quantitative ethnography (QE) in research, I believe it would be valuable to incorporate QE tools in this study. I have attended lectures and workshops on the overview of QE and learned that it provides a means to quantitatively analyze qualitative data. In this study, I anticipate that utilizing QE will allow me to visualize the changes in decision factors quantitatively when analyzing shifts in thinking through conversations. Additionally, I am interested in exploring the potential of using QE to interpret aspects that may not be explicitly manifested in the speech data, such as the parent-child relationship.

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Motivation, Persistence, and Resilience in Small Group Science Activities

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Abstract. This transdisciplinary research agenda explores the intersection of small-group educational activities and persistence and well-being in science education. Using collaboration analytics and multimodal data, the study aims to identify indicators of reflection, persistence, and a positive approach to failure on a group level. The project seeks to develop non-intrusive data collection technology for broader use in classrooms.

Keywords: group work, persistence, learning analytics

1 Area and Domain of Research

Our objective is to create a transdisciplinary research agenda that explores the intersection of small-group educational activities and to persistence and well-being. This research encompasses various fields, such as educational sociology/psychology and learning sciences: more specifically, multi- and trans-modal learning analytics, science education, research on motivation, and resilience.
Our underlying hypothesis posits that group activities in science can serve as catalysts or obstacles in fostering courageous and positive engagement with the subject matter. This engagement is reflected through persistence, a positive attitude, and shared reflection within the group.

1 Background

Science, engineering, and design advances require embracing failure, conducting experiments, and making revisions. Collaboration is essential for scientific progress, involving shared hopes, knowledge, experiences, and motivation to overcome challenges. To foster this collaborative courageous mindset, students must learn how to turn failure into productive learning opportunities. The research is situated at the Novo LIFE campus. LIFE is dedicated to enhancing science education, training, and research. Through theme-based science courses addressing global challenges, LIFE promotes inquiry-based learning. At the campus, schools can visit and utilize the state-of-the-art facilities. At LIFE, students participate in group-based explorations, making it an ideal setting to study collaboration. This project aims to develop tools for measuring shared reflective persistence among students engaged in science activities.

We draw from a combination of theories that include group cognition [1], reflection in practice [2], and the notion of productive failure [3]. We adopt recent developments in the field of Collaboration Analytics (CA) to collect multimodal data that utilize both sensors, video, audio and human observations from real-world teaching contexts, which are producing results, especially regarding small groups of learners' interactions. By analyzing the interactions between people, it is possible to trace patterns of how small groups work together. We intend to identify critical indicators of reflection, persistence, and a positive approach to failure from CA data. We are interested in using trans-modal analysis to combine the theories and the interaction data into meaningful and grounded insights.

2 Research Objectives

The main aim of the research project is to investigate the influence of group work that can make the work with science subjects interesting for children so that they learn something and become passionate about science. Additionally, to further develop theories and methods for collaboration.
The project aims to communicate with researchers and practitioners in science education. Especially we aim at answering (1) what patterns of group activity (dialogue, movement, etc.) characterize SRP in the LIFE setting? (2) How sensitive are groups' observed SRP to the individual traits of the members as measured by pre/post surveys? How can the findings of questions 1 and 2 be condensed into non-intrusive data collection technology, suitable for use beyond the LIFE campus?
The project has just started in May 2023 and phase one involves collecting ethnographic and multimodal data on student collaboration at LIFE, while phase two streamlines data collection into a collaboration analytics system. The goal is to identify key indicators of courageous and reflective approaches to science and promote and assess courageous collaboration in Danish classrooms.

3 Prior Experience and Expectations

Research at the Center for Digital Education has explored both the use QE methodologies and multimodal learning analytics (MMLA). Additionally, Spikol has been one of PI in PELARS and EU (FP7) funded projects that investigated MMLA for group work.

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Validating the Hustlenomics Model for Success

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Abstract. This study's goal is to comprehend the relationships between the barriers and strategies identified in the Hustlenomics Model for Success. The Hustlenomics Model for Success was created to assist hustlers attain success within the hustle economy. I want apply QE techniques to assess the relationship between the identified barriers and the strategies that lead to success.

Keywords: Entrepreneurship, hustle economy, change model, hustlers

1 Area and Domain of Research

This proposed research is in the domain of Hustle Economy-Serial Entrepreneurship.

2 Background

The hustle economy is a subset of the entrepreneurship economy. It is fast paced, innovation driven, and flourishes in an unregulated environment (Bansal et al, 2020). It is a limitless economic space where individuals hustle ferociously by doing whatever it takes to make money such as sales, artistry, consulting, housecleaning etc. (Kost et al., 2020; Oberholtzer, 2016). Hence, those that engage in it are known as hustlers. They hustle by taking advantage of opportunities to make money by balancing multiple jobs and businesses (Thieme, 2018; Oberholtzer, 2016; Schnieder, 2016). Historically, the hustle economy which is also known as the informal economy provided the economic space for those that are economically marginalized because they are unable to earn adequate income within the formal economy. The formal economy is the economic space whose guidelines, protocols, and regulations are set forth by governmental authorities. The hustle economy is expanding and is no longer just for the economically marginalized. This is a result of the proliferation of online platforms and applications like Amazon, Facebook, Squarespace, LinkedIn, Lyft, Fiverr, YouTube, etc. that have made it easier for hustlers to market their products and services and contact consumers (Koutsimpogiorgos et al., 2020; Oberholtzer; 2016; Ravenelle; 2019).

The hustle economy is described as a high-risk and challenging economic environment to operate in because of its resemblance to a free market, but it is also seen as a place where hustlers can survive, emerge, and prosper (Thieme, 2018; Oberholtzer, 2016; Schnieder, 2016). Furthermore, despite its expansion, the hustle economy is still widely misunderstood and undervalued (Khanna and Palepu, 2010). It is seen as the economy of the lower classes, illegal i.e., drug dealers, and the developing world (Khanna and

Palepu, 2010). This limits the possibilities of the hustle economy (Khanna and Palepu, 2010, Thieme, 2018). In order to address these problems, a qualitative phenomenology study was carried out to comprehend the barriers and successful hustlers' best practices. The study's outcome is the Hustlenomics Model for Success
.

3 Research Objectives

The purpose of this study is to examine the relationships between the strategies and best practices and the barriers outlined in the Hustlenomics Model for Success. Thus, the research questions are: (1) How are the obstacles listed in the Hustlenomics Model for Success related to the best practices and strategies? (2) How do the strategies affect the obstacles? Interviews and observational data collection will be gathered and analyzed to discover concepts or themes that emerge. Ss far, no data have been gathered.

4 Prior Experience and Expectations

I am interested in knowing which QE strategies can help this study. Additionally, I would like to discover the most effective methods for gathering and arranging data so that QE analysis can be performed. I completed a QE course at Pepperdine University; thus, I believe using the methodology in this study will be beneficial. To better understand the relationships and effects of the barriers, tactics, and best practices within the model, I'll like to learn more about visualizing and modeling connections.

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A Quantitative Ethnographic Examination to Improve the Quality of Training for Caregivers for a Simulated Immersive Virtual Reality Setting

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Abstract. This project aims to explore how the epistemic network analysis of nurse experiences in the real workplace can be used in the development and implementation of a simulated virtual training system for geriatric care. While the simulation is in the conceptualization phase, the data from structured interviews with nursing assistants as caregivers has been collected and analyzed using quantitative ethnography (QE) techniques. The interviews highlighted the attitudes and challenges of caregiver careers, and QE analysis revealed a lack of empathy in formal training, suggesting the inclusion of communication skills and positive caregiver attitudes in our virtual geriatric care training system.

Keywords: Caregivers training, Virtual reality simulations, Epistemic network analysis, Quantitative ethnography, Fundamentals of nursing.

1 Area and Domain of Research

This proposed research study is in the intersection of Social and Behavioral Sciences, Computer Science, Nursing Education, and Educational Technology.

2 Background

The population of older adults is expected to grow significantly in the next few decades, yet currently, nursing homes report staff shortages. In addition, caregivers must learn how to communicate effectively with older patients, which can be best improved by alternate approaches (e.g., immersive virtual reality). Virtual reality (VR) technologies have been increasingly used for training purposes [1], and they might benefit nursing students' education [2]. However, VR-based systems informed by, and improved with

quantitative ethnographic (QE) methodologies are still underrepresented. When training caregivers, critical thinking, empathy [3], communication skills, and flexibility should be considered. Research is needed to explore how these factors intersect, connect, and contribute to better interaction with geriatric patients. We aim to apply these factors in our immersive virtual training and offer a realistic experience with geriatric patients.

3 Research Objectives

The aim of this proposed research is to explore how using a QE examination of caregivers' data, combined with VR can contribute to exposing future workers to a realistic interaction with a geriatric patient. The intervention would include analyzing caregivers' feedback from our interviews and integrating it with our new generation of immersive virtual humans. A total of ten caregivers have been interviewed so far. Research questions include: (1) What are the key constructs and their connections and interplay for effective interaction with a geriatric patient? How can these insights from real-life experiences be transferred to a virtual world? (2) How combining QE and VR can enhance nursing students' experience? Through interviews with ten caregivers, we transcribed and coded preliminary data, and identified key constructs centered around communication, empathy, and other metrics that arise from the interviews. QE analysis revealed a lack of empathy in formal training, indicating the need to incorporate this skill and other positive attitudes in implementing our future virtual geriatric care training system. VR implementation is in the design phase, and we hope to include some of the key findings from QE as part of our VR training scenarios.

4 Prior Experience and Expectations

Co-authors have a good understanding of QE concepts through reading ICQE papers and group discussions. However, this is our first QE study, and we wish to gain more insights from different aspects of the issue. During the session, we are interested in learning more about modeling connections between the more complex factors that nurses deal with and determining how that can be incorporated into a VR environment.

Acknowledgments. We wish to acknowledge the support from our sponsors, the National Science Foundation for award #2222661-3.

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Analyzing Music Therapy Sessions in Treatment of Dementia

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Abstract. This study proposes analyzing music therapy sessions in treatment of dementia. Music therapy is effective in alleviating "anxiety, depression, and behavioral disorders" as behavioral and psychological symptoms of dementia, but both music therapists and we have not understood the mechanism of the effectiveness yet. We have recorded videos of music therapy sessions and plan to analyze music therapy interactions.

Keywords: Music Therapy, Dementia, Epistemic Network Analysis.

1 Area and Domain of Research

This proposed study is in the domain of Health Sciences and Healthcare Improvement.

2 Background

Dementia becomes a social issue where its behavioral and psychological symptoms often make caregiving difficult. We have studied music therapy in treatment of dementia, since music therapy was effective in alleviating "anxiety, depression, and behavioral disorders" as behavioral and psychological symptoms of dementia [1].

However, it is not clear how music therapy contributes to alleviating "anxiety, depression, and behavioral disorders." Neither music therapists grasp the mechanism of effectiveness in detail nor how to improve the effectiveness.

We have thought that there are differences in the effectiveness of music therapy for dementia between the sessions conducted by skilled and novice music therapists. So, we think comparing and analyzing music therapy sessions by the skilled and novice music therapists may clarify the mechanism of the effectiveness of music therapy and can be used for improvement of the effectiveness. To this end, we propose to use epistemic network analysis (ENA) to the discourse in music therapy sessions.

In the previous study, we also found that the effectiveness of remote music therapy is almost the same as that of in-person music therapy [2]. So, we also plan to compare remote and in-person music therapy sessions.

3 Research Objectives

In a music therapy, participants sing songs according to the therapist's guide, and the therapist talks to the participants in between songs. We plan to analyze interactions between the participants and the therapist in both the singing and the talks. We will obtain codes used for ENA from utterances and other behaviors in the interactions.

On constructing the epistemic networks, we aim at comparing skilled and novice music therapists and comparing remote and in-person therapy sessions. We will perform ENA with skilled/novice condition and remote/in-person condition as independent variables.

We have video recordings of music therapy sessions in all the condition mentioned above, but do not start any analysis or coding. Starting with coding interactions, we will perform the analysis.

4 Prior Experience and Expectations

This is our first QE study, and we have no prior experience. But, we feel QE and ENA bring new insights to our research. We are actually new to QE tools as well, so we will try it ourselves, but we would like to ask questions about what we wonder about the tools. We are also interested in how to define codes for interactions in music therapy sessions. In addition, we would like to talk with healthcare researchers in QE community to discuss our plan and to know how they apply QE to their studies.

Acknowledgments

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Examining the Educational Feedback Capabilities of Generative AI

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Abstract. This study aims to assess the effectiveness of GPT-4 at providing feedback on student learning from cognitive, affective and self-regulated learning perspectives. The study will design prompts to test GPT-4's ability to provide different types of feedback and evaluate the feedback using quantitative ethnography approaches. The results of this study have the potential to benefit a wide range of stakeholders directly involved in education, including students, educators, and educational institutions. Furthermore, the study will contribute to the field of educational psychology and quantitative ethnography by expanding our understanding of how AI can be effectively integrated into the educational process.

Keywords: Feedback; Artificial intelligence; Self-regulated learning.

1. Area and Domain of Research

This research falls under the area of educational feedback in the context of writing in secondary education. It aims to explore how generative AI can support and enhance feedback provision based on the writing samples. By integrating concepts and methods from Educational Psychology and Quantitative Ethnography, this study takes a comprehensive approach to examine the capabilities of generative AI as a feedback provider.

2. Background

Feedback is an essential component of the learning process (Wongvorachan et al., 2022). Research conducted by Wisniewski et al. (2020) highlights that feedback encompasses multiple dimensions, including cognitive dimension that focuses on enhancing knowledge acquisition and understanding, an affective dimension that addresses learners' emotions and motivation, and a self-regulated learning (SRL) dimension that promotes metacognitive skills and self-directed learning strategies. Overall, feedback serves as a catalyst for learners by providing them with information about their performance, fostering positive emotions, and reinforcing positive behavior, all of which contribute to their learning outcomes (Lu and Law, 2012).

However, external constraints on time and attention often mean that it can be difficult for teachers to give timely and constructive feedback to all of their students. One approach to addressing this issue is using AI to provide feedback to students (Swiecki et al., 2022). Among AI-assisted educational technologies, generative AI is uniquely

positioned given its impressive performance in various natural language processing tasks, such as text generation and question answering (OpenAI, 2023). However, its effectiveness in providing cognitive, affective and SRL levels of feedback in educational contexts has not been systematically evaluated.

3. Research Objectives

This research will be guided by the following research questions:

a. To what extent can generative AI provide cognitive, affective, and SRL-based feedback to secondary school students' writing?
b. What are the implications of using GPT-4 for students' cognitive and affective development?
c. To what extent can GPT-4-generated feedback promote self-regulated learning in students?

The proposed study is currently in the planning stage. The research will be conducted using a mixed-methods approach, including both qualitative and quantitative methods. Data will be collected through prompts designed to interact with GPT-4, the most recent AI language model developed by OpenAI, to obtain different types of feedback. The collected data will be constructed in an epistemic network and analyzed using QE methods to evaluate the effectiveness of GPT-4 as a feedback provider. The study will also explore the extent to which GPT-4 can promote self-regulated learning in students. The findings of this study will contribute to the development of more effective feedback strategies in educational psychology, particularly in the context of writing in secondary education.

4. Prior Experience and Expectations

Yixin hopes to get some insights on how to code the AI-generated feedback and develop network models that help to distinguish its effect on students. As for the expectations from sessions, he hopes to have the comments of the proposal, as well as the suggestions from the interaction with QE researchers.

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Efficacy of Independent Audit of Artificial Intelligence (AI) Systems to Assess and Mitigate Negative Impact to Organizations, Society, and Individuals [RAD]

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Abstract. This research aims to explore how independent audit of AI-based systems may be used as a governance tool for oversight and accountability of AI-based tools to organizations, society, and individuals in order to mitigate negative impacts generated from their use. Specifically, we are interested in understanding the way in which independent audit of AI-based systems and generative AI-based tools are being enculturated—or acculturated—into society in order to better guide the development and enforcement of their regulation. This study is in the conceptualization phase and no data has been collected.

Keywords: Independent Audit of AI Systems, Generative Artificial Intelligence (GAI), AI Ethics, Human Subject Research, Digital Transformation, ChatGPT, Otter.ai

1 Areas and Domains of Research

The proposed research study is situated in the domains of knowledge, transparency, and ethics; digital transformation of organizations and societies; and teaching, learning, and scholarly research.

2 Background

The rapid deployment, adoption, and development of artificially intelligent tools—particularly those in the category of generative Artificial Intelligence (GAI) such as OpenAI's ChatGPT—are advancing at a historical rate without regulation or restriction [1]. Experts across domains are excited and alarmed by their transformative power, including positive and negative impact to organizations, society, and individuals [2]. The lack of public transparency of algorithmic and ethical risks these AI-based tools generate have exponentially complicated related ethical dilemmas, legal challenges, and digital policy. On May 16th, 2023, Sam Altman, CEO of OpenAI and ChatGPT creator, testified before the United States Senate Subcommittee on Privacy, Technology and the Law during a hearing on oversight of AI and rules for artificial intelligence [3]. In his testimony, Altman said, "We think it is important that our safety approaches are

externally validated by independent experts, and that our decisions are informed at least in part by independent safety and risk assessment…[to mitigate] destabilizing public safety and national security." Experts also agree that independent audit of AI-based systems can serve as a pragmatic governance approach when prospective risk assessments, operational audit trails and system adherence to jurisdictional requirements are included [4].

3 Proposed Research Objectives

The aim of this research is to explore how independent audits of AI-based systems might be used as governance tools for oversight and accountability for mitigation of negative impact to organizations, society, and individuals. The intervention may include analysis of available independent audit frameworks and their use case on widely adopted GAI-based tools. Potential questions include: 1) Are currently available independent audit of AI-based system frameworks designed to mitigate the risk they purport to mitigate? 2) How to reconcile the lack of transparency and bias that come with the use of these tools with methodological requirements of sound *and safe* research—especially those which aim to study human subjects? Data collection would include observations, textual or visual analysis, and interviews. Once data is available, analysis would involve the identification of concepts or themes that emerged from data collected. This study is in the conceptualization phase. No data has been collected.

4 Prior Experience and Expectations

Quantitative Ethnography (QE) tools or techniques may benefit this study in many ways, including, understanding the current enculturation—or, acculturation—process of AI-based tools and independent audits to better inform the development and enforcement of their regulation. During the session, we are interested in learning more about visualizing and modeling connections between variables that influence how these tools generate risk—particularly negative externalities—and how said risk might be effectively mitigated. Our experience with QE varies from none to experienced.

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Workshops

Workshop: Writing Custom ENA Rotations in the Julia Programming Language

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Abstract. Epistemic Network Analysis remains a flexible tool in Quantitative Ethnography for understanding high-dimensional discourse data, in part by providing researchers multiple "rotations" for highlighting features of interest in one's data. We propose a tutorial workshop on choosing the right rotation for the job and developing new rotations open-source in the Julia programming language. Learners at all levels welcome.

Keywords: Epistemic Network Analysis · Julia Programming Language · Dimension Reduction · Workshop

1 Introduction

The Epistemic Network Analysis (ENA) approach is, generally, a process involving five steps [1–6]. First, one accumulates connection counts between qualitative codes over a sliding window, resulting in a high dimensional representation of the discourse one's units of analysis engaged in. Second, one embeds a network representation into that space as a way to approximately understand the accumulated model's dynamics in terms of connections between qualitative codes. Third, one reduces the dimensionality of that space to highlight one's features of interest by using multidimensional scaling, colloquially referred to as rigid body "rotations" in the Quantitative Ethnography (QE) community. Most commonly, ENA-users choose between SVD or means rotation, to show the dimensions of highest overall variance or between-group variance, respectively. And Knowles has explored alternatives where SVD and means rotation can mislead or be uninsightful, such as when one has several groups to compare (eg., schools), continuous features (eg., grades), or complex temporal data (eg., life transitions) [7–9]. Fourth, one visualizes the lower dimensional space resulting from that rotation, to make clear its stand out features, illustrate the dynamics of the space, show comparisons between groups, and so on. And finally, one interprets the results.

To help researchers get to this last step as quickly and painlessly as possible, user interfaces like WebENA and application programming interfaces (APIs) like rENA manage the first four steps for them. In this vein, EpistemicNetworkAnalysis.jl ("jENA") is an ENA API created with two aims in mind, complementing

its rENA counterpart. First, jENA is designed to allow researchers to painlessly create custom ENA models and rotations. And second, it is designed to allow researchers to painlessly adjust ("reconstruct") model configurations, without having to recompute information more than once when possible. These two features are important when exploring new QE methods, iterating one's models in interactive programming sessions, and working on prohibitively large datasets.

2 Julia and jENA

jENA is a package for the Julia programming language [10]. Julia is a high performance scientific programming language with (i) a robust, parametric type system, (ii) a multiple dispatch function design, and (iii) a syntax similar to other popular languages, such as Python. Julia was chosen for this project for two main reasons. First, package development in Julia is by design open source, allowing one to easily report issues with a package through GitHub issues, as well as to follow the history of its development. And second, Julia's multiple dispatch and type system features allow one to override the behavior of functions for complex *combinations* of types. This, unlike mere object-oriented programming in R and Python, allows one to define how a plot should be drawn for, say, directed ENA models that use a means rotation, without affecting the execution of other configurations. Moreover, this permits one to define new ENA model and rotation types minimally, inheriting the logic of existing type combinations as much as possible. To that end, jENA has been developed with sensible default behavior for its built-in range of ENA model and rotation types and their combinations.

To give an example, the jENA interface allows one to quickly define one's models and their configurations,

```
model = ENAModel(data, codes, conversations, units, windowSize=10,
↪  rotateBy=MeansRotation(:Play, "Romeo and Juliet", "Hamlet"))
```

as well as to quickly perform common tasks with those models, such as exporting, running statistical tests, and plotting.

```
to_xlsx("model.xlsx", model)
display(summary(model))
display(plot(model))
```

Moreover, jENA's flexible rotation options allows one to perform cross validation tests, by taking the embedding of a model based on a training dataset, and reusing it in a model based on a test dataset.

```
train_model = ENAModel(...omitted...)
test_model = ENAModel(...omitted...,
↪  rotateBy=TrainedRotation(train_model))
display(summary(test_model))
```

More importantly, jENA allows one to reconstruct a model from one configuration to another without performing unnecessary extra computation, such as changing one's rotation, one's model type, and both simultaneously.

```
model2 = ENAModel(model, rotateBy=LDARotation(:Act))
model3 = DigraphENAModel(model)
model4 = DigraphENAModel(model, rotateBy=LDARotation(:Act))
```

And for the advanced users in this workshop, jENA allows one to define custom rotations. This involves, at minimum, defining a rotation type and its fields, defining a rotation function for that type, and using that rotation type in one's model configuration. Most importantly though, all jENA's features are developed open source, allowing its users to (i) review its development, (ii) request assistance through Github issues, and (iii) contribute directly to its development, regardless of the researcher's home institution.

3 Workshop

We propose a two-hour jENA tutorial workshop. Our goal is to give QE researchers the power to choose and develop custom rotations to fit their research aims by introducing them to open-source ENA-based tools. Specifically, the target audience is QE researchers who already have familiarity with ENA, a beginner's understanding of at least one programming language, and who want to use rotations beyond SVD and means rotation in their own research. The learning objectives and benefits to the QE community are: Learners will be able to (a) create and interpret ENA models that have rotations beyond SVD and means rotation; (b) understand the steps of the ENA algorithm and the connections between rotation choice and research aims; and (c) use Github issues to get assistance, troubleshoot problems, and contribute to ENA API development.

The workshop will include four short, focused activities. First, before the conference, registered learners will be sent Julia and jENA setup instructions and a prior knowledge survey. The workshop instructional team will review survey results to adjust workshop content, and they will help learners troubleshoot errors from setup. Second, at the start of the workshop, the instructional team will introduce the workshop and its aims, then lead the learners in a hands-on demonstration of jENA on a sample dataset. This activity will mirror and build on the setup instructions, and it will be taught in a live-coding format, where learners follow along as an instructor writes code, explains the code, and helpers float around the room to troubleshoot learners' errors. This first activity is intended to be a short dive into jENA showing a real result as soon as possible. The instructor will continue to build on this opening example, introducing more features of the jENA API, including: loading one's own data, model configuration options, basic plot interpretation, and various rotations. Learners will check their understanding with short activities throughout, adjusted for workshop pace and audience. Third, the instructor will introduce the geometric intuition behind ENA, multidimensional scaling, and ethnographic stories,

along with a cheatsheet of how different rotation choices connect to different research aims—in particular beyond SVD and means rotation. Time permitting, learners will practice their understanding by illustrating the "shape" of a real researcher story. Finally, in the remaining time, the instructor will introduce and lead a discussion on open source development of ENA tools. Then, learners will split into two groups. In group one, "users," learners will practice using jENA on their own data with assistance from workshop helpers. They will also be introduced to using Github issues to seek help on issues and get ongoing jENA-related advice. In group two, "developers," learners will be oriented to jENA API development, resources, documentation, and contributor norms. In either group, learners and instructional staff will coordinate and plan post-conference learner check-ins (group one) and post-conference ENA API working groups (group two). Each activity (beyond pre-conference setup) is expected to take approximately 30–45 minutes, while being flexible to (i) prior knowledge survey results and (ii) necessary on-the-fly adjustments.

This workshop is short, technical, research-oriented, and will include learners with a range of prior experience, and so its design necessarily differs from that of a full-semester course. The instructional team recognizes this and includes members trained on Carpentries workshop design and instruction [11–13]. Following Carpentries best practices, (i) the workshop objectives focus more on transferable skills of using the right rotation for the job, and less on jENA specifically; (ii) the workshop design includes multiple formative assessments that allow the instructional staff to address learner misconceptions and help learners retain what they are learning; and (iii) the learning space will be setup to provide learner support through multiple communication channels, including in-person helpers and a shared class Google Doc, where a notetaker will keep notes and learners may ask questions in chat. Moreover, students may flag to the helpers that they need assistance by setting out a red-orange index card, or conversely flag that they have completed an activity by setting out a blue-green index card. The content and design of this workshop and its activities builds on the instructional teams' prior experiences designing and teaching similar workshops, including introductory workshops on Julia and Git [14, 15].

Finally, the expected outcome of this workshops is that the QE community will have been introduced to rotations beyond SVD and means rotation, which will deepen their existing understanding of ENA and connect that understanding to broader developments in machine learning techniques for multidimensional scaling and high-dimensional analysis. To help translate these understandings into practice, learners will schedule a post-conference check-in with workshop instructional staff, and learners will be invited to form working groups for post-conference ENA API development (in potential collaboration with the Open Science QE SIG).

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Participatory Quantitative Ethnography: Exploring New Possibilities

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1 Overall Focus of the Workshop

The goal of this interactive workshop is to introduce participants to *Connect*, a tool that draws on principles of Epistemic Network Analysis (ENA) to facilitate the co-interpretation of discourse data between researchers and participants. Also, participants will discuss conundrums and perspectives about participatory approaches in quantitative ethnography (QE) and how they have integrated them into their research or plan to do it in future projects.

1.1 Participatory Quantitative Ethnography and Connect

Participatory quantitative ethnography (PQE) has emerged as QE scholars have recognized the need to support equitable researcher-participant relations in the co-construction of knowledge. Participation in research implies that participants and researchers jointly co-construct knowledge during the research process. Participatory methods bring to the front the role that participants can take in shaping the research and ultimately in participating in more democratic forms of inquiry with positive outcomes for them. Calls for imagining and designing possibilities for such collaboration agree on the potential of already existing tools, such as ENA, within QE. Traditionally, ENA has been used by researchers as it was created for data analysis tasks, typically conducted by research experts. In recognizing that ENA can be expanded to accommodate researcher and participants' interactions, in our previous research, we tested initial prototypes that led to the design of *Connect*. This tool supports researcher-participant co-interpretation of discourse data from interviews.

Connect is a collaborative space hosted in Shiny App, where researchers and participants can analyze interview transcripts together by creating networks based on themes or codes from the data. In the first design phase of *Connect*, users can jointly analyze data before establishing a codebook. The pre-coding interface includes two sections (Figure 1): (a) the transcript (right-hand-side) and (b) the network (left-hand-side). On the transcript side, the users have access to the interview transcript they have previously uploaded. In the network section, users can add nodes and edges (lines) to manually form networks based on their understanding of the discourse data.

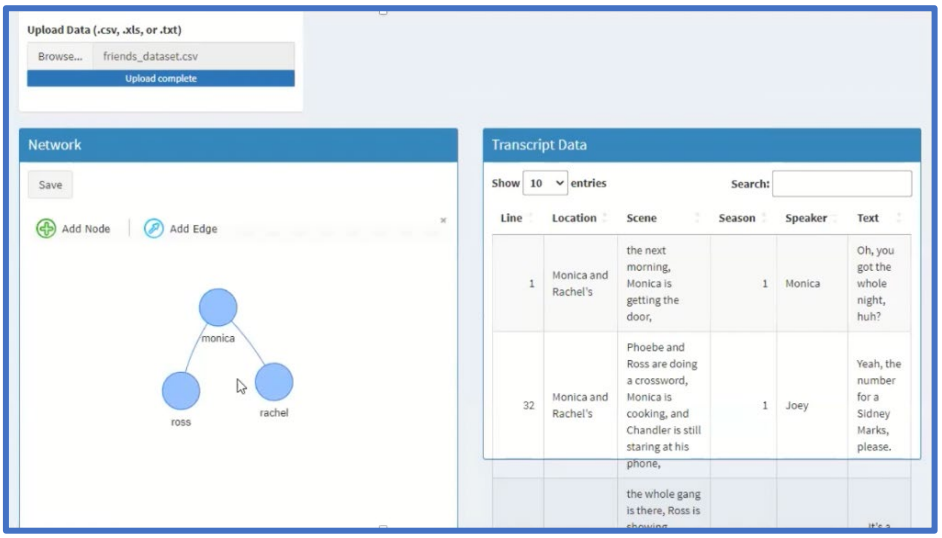

Fig. 1. Screenshot of the pre-coding interface of *Connect*.

2 Potential Participants and Anticipated Benefits

Any conference attendee can be part of this workshop. The activities may be of interest to researchers who have incorporated or wish to use PQE in their scholarship, particularly for those looking for options to engage in collaborative data analysis with participants. Knowledge or experience with PQE is not required for this workshop. However, basic expertise in qualitative data analysis and familiarity with ENA can be helpful to take full advantage of the activities. Participants of this workshop will benefit from interacting with facilitators and audience members to discuss how they can use *Connect* and PQE more broadly in their research. Furthermore, participants will be encouraged to contribute their feedback to the app developers for improvements or new possibilities for *Connect*.

3 Workshop Structure and Activities

This workshop consists of four parts: 1) introduction, 2) tool tutorial, 3) experimenting with the tool, 4) discussion. Table 1 details the activities for each of these sections of the workshop.

Table 1. Activities Description

Part	Task	Description
Introduction	-Brief introduction to the workshop and PQE	-Facilitators provide a bit of information about the background of PQE. -Dialogue between 2 researchers who have used PQE.
	-Interactive activity	-In teams, the audience discusses what they know and would like to know about PQE.
Tool Tutorial	-Role-play demo	-Facilitators role-play using *Connect* in a real-like scenario.
	-Step-by-step demo	-Facilitators provide a tutorial using *Connect.*
Experimenting with the tool	-Using *Connect* with a mock dataset	-Facilitators provide a mock dataset for participants to use *Connect* in small teams or pairs.
	-Discussing how to use *Connect*	-Participants meet with other teams and discuss possible applications for *Connect* in their research/context. They generate a list of challenges and opportunities.
Discussion	-Whole group discussion about applications of *Connect* and feedback for developers	-Participants and facilitators come together as a forum to analyze possible applications and discuss feedback.

4 Expected Outcomes

Workshop participants will become familiar with PQE approaches and a concrete tool to engage research participants in data analysis. With the interactive activities, they will also contribute to other researchers' ideas about possible applications. Workshop participants will also be encouraged to access and modify the open-source Connect code or develop their own applications for the future. Finally, as the design of Connect is not fully finalized, the feedback in this session will help current developers to further improve the tool.

Symposium

How do I do "Quantitative Ethnography": Broadening perspectives and practices of QE

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Abstract. With the advent of advanced computing methods, the QE community has been presented with opportunities to broaden the definitions and fundamental practices of QE. The purpose of this symposium is to showcase the latest innovations within the QE community and demonstrate how these advancements push the boundaries of traditional QE concepts, while remaining committed to core commitments such as validity and fairness.

Keywords: Quantitative Ethnography, Method, Qualitative Coding, Big Data

1 Overall focus of the symposium

Quantitative Ethnography (QE) emerged as a field in approximately 2019, when the methodology was formalized with the publication of Shaffer's book on Quantitative Ethnography in 2017 [1]. However, the methodological foundations of QE can be traced back to the period of 2015-2017 [2]. Since its establishment, QE has gained considerable attention from researchers and practitioners across various disciplines, including education, data science, medicine, and policy, who wish to leverage computational and quantitative methods to conduct qualitative investigations into various phenomena.

Initially, the QE community primarily focused on methods and tools such as Epistemic Network Analysis, which originated from the analytical framework developed by Shaffer and his colleagues at UW-Madison. However, the field has since expanded to incorporate interdisciplinary approaches and perspectives [1]. In a broader sense, QE is an approach to data analysis designed to warrant theoretical saturation of qualitative analyses using quantitative techniques, and practitioners of QE use quantitative and computational techniques to better support "principles of good qualitative research," aiming to develop comprehensive descriptions of the contexts from which their data is derived [2].

As a community with a relatively short history situated within the era of dynamic computational development, the QE community must remain open to the potential offered by advancements in computing and artificial intelligence, such as generative AI. However, these two aspects of the field, ethnography and quantitative analysis, often raise the question of what exactly constitutes Quantitative Ethnography.

This symposium aims to highlight diverse and innovative perspectives within the field by featuring panelists from various disciplines and methodological traditions, who will share how they have integrated the Q and E components in their own work. The panelists will discuss their approaches to the E component of QE when dealing with data that might not appear to be "ethnographic data" and how they leverage new opportunities in computing (i.e., Q competent of QE), such as employing generative AI for coding processes. The symposium will provide a platform for the community to collectively reflect on the core principles, including fairness, that underpin these expanding notions of QE and how we should address them in light of the rapidly evolving landscape of computational methods and AI. Thus, the target audience is both existing and new members of the QE community who are wrestling with the question of What QE is.

2 Organization of the symposium

The chair of the symposium will begin by providing an overview of the history and growth of the QE field, along with a review of established definitions and principles. This will be followed by an exploration of the core commitments (e.g., fairness) and practices (e.g., closing the interpretation loop) that distinguish the QE community from related scientific communities (~10 minutes). Subsequently, each presenter will share their current QE projects (~10 minutes per speaker). In preparation for the symposium, the chair will request that the presenters structure their talks around four framing questions: (1) How does your work embody qualitative research? (2) Which new computational methods and tools have you utilized, and what are the reasons behind their application? (3) How does your work expand QE?, and (4) What questions does it pose to the community regarding the definition of QE? After the individual presentations, the panelists will engage in discussions, identifying common themes and challenges that emerge from each other's work. The chair will actively facilitate a dialogue with the audience, encouraging an interactive exchange of ideas and perspectives (~15 minutes).

3 Individual Contributors

3.1 Detector-driven classroom interviewing and computer-human collaborative coding

Ryan S. Baker, University of Pennsylvania, USA

The Penn Center for Learning Analytics is conducting work using learning analytics to support research in quantitative ethnography. In this symposium, I will discuss two of our recent directions.

The first direction, detector-driven classroom interviewing (DDCI) [3, 4], consists of using machine learning to develop models of key events during blended learning (such as changes in affect or self-regulated learning strategy), and then using the

machine learned models as "triggers" for in-the-moment focused interviews. Within these interviews, a human coder asks the learner probing questions about the recent key events. The interviews are then qualitatively coded and analyzed to learn about the phenomena identified by the models. As such, DDCI uses machine learning not just to process the data that has been collected, but to select which data to collect, and target how that data is collected (i.e. shaping the content of interviews). In this fashion, DDCI demonstrates how the Q in QE can not only make new research possible with existing data but also facilitate proactively collecting the right data to answer research questions.

In the second direction [5], we are using Large Language Models (LLMs) to enhance our QE coding processes. We ask ChatGPT to code the same data that has been coded by humans, using their codebooks. When ChatGPT disagrees with the human coder, we ask it to explain its reasoning. Doing so helps to identify and resolve ambiguities in the code book and coding scheme, and helps to improve the quality and precision of both human and machine coding, towards increasing fairness to the data [6].

3.2 Conversations with Computers: Viewing the Actions of Player and Game as and in Context

Jennifer Scianna, University of Wisconsin-Madison, USA

Ethnography traditionally centers on people. Shaffer and Ruis highlight this in describing the *what* of QE research as being grounded analysis of "some specific people in some specific setting" [2]. Most often, it seems that QE researchers consider [D]iscourse in a literal sense, focusing on language and the words used by the people they are studying. Yet, there are some contexts which may push QE researchers to broaden their thinking around what constitutes communication and whether people are the only agents who partake. For example, interactive technologies (such as educational games) may directly contribute to the conversation, prompting response from the human participants. We can gain new insights into student learning and player behaviors more broadly by incorporating these technologies as agents themselves. In this talk, I will discuss how agency can be expanded in QE to non-human "participants".

In my work, I leverage the theoretical framing of cybernetics to incorporate game actions alongside player actions to better understand players. Following the work of Giddings and Kennedy [7] who recognized the utility of employing a cybernetic lens that dedicates agency (the ability to act and have power in a situation) not only to each other, but also to the game itself when trying to describe their avatars being moved against their will by the game in Lego Star Wars. Telling their story of being dragged along necessitated talking about the game mechanic. In an educational context, the inclusion of these elements in telling stories of player experiences (see [8]) has the affordance of being able to see the connections between user actions and the game to better understand how players were experiencing the context of the problem or level. The "ebb and flow" of cybernetic communication [9] means that dropping what the game is "saying" may lead to potential misinterpretation of student actions.

Interaction logs give a voice to the technology in the conversation. For players, I use developer documentation to create text-based descriptions of their clicks: what the click was on, the intended result, etc. For the game, I use events that signal state changes that

would be perceivable by the player: a color changed, an object moved, a score was provided, etc. This processing results in an interwoven narrative between game and player which can then be more easily parsed in typical QE workflows.

Coding this type of data can be accomplished using both etic and emic perspectives. For instance, in formal education settings, emic perspectives of the player can be generated by immersive gameplay, observing how other people talk about their play, as well as gaining insights from teachers who are situated within the formal educational context of play [10]. This allows for characterization of the player and game actions from a goal-oriented and sensory framing respectively. For example, in the digital, town-building game Lakeland, players self-described creating "vegan" cities despite the game tutorial pushing them to create dairies. This decision by the user needed to be contextualized within a broader understanding of them and their own motivations. Etic perspectives of the designer and researcher rely on close study of the mechanics and feedback presented by the technology. For example, as a product of evidence-centered design, Shadowspect has explicit meaning tied to what solutions are valid for a given level. Designers may expect users to rotate a piece within a particular level. What does it imply if they rotate the gamespace instead? What does that mean about the player?

Combining these lenses, researchers can interpret the dance of game and player where action and inaction are equally weighted on behalf of the player and positive and negative feedback systems can be inspected for their intention from the game [11]. Bringing technical events into the analysis broadens the work of QE researchers by opening the door to considering what elements of your system deserve to hold agency. With games, I grant agency to the technologies and tools that students use thus shifting into a more post-human framing [12] where humans and games both serve as sensors and activators in a technical system [11]. This allows for new questions that cross beyond the interactions of people and language to environments, tools, and more. Future work may consider how humans are in conversation not only with one another and technologies, but also with their surroundings, other living things, etc.

3.3 Advancing QE Models of Collaboration

Zachari Swiecki, Monash University, Australia

A core focus of QE is modelling complex socio-cognitive phenomena. Along these lines, many researchers have used QE to investigate different forms of collaboration (e.g., [13]). Recently, my students and I have been trying to push the boundaries of QE in relation to studying collaboration in three areas.

First, several theories of learning—such as sociocultural theory and distributed cognition—emphasize the interactions among humans as well the interactions they have with tools. However, investigations of collaboration typically focus on human-to-human activity and ignore the role of tools in the analysis. As tools become more sophisticated, this practice becomes increasingly suspect. For example, interactions that students have with generative AI, seem more akin to interactions between collaborators than typical tool use. We are beginning to investigate these human-tool interactions using QE models of collaboration. These models elevate the tools themselves to

important units of analysis. Our hope is that these models will eventually lead to more valid assessments of human activity and deeper insights into the relationship between tools and human learning.

Second, collaboration is widely recognized as a socio-cognitive phenomena. However, many analyses focus either on the social or cognitive components—or neglect to investigate how they interact. Preliminary work by Gasevic and colleagues [14] and Swiecki and Shaffer [15] has combined social and epistemic network analysis to investigate the complex nature of collaboration. My students and I are currently exploring ways of advancing the combination of social and epistemic network analyses using graph neural networks (GNNs)—powerful deep learning techniques for graph-based data. The integration of GNNs into QE analyses opens up interesting research areas related to the interpretability of deep learning results and how they affect our ability to "close the interpretive loop" in QE.

Finally, data collection and analysis can be particularly difficult for collaborative scenarios and any results are limited by the data on hand. We are currently exploring ways to simulate the kinds of data produced during collaborative interactions [16]. Such work may allow us to generalize beyond the properties of the particular sample of data we have. Data simulation presents unique problems in the context of QE. For example, the practice of closing the loop requires an examination of qualitative data, however, data simulation is typically done at the level of quantitative parameters and the point of simulation is to address situations for which there is no real data present—in other words, there may be no qualitative data that is appropriate to return to. Nonetheless, the ethnographic components of QE can be useful for determining appropriate simulation parameters. Moreover, advances in generative AI may make it possible to associate qualitative data with simulations, allowing researchers to close the interpretive loop.

3.4 QE in Multimodal Learning Analytics

Roberto Martinez-Maldonado, Monash University, Australia

At the Centre for Learning Analytics at Monash University, we are developing infrastructures to create multimodal learning analytics interfaces. Our focus lies on embodied teamwork activities, where students apply theoretical knowledge while collaborating, utilizing the space effectively, and interacting with various physical objects and digital devices in the environment. One type of learning activity or research context we focus on involves team simulations in healthcare. In these activities, nursing students operate in a realistic, immersive learning environment resembling a hospital ward. This space, enhanced with advanced data collection capabilities like sensing devices and event logging options [17], allows us to gather a diverse range of data, from positioning coordinates and body rotation angles to raw audio and physiological signals. The challenge is to extract meaningful insights from this complex, low-level data. In this symposium, I will discuss two of our recent approaches in addressing this challenge. In this symposium, I will discuss two recent directions of our work.

Our first direction entails creating a modelling approach to imbue multimodal sensor data with meaningful information. This approach allows us to map from low-level data to higher-order team constructs [18]. Drawing inspiration from the foundations of QE, we proposed a practical approach called the "multimodal matrix" [19]. This approach codes low-level sensor data into discrete data points with contextual meaning. Rather than analyzing or visualizing raw student coordinates in the physical space, we associate spatial coordinates with areas-of-interest (e.g., whether a student is near a specific patient or a medicine trolley) and activity tasks (e.g., whether the student is in a space representing the activity's primary or secondary tasks as per the intended learning design) [20]. We also determine whether students exhibit spatial configurations (e.g., based on their proximity and body rotations) indicative of conversation with each other (a construct studied using the notion of f-formations) [21]. The resulting coded spatial data, paired with information from audio devices, provides a richer portrayal of the complex embodied teamwork activity. We have begun coding speech data into teamwork codes automatically using emerging AI technologies, such as Large Language Models, which facilitate automated transcription and coding [22].

Our second direction aims to complete the learning analytics cycle by developing multimodal learning analytics interfaces and deploying them in-the-wild [23]. Work done in the first direction has generated a deeper understanding of highly dynamic and complex teamwork activity within the physical learning space, providing various research contributions. However, the ultimate goal of learning analytics is to have a tangible impact on practice. Hence, building upon the same QE and modelling foundations, in this second direction we are developing multimodal learning analytics interfaces that are accessible to teachers and students. For instance, we have created data storytelling interfaces that probe the multimodal matrix to highlight specific data points relevant to formative assessment according to teachers' learning designs [24]. We are currently exploring ways to convey insights from applying epistemic network analysis (ENA) using simplified epistemic networks, narrative reports, and graphical stories.

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Identifying Identity: A Symposium Discussion on Identity Theory and Practice in QE

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Abstract. The field of Quantitative Ethnography (QE) and related visualization techniques such as Epistemic Network Analysis (ENA) present an opportunity to enhance understanding of complex cognitive processes. As a result, the QE field has seen an influx of research around identity, drawing on the alignments between different theoretical perspectives and the affordances of QE when applied to a variety of contexts. The aim of this symposium is to extend our understanding of current and future applications of identity in QE through interactive engagement with a diverse group of theoretical and practical experts. Topics will include (1) an overview and summative review of existing identity work in QE, (2) exploration of how QE techniques may align with and support identity theories and perspectives, (3) discussion of next steps (practical, methodological, and theoretical) for the future of identity in QE. Through interactive presentations and discussions, attendees will engage in a dialogue on the development of robust methodologies for modeling complex identity processes and contribute to the preparation of future contributions to the community.

Keywords: Identity, Identity Exploration, Quantitative Ethnography, Epistemic Network Analysis.

1 Background

Quantitative ethnography (QE) is an interdisciplinary approach that combines elements of ethnography, which traditionally leverages qualitative methods for closely examining the complexity of thinking and doing in contextually situated cultures and social phenomena, with quantitative techniques for visualization and analysis [1]. In recent years, applications of QE tools and techniques such as Epistemic Network Analysis (ENA) have gained prominence across various disciplines, including anthropology [2], sociology [3], education [4], and psychology [5], as researchers recognize their utility for understanding the complexity of individual and group cognition and self-reflection.

In response, an increasing number of researchers and projects have adopted a QE approach and leveraged tools such as ENA to understand individual and group identity practices by providing insights into how individuals/groups perceive, construct, or connect to their identities within specific social and cultural contexts. Initial alignment between QE approaches and identity research likely stems from work on Epistemic Frames, which conceptualizes the context and domain-specific set of skills, knowledge, identities, values, and epistemologies inherent to communities of practice in which learners may need to engage and build literacy as part of learning [6-7]. This theoretical framing served as the foundation on which techniques to visualize and understand this complexity (e.g., ENA) were built.

Reviews of thematic and practical trends in submissions to the International Conference on Quantitative Ethnography have highlighted identity as a prevalent theme [8-9], with over 30 submissions from at least 40 authors across the last five years. Theoretical and practical topics in this vein have so far included examinations of (1) Sociocultural identity formation and negotiation [10-11], (2) Teacher identity and teaching practices [12-13], (3) Racial and intersectional identities [14], (4) Identity in games and virtual spaces [15-16], and (5) Identity development and trajectories of change [17-18] to name a few. These areas serve as valuable points of discussion on the status of the QE field in terms of "identifying identity" across diverse contexts and from different theoretical perspectives. We hope to extend this benefit by bringing together insights from leaders in this community of QE identity scholars to discuss their applied work, shedding light into the affordances and constraints of techniques such as ENA for understanding identity, mapping next steps for research and practice, and preparing current and incoming researchers to adopt novel techniques in the service of identity research.

2 Symposium Aims and Contributions

2.1 Aims

The aim of this symposium is to expand our knowledge regarding the current and ongoing applications of Quantitative Ethnographic approaches and techniques to understand identity processes through engaging interactions with a diverse group of experts in theory and practice. The symposium will cover the following topics:

1) A summative overview and review of existing work on identity within the field of Quantitative Ethnography.
2) An exploration of the alignment between specific QE techniques such as ENA with different identity theories and perspectives, framed around applied identity research in diverse learning contexts.
3) An open-ended discussion of the next steps, encompassing practical, methodological, and theoretical aspects, for the future advancement of identity research within Quantitative Ethnography.

We anticipate that the following benefits and contributions will emerge from the symposium discussion and subsequent research outputs:

1) A collaborative, accessible overview of existing research on identity in QE for incoming scholars.
2) Dialogue between new and returning scholars around the potential applications of QE approaches and techniques to identity research from different theoretical approaches and applied contexts.
3) Sharing of study designs and analysis procedures for understanding:
    a. Individuals and group identities in sociocultural contexts.
    b. Trajectories of identity change over time.
4) Summary of analysis practices for QE identity research, including:
    a. Identification and selection of codes, including mapping identity perspectives to specific constructs.
    b. Coding procedures and techniques for identity constructs, particularly when codes are more subjective or personalized by participant.
    c. The utility of both epistemic and ordered networks for understanding different facets of identity.
5) A discussion of the affordances and constraints of QE, including:
    a. Examinations of identity in multimodal data (e.g., data traces, gestures, types of data)
    b. The application of multiple approaches in tandem (including QE) to address potential limitations of each.
6) A roadmap for areas of emergent research, methodological innovations, possible future collaborations, and notes generated from symposium discussion to be shared with the broader QE community.

2.2 Proposed Symposium Structure

To address aim 1 (summary of existing work), the authors will jointly contribute to the development of a summative presentation on the themes and features in existing QE research on identity, to be presented by 1-2 collaborators. To address aim 2 (applied examples), scholars from each participating institution (Clemson University, Drexel University, Pepperdine University and University of Pennsylvania) will introduce their relevant research projects, with an emphasis on their identity framing and the affordances and constraints of QE techniques for their projects and aims. Our intention is to showcase diverse application contexts that might serve incoming QE scholars and set the stage for next steps in the field and topic. To address aim 3, 1-2 collaborators will create and share a summative overview of proposed next steps (both practical and methodological) offered in individual presenters' work, with prompting discussion questions to further whole-group discussion with session attendees.

The symposium will be structured as follows:

1) A 5–7-minute introduction to the summative review of existing identity research in Quantitative Ethnography.
2) 25 minutes for collaborators from each participating institution (5-7 minutes each) to introduce their research, with emphasis on the following topics:

a. In what context(s) did you conduct research on identity that leveraged a Quantitative Ethnographic approach? Which populations did your research serve?
b. What is your theoretical conceptualization of identity? In what ways do QE techniques and approaches align with this framing?
c. What QE techniques or approaches did you adopt as part of your research? What were the affordances and constraints of this approach?
d. What next steps do you hope to address in future work (or do you hope other scholars address)?

3) A 5–7-minute summary of proposed next steps for QE identity research, including a brief discussion of emergent QE techniques (e.g., Ordered Network Analysis) as a "hook" for whole-group discussion.
4) 20 minutes of open discussion with attendees with a focus on questions, ideas, collaborations, or future contributions to the community.

We aim to engage the audience by sharing a Padlet of topics and categories at the beginning of the symposium and inviting participants to contribute questions and ideas throughout for discussion at the conclusion of the session.

3 Symposium Contributors

The symposium on identity in quantitative ethnography research brings together a distinguished panel of seven contributors, each making significant contributions to the ongoing discourse on reporting in research on identity and within the field of Quantitative Ethnography. Participating scholars will bring rich perspectives on identity applied to diverse learning contexts and will share findings and next steps from their respective areas of work.

Amanda Barany. Amanda Barany is an incoming postdoctoral scholar in the Learning Analytics and Teaching, Learning and Literacy departments in the University of Pennsylvania Graduate School of Education. She recently completed her postdoctoral work for the Louis Stokes Alliance for Minority Participation (LSAMP), working in the School of Education at Drexel University to leverage QE techniques to understand how LSAMP students engaged in STEM identity exploration. She completed her graduate work with Aroutis Foster's GLIDE lab at Drexel, which unifies her interests in game-based learning, the design of computer-based learning environments, identity, and interest and motivation. Dr. Barany has also published work on learning as identity exploration is carried out in video game community forums, and taught QE courses for the last two years.

Lara Condon. Lara Condon is a PhD Candidate at the University of Pennsylvania Graduate School of Education in Teaching, Learning, and Teacher Education. Lara began her work in QE in 2022, participating in the doctoral consortium and presenting her work on the patterns of feedback posted in an online, asynchronous inquiry group

of early career teachers. Lara's research focuses primarily on teacher education, mathematics education, with her dissertation research exploring the conceptualization and mapping of mathematics teaching identity in different organizational contexts. Her work explores the application of QE techniques such as ENA and leverages Kaplan's Dynamic Systems Model of Role Identity (DSMRI) to conceptualize teacher growth.

Danielle Espino. Dr. Danielle Espino is a co-principal investigator at Pepperdine University for NSF-funded research examining the impact of cross-boundary collaboration in informal STEM learning on adolescent identity development (NSF Awards # 2215613), utilizing quantitative ethnography (QE) as a primary methodological approach. Papers she has authored highlight different ways epistemic network analysis (a QE tool) has been used to discover findings on cross-cultural community building, global competences, connections between affect and discourse, group dynamics and advancing conversations on justice, equity, diversity, and inclusion (JEDI). Her previous professional experiences include project management roles with the arts nonprofit sector and various higher education institutions in California, New York, and Virginia.

Aroutis Foster. Aroutis Foster is a Professor of Learning Technologies and interim Dean of the School of Education at Drexel University in Philadelphia, PA. He leads the Games and Learning in Interactive Digital Environments (GLIDE) Lab and is the founder of the Drexel Learning Games Network. He teaches and conducts research on the theoretical and practical applications of designed environments such as games and interactive digital environments to advance our understanding of learners' knowledge, identity, and motivation in different settings including schools, workplaces, informal, and online environments. His broad research interests focus on the design of technology, computer-based learning environments, automated and personalized learning, technology integration, identity exploration, motivation, cognition, and learning. His research aims to explore the learning process including motivation to learn and learners' identity change using immersive digital technologies, such as games. This includes model testing and development to integrate games and immersive technologies to support teachers and learners; the design of immersive and game environments to impact knowledge, identity change, and motivation to learn; and the investigation of the pedagogic, assessment, and motivational affordances of immersive digital environments for cognition, motivation, and behavior. Dr. Foster's background is in educational psychology, educational technology, digital media, information technology education, and communications. His professional agenda has emerged from both his research and life experiences growing up in the Caribbean (Jamaica) and studying and living in New York City; East Lansing, Michigan; and Philadelphia.

Eric Hamilton. Dr. Eric Hamilton is a learning technologist who directs the International Community for Collaborative Content Creation (http://ic4.site), a five-year research effort funded by the US National Science Foundation (NSF). He has published on QE and identity work through this and other projects and has directed numerous research projects funded by NSF, the Department of Education, the US State

Department, and the Microsoft Research Foundation. He recently completed a three-year Fulbright Research Fellowship in Namibia, spanning work over three years. Prior to joining GSEP in 2008, he served as director of the United States Air Force Academy Center for research on learning and teaching. He has held two directorship positions at the National Science Foundation. While in those roles he supervised with signature program authority approximately $500 million in National Science Foundation investments in science and mathematics education and education research. Hamilton has also served as a visiting professor at Hiroshima University at the Center for the Study of International Cooperation in Education; Visiting Professor at Tampere University of Technology in Pori, Finland; and was a faculty member at Loyola University Chicago. In addition, he has experience as a mathematics teacher for grades 6-12.

Seung Lee. Seung Lee is an Assistant Professor at Pepperdine University whose research focuses on collaborative learning, online interactions, socio-cognitive processes, and creativity among K-12 students, particularly in the context of STEM education and is currently involved in two studies funded by the National Science Foundation. Dr. Lee's methodological expertise is in quantitative ethnography and epistemic network analysis (ENA), which apply statistical and visualization techniques to model the structure of connections in the data. He served as the Program Committee Co-chair for the 2020 International Conference on Quantitative Ethnography. His previous professional experiences include policy research and program management roles with the United Nations Children's Fund (UNICEF), International Organization for Migration (IOM), and nonprofit foundations in Korea and the U.S.

Hazel Vega. Dr. Vega is currently a Grant Project Manager in Education and Human Development at the College of Education at Clemson University. With research expertise in Participatory Quantitative Ethnography (PQE) and subsequent projects examining identity using QE, her research interests focus on digital literacy and new literacies for second/foreign language learners, as well as translanguaging practices.

4 Summary

Initiating a conversation on the current status and future directions of identity research in QE holds benefits for supporting community, connection, and interdisciplinary understanding for researchers using QE to study complex cognitive processes including, but not limited to, identity work. The session also holds value for newcomers to ICQE who are interested in research in these areas, so that they may gain an understanding of the current status of this work and find inspiration or collaboration opportunities to conduct research in novel contexts using emergent techniques. Through this symposium, we hope to structure an active dialogue on alignment between theory and practice that might be of value to the broader QE community, and result in outcomes that support the development of innovative research, further summative reports of QE research, and a more connected and collaborative research community.

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Posters

An Entropy-Maximization Approach for Identifying Observer Bias *

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Abstract. A statistical, information-theoretic approach to identify bias in Likert-type observational survey instruments is presented. The approach is formulated based on the principle of maximum entropy, a useful framework for the unbiased estimation of population characteristics in the presence of limited data. The application of the approach towards the analysis of a small-sized sample data set is presented. The results demonstrate how the approach can provide a more nuanced characterization of clustering or outlier behavior than that possible from summary statistics or assumptions of prior distributions.

Keywords: bias modeling · maximum entropy · observational surveys · scoring uncertainty · contextual engineering

1 Introduction And Motivation

This work is motivated by the need to discover patterns of clustering behavior when dealing with small-sized Likert-type data set concerning observed social behaviors. The approach is a statistical, information-theoretic technique to uncover patterns that may help provide insight on possible sources of subjective observer bias. The primary objective behind its development is to provide a level of familiar mathematical rigor and quantification to the analysis of qualitative observational data by engineering practitioners unaccustomed to qualitative analysis. An example data set is provided next that will be used as a case study to illustrate the proposed modeling approach.

1.1 An Illustrative Data Set

The data set, shown in Table 1, originates from an ethnographically-informed observational survey instrument, referred to as the Contextual Influence Predictive Tool (CIPT) [2]. It is an empirical tool developed specifically for engineering professionals from the Global North practicing in communities in the

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Global South. It provides a quantitative means of distilling the generally nebulous concept of societal uniqueness into a set of five societal characteristics, referred to as contextual influences: Cultural, Political, Educational, Economic, and Mechanical. Structurally, it is a questionnaire comprising 41 questions related to observations of various societal behaviors and lifestyle practices, each scored on a 1-5 Likert scale. These assigned scores are compiled and processed to output a numeric score between 1 and 5 for each influence. The scores in Table 1 are the computed contextual influence scores for 11 observers, untrained in Contextual Engineering methodology, who conducted a field survey in a rural Honduran community for the design of a communal water distribution system.

Table 1: The sample data used in this study

Observer	Cultural	Political	Educational	Mechanical	Economic
O1	2.67	3.31	3.13	3.18	3.09
O2	2.89	3.29	3.22	2.36	3.37
O3	1.94	2.85	3.13	2.64	3.10
O4	2.94	3.46	2.56	2.91	2.77
O5	2.33	3.08	3.63	3.27	3.00
O6	3.06	2.96	3.00	2.55	3.50
O7	2.78	3.46	2.75	3.18	3.14
O8	2.61	3.00	2.25	2.55	2.86
O9	3.00	3.00	3.25	2.91	3.32
O10	2.83	3.23	2.69	2.82	3.27
O11	2.22	2.62	3.19	3.09	3.14
mean $\widehat{\mu}$	2.66	3.11	2.98	2.86	3.14
std. dev. $\widehat{\sigma}$	0.36	0.26	0.38	0.31	0.22
skewness $\widehat{y}$	-0.95	-0.34	-0.39	-0.19	-0.10
kurtosis $\widehat{k}$	-0.02	-0.38	-0.11	-1.29	-0.34

If the community contextual influence scores are regarded as random variables, the observer scores represent a set of samples from the underlying (unknown) distributions. Characterization of the underlying distribution can provide a description of the observed data, as clusters and outliers can be identified for further investigation. The method of entropy maximization is an attractive approach for this purpose, as the uncertainty inherent to a small data set can be directly incorporated into the modeling framework, obviating the need to make additional statistical assumptions. Details of the method are elaborated upon in the next section.

2 The Approach – The Principle of Maximum Entropy

Consider a random variable X that can realize one of n finitely many outcomes from the set $\{x_1, x_2, \ldots, x_n\}$, with each outcome x_i having an associated probability p_i of occurrence. The principle of maximum entropy (ME) states that the most appropriate choice of the possible values of p_i are those that maximize the entropy $H(X)$ of the random variable X [1]. Mathematically, the ME probability distribution $\{p_1, p_2, \ldots, p_n\}$ is the solution of the following constrained

optimization problem:

$$\begin{aligned} \underset{p_i}{\text{maximize}} \quad & H(X) := -\sum_{i=1}^{n} p_i \log(p_i) \\ \text{subject to} \quad & \sum_{i=1}^{n} p_i = 1, \\ & p_i \geq 0, \quad \text{for } i = 1, 2, \ldots, n. \end{aligned} \tag{1}$$

Additional knowledge about the sample data – embodied in the summary statistics – such as central tendency (mean $\widehat{\mu}$), spread (standard deviation $\widehat{\sigma}$), asymmetry (skewness $\widehat{y}$) and tendency for outliers (kurtosis $\widehat{k}$), can be included by adding their respective constraints to the optimization problem, as follows:

$$\sum_{i=1}^{n} p_i x_i = \widehat{\mu}, \qquad \sum_{i=1}^{n} p_i (x_i - \mu)^2 = \widehat{\sigma}^2,$$

$$\sum_{i=1}^{n} p_i \left(\frac{x_i - \mu}{\sigma}\right)^3 = \widehat{y}, \qquad \sum_{i=1}^{n} p_i \left(\frac{x_i - \mu}{\sigma}\right)^4 = \widehat{k},$$

3 Results, Analysis, and Discussion

The computed maximum entropy (ME) distributions for the influences are presented in Figure 1. Figure 2 illustrates the ME probability distribution of the

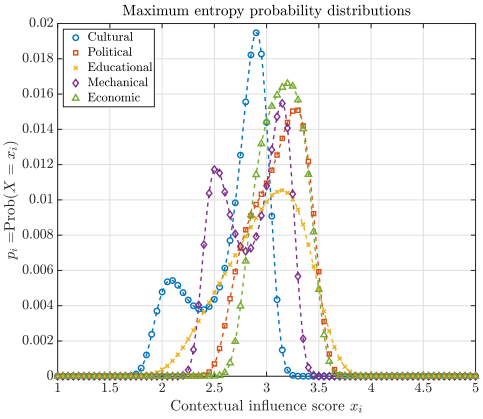

Fig. 1: The ME probability distributions of the contextual scores.

mechanical influence scores, which indicates that the underlying data possesses some clustering behavior, which may not have been readily apparent by observing the data in isolation. Six of the 11 observer scores (O1, O4, O5, O7, O9, and O11) were above the mean and five (O2, O3, O6, O8, and O10) were below. Of

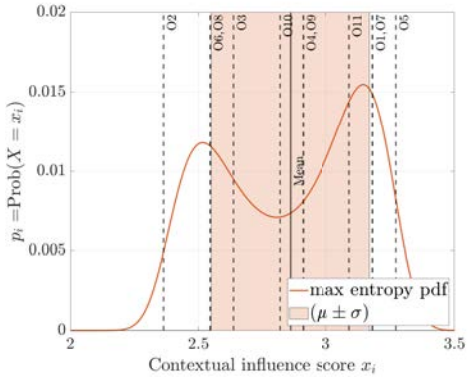

Fig. 2: The ME probability distribution for the mechanical influence scores, with the individual observer scores superimposed as dotted vertical lines.

the five below the mean, two (O6 and O8) were marginally at one standard deviation and one (O2) was beyond it. For the six scores that were above the mean, two (O1 and O7) were marginally at one standard deviation, while one (O5) was beyond it. Three scores (O4, O9, and O10) were clustered around the mean. The bimodality of the ME distribution and the clustering of scores into three groups around the μ, $(\mu - \sigma)$, and $(\mu + \sigma)$ values suggests that there appear to be differing observer assessments of the community's mechanical influence. The differing assessments may indicate that the observers focused on observing different segments of the community during their field investigations.

4 Conclusions and Future Directions

An approach was presented on the characterization of numeric data obtained from ethnographic survey instruments. The principle of maximum entropy was presented as a means to obtain a better understanding of the available data without injecting additional prior assumptions. This "maximally-uninformed" characterization provided a rationale to revisit the available data set to discover subjective observer biases, as well as provided insight on what factors may or may not be relevant in uncovering it. Future work involves the development of an integrated qualitative analysis of the observers and their interactions with the community to develop a method of synthesis that allows the cross verification of the qualitative and quantitative methods.

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Investigating College Students' Epistemic Understanding of Science through Drawing and Epistemic Network Analysis

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Abstract. This study investigated students' understanding of the nature of science (NOS) through the drawing and epistemic network analysis (ENA) methods. Data were collect from 49 students who were enrolled in a general science course at a university in Taiwan. The students were asked to complete the Draw-a-Scientist-Test (DAST). Their drawings were then coded using a coding scheme generated from the current data and past studies on both the DAST and the NOS. Subsequently, ENA was performed using the coded data to generate a network model of students' epistemic understanding of science. It was found that students' epistemic understanding of science predominantly comprises various elements including subject, facilities and equipment, practice, collaborative ethos, and environment. In particular, the interrelationships among the latter four elements were relatively strong.

Keywords: Drawing, Assessment, Epistemic Understanding of Science, Epistemic Network, Analysis.

1 Introduction

The purpose of the study was to investigate college students' understanding of the nature of science through the drawing and epistemic network analysis (ENA) methods. The Draw-a-Scientist-Test (DAST) developed by [1] utilizes drawing as a means to elicit students' views of science and scientists. In the DAST, students are each prompted to produce a drawing portraying not only a scientist but also the activities in which the scientist is engaged [2]. The DAST enables the capture of students' epistemic understanding of science. However, past research [3] analyzed students' DAST drawings mainly using a checklist that indicated the presence or absence of an object in the drawing, such as a lab coat, eyeglasses, symbols of research, and so forth. The conclusions from the checklist analysis focused on whether or not students held stereotypical views of science and scientists, as opposed to students' epistemic understanding of science.

In order to explore innovative methods that may help deepen the analysis and findings from DAST studies so that students' epistemic understanding of science can be revealed, this current study applied the theoretical framework of the family resemblance

approach (FRA) [4, 5] for the coding of the students' DAST drawings and combining it with ENA. The FRA suggests science as a cognitive-epistemic and social-institutional system. It proposes a comprehensive list of the nature of science (NOS) categories [4, 6]. The NOS categories were adapted in this study. Specifically, they were combined with the DAST checklist, to generate the coding scheme for students' epistemic understanding of science as demonstrated in the drawings they produced in response to the DAST. Moreover, ENA was employed to enable the analysis and presentation of students' epistemic network models of science [6, 7]. ENA provides results that are difficult to obtain through only the checklist method. For example, how the NOS elements co-exist in the students' epistemic understanding of science could be investigated and revealed in the current study, which provides insights into the extent to which students' epistemic understanding of science matches the theoretical framework of the NOS, as well as the innovative analytical methods used for drawing and DAST research.

2 Methods

The study recruited a cohort of forty-nine students from a prestigious university located in the northern region of Taiwan. The students were enrolled in a general science course that the university offered and were invited to participate in the research voluntarily. Their participation in the research (the drawing task) did not affect their academic grades, and they were not compensated for their involvement. The participants were comprised of 34.7% (n=17) males and 65.3% (n=32) females.

The DAST [1] was adapted in the study, with students being asked to respond to the following question via drawings: "In your impression, what does a scientist look like? Please think of a scientist, and how the scientist is doing science, and draw all of your ideas below". The students were not restricted in terms of the modes of representation they could utilize. On average, the students spent approximately 20 minutes completing the DAST.

The coding scheme was generated based on the current data, the categories on the checklist used in past DAST studies [3], and the NOS categories suggested in the FRA framework [4, 5]. The final coding scheme is presented in Table 1. For each drawing that the participants produced, the appearance of each sub-category was assigned to a value of 1, and the absence of each sub-category was assigned to a value of 0. All 49 drawings were independently coded by two researchers. The inter-coder agreement using Cohen's kappa was 0.85. Any codes deemed inconsistent were thoroughly examined and resolved through discussion. Epistemic network analysis (ENA) was subsequently conducted utilizing the ENA1.7.0 Web Tool [8] to generate network models comprising nodes and connections [7, 9]. The stanza size for the analysis was set to 1 since there was no interaction among the participants [10, 11].

3 Results

Table 1 reveals that all 49 participants depicted subject (S) characteristics, with 73.5% of the students portraying a male scientist. The element of facilities and equipment (F)

was also represented in all of the students' drawings, with 81.6% conveying images of beakers, 67.3% depicting experimental clothing, and 59.2% showing glasses. Moreover, a considerable proportion of participants (89.8%) referred to practices (P) in their drawings, with approximately 75.5% of the students depicting the concept of an experiment within this element. In addition, the element of collaborative ethos (C) was prevalent, appearing in 87.8% of the drawings, with the majority of students (79.6%) expressing the impression of a scientist's independent work. Finally, the environments (E) in which science occurs were depicted in 83.7% of the students' drawings, with a predominant focus placed on indoor settings (81.6%). Furthermore, some students (26.5%) featured the element of knowledge, data, and subject (K) in their drawings, whereas a smaller proportion of students (16.3%) depicted professional activities (e.g., writing manuscripts and attending conference presentations) in their drawings. In contrast, the elements related to aims and values (A), social values (V), and dissemination (D) were less frequently depicted in the students' drawings, with their proportions ranging from approximately 2% to 6%.

Table 1. The coding scheme and the frequency of categories and sub-categories

Categories and sub-categories							
S. Subject	49(100%)	P.5 Record	7(14.3%)	F.5 Beaker	40(81.6%)	K.1 Sign of knowledge	10(20.4%)
S.1 Male	36(73.5%)	P.6 Observe	13(26.5%)	F.6 Alcohol lamp	10(20.4%)	K.2 Data	3(6.1%)
S.2 Female	1(2.0%)	P.7 Model	6(12.2%)	F.7 Microscope	4(8.2%)	**Pro. Professional activities**	8(16.3%)
S.3 Unknown	12(24.5%)	**E. Environment**	41(83.7%)	F.8 Magnifier	2(4.1%)	Pro.1 Presentation and Publication	8(16.3%)
A. Aims and values	3(6.1%)	E.1 Indoor	40(81.6%)	F.9 Telescope	2(4.1%)	**C. Collaborative ethos**	43(87.8%)
A.1 Explore	2(4.1%)	E.2 Outdoor	3(6.1%)	F.10 Pen	7(14.3%)	C.1 Work independently	39(79.6%)
A.2 Prove	2(4.1%)	E.3 Dangerous	3(6.1%)	F.11 Note	8(16.3%)	C.2 Collaborate	4(8.2%)
P. Practices	44(89.8%)	**F. Facilities and equipment**	49(100%)	F.12 Globe	3(6.1%)	**D. Dissemination**	1(2.0%)
P.1 Research	4(8.2%)	F.1 Experimental Clothes	33(67.3%)	F.13 Book	5(10.2%)	D.1 Teaching	1(2.0%)
P.2 Experiment	37(75.5%)	F.2 Gloves	1(2.0%)	F.14 Test subject	8(16.3%)	**V. Social values**	2(4.1%)
P.3 Imagine	3(6.1%)	F.3 Glasses	29(59.2%)	F.15 Computer	6(12.2%)	V.1 Addressing human needs	2(4.1%)
P.4 Calculate	3(6.1%)	F.4 Caliber	22(44.9%)	**K. Knowledge/data/ subject area**	13(26.5%)		

Figure 1 shows the mean epistemic network model of the students' understanding of science expressed through their drawings, as a result of ENA. It was observed that only the facilities and equipment (F) element displayed a stronger association with other elements such as practices (P), collaborative ethos (C), and environment (E). Also, the epistemic network analysis revealed that the connections between practices (P), collaborative ethos (C), and environment (E) were notably strong. Taken together, the results suggested that most college students' epistemic understanding of science includes multiple elements connected together, as opposed to isolated pieces of elements. Predominantly, their epistemic understanding of science comprises the work environment, ethos, practices, and facilities and equipment. On the other hand, the aims and values

and social values of science are rarely represented, indicating areas of college students' restricted epistemic understanding of science for future enhancement.

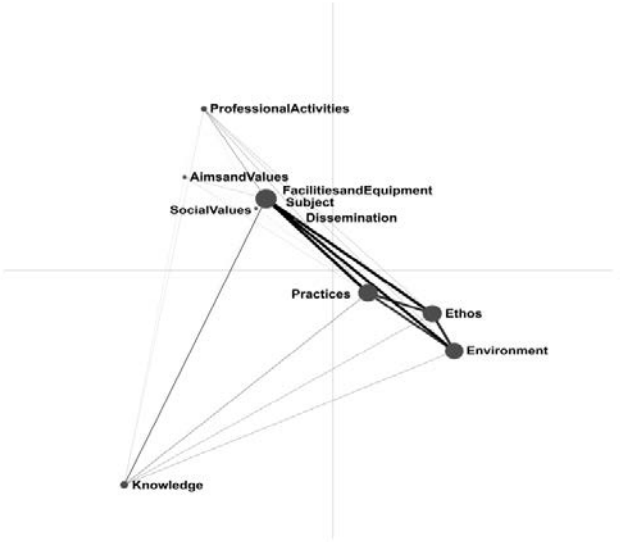

Fig. 1. An overall network model of the 49 students' epistemic understanding of science

4 Concluding Remarks

This study contributes to a new coding scheme combining DAST checklists with FRA. Moreover, the present study employed ENA to investigate how students' epistemic understanding of science was interrelated, such as the aspects of connecting environmental considerations, scientific practices, and norms.

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A Quantitative Ethnography Exploring a High School Mathematics Teacher's Journey Through Artifacts

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Abstract. Few studies have focused on teaching materials as a window into how mathematics teachers' instructional practice develops. In this study, the use of quantitative ethnography (QE) addresses this research gap and explores the utility of QE analysis on artifacts. The preliminary findings show that the instructional materials captured the teacher's shifts in concern, revealing an early focus on algorithm-heavy teacher-focused instruction that evolved into a focus on tailored student-focused materials and collaborative activities that engaged students with rigorous mathematics.

Keywords: Quantitative Ethnography, Mathematics Education, Instructional Practice.

1 Introduction

Mathematics education's current focus is providing all students access to rigorous, high-quality mathematics instruction. Research statically examines mathematics teachers' instruction associated with their knowledge, beliefs, curriculum materials, and professional learning [1]. Studies that examine how teachers' instructional practice develops over time are uncommon and limited in context, like technology integration, interventions, the COVID-19 pandemic, and teacher knowledge and typically study pre-service teachers [2,3]. Few studies have examined teaching materials as a window into how teachers' instructional practice develops. This quantitative ethnography (QE) addresses the gap in the literature by exploring, through an analysis of teaching materials, how one high school mathematics teacher's instructional practice developed over time.

Fuller's [4] Concerns Theory conceptualizes three stages of concern that teachers undergo in their development: self-concerns, task-concerns, and impact-concerns. During the first stage, self-concerns, teachers focus primarily on themselves and their needs by prioritizing classroom control, projecting mathematical and pedagogical competence, and survival [5]. In the second stage, task-concerns, teachers shift onto how, what, and who they teach with priorities of curriculum, instruction, class size, and planning time. The third stage, impact-concerns, sees teachers' attention shift toward impacting their students' learning and meeting each student's academic and emotional needs. The sequential, temporal structure of Fuller's theory frames this

study's research question, **how do the stages of concern manifest within the teaching materials of a high school mathematics teacher?**

2 Methods

In this study, I was the teacher participant. I collected data from 143 of my digital documents, such as worksheets and activities, representing a subset (one unit) of the materials from the unit, systems of equations, because it spans my teaching career. I developed grounded codes and coded the data with the following codes: T.FOCUS, ACTIVE, S.FOCUS, ALGORITHM, APPLY, GR.TASK, and MULTI.REP (link to **Codebook**). The data were segmented to the mathematics problem level to ensure line uniformity [6]. Stanzas were one document, and the stanzas aggregated into a higher category equivalent to a lesson. The higher stanzas aggregated into conversations equivalent to the unit's topics. I used a whole conversation model to aggregate connections across the entire unit topic. Goodness of fit of the model (x-dimension) according to the ENA tool was calculated as .96 (Pearson) and .94 (Spearman).

This QE study uses epistemic network analysis (ENA) and inferential statistics via the ENA web tool to visualize and provide statistical evidence of the differences in the first and last teaching stages according to Fuller's Theory [4]. The units of analysis are all stanzas of data from 2004-2012 (Early) and all stanzas from 2013-2021 (Late).

3 Preliminary Findings

Figure 1 shows a subtracted network visualization between the Early and Late stages. The red points, mostly on the left side of the space, represent teaching materials from the Early stage, and the blue and green points on the right represent the Late stage. The means of the instructional materials for Early (red square) and Late (blue square) suggest that the two groups differ in how they progress through time (x-axis) but not in mathematical understanding (y-axis). In the x-dimension, teacher-focused instruction connections (red lines) are stronger in Early, but student-focused instruction connections (blue lines) are stronger in Late. Statistical testing with a two-sample t-test assuming unequal variance confirms that along the x-axis, Late (mean=0.58, SD=0.29, N=90) is statistically significantly different at the alpha=0.05 level from Early (mean=-0.99, SD=0.61, N=53; t(65.56)=-17.49, p=0.00, Cohen's d=3.59).

According to the model, I began teaching with the goal of engaging students with rigorous mathematics, but my principal focus quickly became survival and classroom control. I employed teacher-focused instruction, engaging my students with application problems and multiple representations, but relied heavily on algorithmic drilling as shown by the most robust relationships (thickest red lines in Figure 1) and the guided notes teaching (Figure 1) document with fill-in-the-blanks to maintain organization and classroom control. Near the midpoint of my teaching career my attention shifted toward instruction. I embraced a more inquiry-based and collaborative teaching style that included more opportunities for applied thinking, peer collaboration, and

thinking through rigorous mathematics from different perspectives as shown by the most robust relationships (thickest red and blue lines in Figure 1), several weaker relationships (thin red and blue lines in Figure 1) that connect the middle of the graph to both the left and the right sides, and a class activity in which students had to collectively reason through a "word problem," without explicit instruction on solving applications of 3x3 systems of linear equations, to formulate the system of linear equations. In the last years of my teaching, I concentrated mainly on my students as individual learners with individual needs as I created and tailored my materials to different student interests and abilities and engaged my students daily with rigorous mathematics. This student-focused relationship is shown by the most robust relationships (thickest blue lines in Figure 1) and the floral business class project (Figure 1) selected. In this project, many students were motivated by the relevant connection to their floral class, which broadened mathematical access for students by shifting between multiple mathematical forms and interpretations.

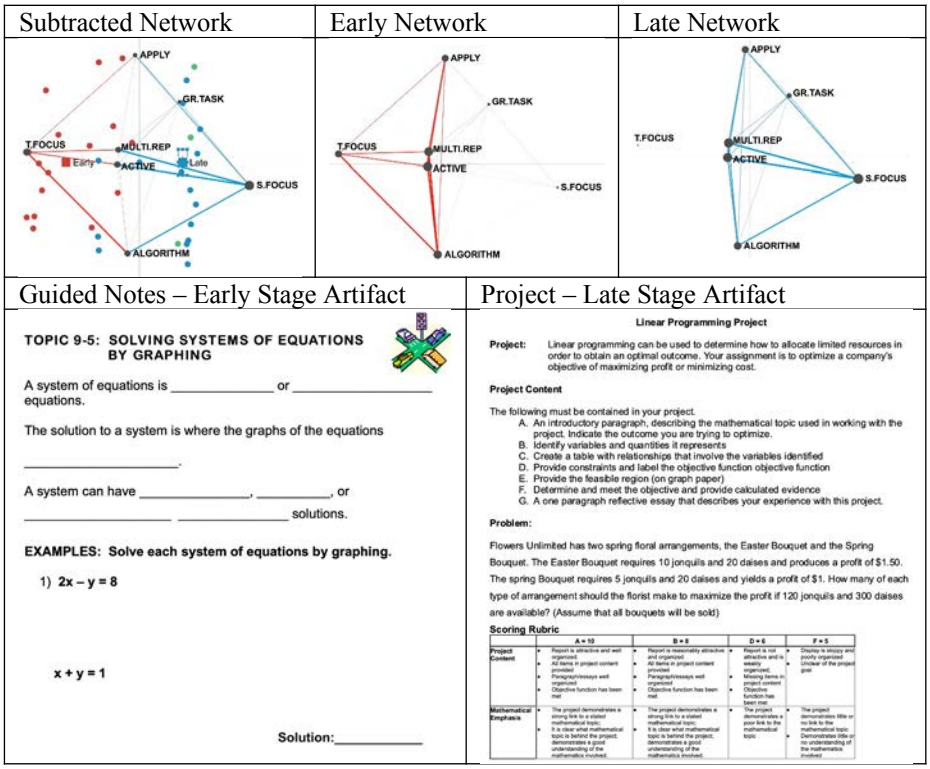
The network graphs and the guided notes emphasized procedure-heavy instruction and confirmed strong connections among algorithmic problems, providing multiple representations, actively engaging students, and teacher-focused instruction in my Early years, characteristic of the self-concerns stage of a beginning teacher [4]. As I developed my teacher identity, I began to enact pedagogical changes transitioning me into the task-concerns stage. My concerns shifted toward my students' learning with higher-quality tasks and more opportunities for student collaboration. The network graphs and the class project confirm strong connections involving student-focused instruction, algorithmic problems, providing multiple representations, actively engaging students, and application problems in these Late years as I entered the impact-concerns stage. The connections to applications, algorithms, multiple representations, and actively engaging students demonstrate how I revised my early practice by utilizing these characteristics differently over time rather than drastically changing my practice.

3.1 Conclusion

The findings from this study show how the stages of concern manifest within my teaching materials. The findings suggest that as I evolved professionally, my primary focus shifted from myself to my instruction for my students. My instructional materials captured the shifts in concern, revealing an early focus on algorithm-heavy teacher-focused instruction that evolved into a focus on tailored student-focused materials and collaborative activities that engaged students with rigorous and alternative forms of mathematics. These findings align with Fuller's [4] Theory and add to the small body of empirical research regarding how teachers' instructional practice develops over time. This study satisfies the gap in the literature by expanding the examination to the contexts of high school mathematics and teacher instructional materials. This study has several limitations: the qualitative analysis was limited to a single coder (the ethnographer), so no interrater reliability statistics could be calculated, the data for this study was a purposefully selected unit from the population that may not be representative of the entire data set, the researcher knows the data intimately and

may have unexamined subjectivities, and the data set consists of only the files stored upon the google drive so paper and other media were not considered. Regardless, these preliminary findings suggest that future studies could model aspects established in this study to formulate a generalizable depiction of how teachers' instructional materials provide evidence for their instructional practice development.

Figure 1. Networks and Artifacts



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Categorizing Interpretative Steps for Group Work

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Abstract. New data modalities are increasingly used to study group work. While it promises novel understandings of groups, new modalities also demand new interpretative arguments in order to be meaningful. In this poster, we suggest a categorization of data, methods, and research areas in group work to study how interpretative loops have been closed and to what extent the interpretations are transferable across studies of different aspects of the group work.

Keywords: multimodal learning analytics, group work, interpretative loop

1 Measures of Dimensions of Group-Work

Group work is a prominent instruction design in education, involving group-based activities with shared goals and possibilities to learn from peers [1]. It is a complex instruction form and can be a means to several different ends, such as participating in group work to learn from each other, to be able to overcome more difficult tasks or simply to be better at doing group work. Thus, the evaluation of group work is contingent on the outcome of the group work. An example is that groups that perform badly at a test might do so due to spending more time on meta-cognitive aspects of the group work, which might benefit their future group encounters.

Group work in education is an embodied practice in which students communicate in a multitude of modalities. Students can point, make faces, change their body postures, talk, whisper, write, or draw, all of which are informative to understand the interaction in the group. Technological advances, particularly within learning analytics, have utilized new multi-modal indicators. This adds physiological and physical measures to the more traditionally used discourse data [2]. Furthermore, discourse data has also over time become subject to quantifications, such as counting uses of specific words or human-coding cognitive or meta-cognitive features, to use in statistical models of the group work.

By quantifying qualitative dimensions of group work there is a reduction of complexity from thick descriptions in the qualitative data to thinner descriptions in the quantitative data. Through this reduction, an interpretive step is added to the analysis in which authors need to make meaning of their quantitative measurements. This is a key aspect of quantitative ethnography. The same process is a key aspect to multimodal analysis as the field is getting to understand and interpret how different modalities are connected and how different data types can help qualify analyses.

Based on this understanding of interpretative loops we find that group work interpretation becomes interesting and relevant to research in multimodal settings. This is important in understanding what assumptions drive the creation of new technologies and using measures and data across studies. To better understand this, we decided to do a literature review, focusing on the data sources and methods employed, depending on the specified research aim. Our research question guiding this poster is: *How can we characterize how research on group work is closing the interpretative loop between different data forms?*

To answer this question, we mapped literature on group work in education that used both qualitative and quantitative methods that have been published between 2000 and 2023. We used this to exemplify what a mapping of the field could look like, based on a grounded coding of the papers' data, methods and tools, and themes identified from the papers' stated aim and research questions. For the poster, we want to discuss these categorizations.

2 Advances and Questions in Multimodal Learning Analytics

Technological advances have led to an increase in the field of learning analytics to an extent where these systems can capture and utilize multiple modalities (multimodal learning analytics). Two existing reviews are important for understanding the connections between measures and theoretical constructs. First, Schneider and colleagues [3] surveyed Multimodal Collaborative Analytics and mapped the use of theory to see connections between sensors, outcomes, and theoretical frameworks [3]. In doing so, they focused on education and social computing. They described how theoretical constructs were operationalized into outcomes, which they then classified in terms of data form and what the outcome should measure. Verbal data was the most common form, and the most frequently assessed aspect of group work was the product. Schneider and colleagues reported a lack of consistency in terminology and missing agreement on what constitutes a group process to be investigated. Furthermore, they found that most articles used theoretical arguments for using outcomes or metrics but seldom for a larger discussion, and a significant share of the papers were not bound in theory at all. This is in the same vein as Kaliisa and colleagues, who surveyed 36 papers on social learning analytics between 2011 and 2020, and found that 14 of the 36 studies did not reference an explicit learning theory [4]. Kaliisa et al. also find that only one of the 36 papers uses qualitative data to interpret the results of social learning analytics.

Both reviews highlight a need for both theoretical arguments and qualitative investigations to interpret results collected by sensors and learning traces in social learning analytics. Wise and Shaffer [5] have strongly argued why theory matters in the age of big data, especially for education, and in line with this are we interested in the conceptualizations and interpretations of data forms in learning analytics on group work.

3 A Proposal for Relevant Mapping Categories

For scoping articles, we will search prominent databases and proceedings of conferences that focus on either quantitative ethnography or learning analytics. We read all abstracts and only kept articles that fit our criteria; 1) included both qualitative and quantitative data and/or methods, 2) were about group work, and 3) were situated in an educational setting. From the articles that live up to these criteria, we will select articles that focus on data collection relating to 1) physical group work of 2-6 people, 2) synchronous in the same room, and 3) not excluding teacher-student interaction.

For this poster, we use three seminal papers that fit these criteria to discuss how to structure our mapping. The aim of mapping the field is to understand how different data modalities, tools, and methods are being used. Furthermore, we want to survey whether some combinations are more prominent in specific research areas on group work. To map the field, we structured a framework focusing on three levels: Data, methods and tools, and research areas.

Table 1: Categories in the Mapping

Data	Methods and tools	Research area	Ref
Discourse- & assessment data	Statistical discourse analysis and discourse analysis of a subset	Regulation, patterns of collaboration, and relation to instruction	[6]
Gesture, speech, electrodermal, video	Decision tree and qualitative analysis	Methodological contribution, performance prediction	[7]
Movement and assessment data	Epistemic network analysis, qualitative interview analysis	Methodological contribution, use of visualisations	[8]

For the first level, a multitude of data types are presented. Much of it relates to conversations, which is an important feature of group work. In terms of the interpretative steps, there does, however, seem to be a qualitative difference between speech patterns (as in [6], [7]) and discourse data as in the discourse analysis [6]. Of the newer data sources, there is a difference between physical markers, such as the distance to different places in a nursing room, and physiological markers, such as stress indicators [7], [8]. One categorization within data, based on the thickness of the data descriptions, could be discourse data, physical data (including gestures, movements, and speech patterns), physiological data (including electrodermal activity), and assessment data (including grades or grading of group work).

The second level is methods and tools. One difference is between methods based on qualitative interpretations (such as discourse analysis) and methods based on quantitative pattern-searching (such as statistical discourse analysis, regressions, or decision trees). Epistemic analysis stands out in its aim of doing both and bridging between these interpretative forms. Still, the other research designs all integrate these different interpretative elements through combinations of other analyses.

In the last category on research areas, we distinguish between articles that aim to contribute to a specific sub-area of group work and articles that aim to contribute to

general methodological developments of group work studies. All the papers are pointing towards methodological developments, but in different areas of the group work, differing between the structure of the group work, the regulation, and to the use of learning analytics for the teachers.

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Supporting and Shaping STEM Identity: A Retrospective Study

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Abstract: This paper examines the impact of an enrichment effort funded by the US National Science Foundation (NSF) in the 1990s, called the Young Scholars Program (YSP). The purpose of the YSP was to expose students to science, technology, engineering, and mathematics (STEM) fields in hopes of encouraging them to pursue STEM as they entered the workforce. This study examines the nature of the impact YSP had on the participants' STEM identity and eventual career paths Epistemic network analysis was used to analyze interviews of 25 YSP participants as it related to their experience during and after the YSP. Guided by Bandura's theory (1978) [1] of reciprocal determinism and the facets of participatory learning, results show evidence of strong impact of specific YSP features on both participant STEM identity formation and eventual career pathways.

Keywords: STEM, STEM Identity, Participatory Learning, Epistemic Network Analysis

1. Introduction

Understanding and successfully facilitating precollege learners' life pathways toward science, technology, engineering, and mathematics (STEM) fields remains a significant workforce issue in the United States. This issue is directly attributed to the increasing need to maintain an adequate STEM workforce in the US [2,3]. The US National Science Foundation (NSF) has supported a wide spectrum of formal and informal programs in an effort to motivate learners toward STEM-related disciplines and eventual career paths. NSF administered the Young Scholars Program (YSP) from 1989 to 1996. With the intention of increasing awareness of STEM-related academia to already intrinsically motivated STEM learners, YSP aimed to expose learners to STEM areas in universities and research institution contexts. A retrospective study [4] analyzes data collected from semi-structured interviews of 25 YSP participants. The study found that nearly half of the participants ultimately chose STEM careers, while the other half of participants chose careers outside of STEM. This study seeks to understand the nature of the impact YSP had in shaping the STEM identity and career path of these participants.

2. Methods

The retrospective study [4] this paper reports examined the experiences of learners who participated in the YSP through in-depth interviews with YSP participants who engaged in the program during their middle or high school years during the 1980s and 1990s. This study analyzed data from semi-structured interviews of 25 YSP participants, in 2021-2022, several decades later. Table 1 summarizes current professional fields, gender, and ethnicity of this sample..

Table 1. Summary of participants by professional field, gender and race/ethnicity

	Current Professional Field	
	STEM Field	**Non-STEM Field**
Gender		
- Female	5	9
- Male	8	2
- Non-binary	0	1
Race/Ethnicity		
- American Indian/Native American	0	1
- Asian	1	2
- Black/African American	3	3
- Hispanic/Latinx	2	1
- Pacific Islander	1	0
- White/Caucasian	5	2
- Other/Not specified	1	3
Total	**13**	**12**
Sample Professional Roles	Research Scientist / Administrator, Science Teacher, Professor (STEM), Aerospace Engineer, Computer Network Engineer	Artist/Writer, Designer, Judge, Professor (Non-STEM), Business Executive, Higher Education Administrator

Interviews took place via online video conferencing software and were recorded and transcribed. A codebook was developed through a grounded analysis of the data, seen in Table 2. Each sentence of each interview was coded by two raters, following a process of social moderation to reach agreement on the final coding decision. Epistemic Network Analysis (ENA) was used to examine the pattern of connections between shared themes in the participants' interviews.

Table 2. Codebook used for the analysis of YSP participants

Type	Definition
STEM	A direct reference to a STEM discipline
Non-STEM	A direct reference to a Non- STEM discipline
Recreational	A direct reference to a recreational or extracurricular activity
Identity	Sense of self/ independence; permanent or long term characteristic
Self-Efficacy	Development of confidence or pride
Motivation	Gaining interest, setting goals, expectations for the future

Engagement	Active participation and involvement in an activity
Knowledge Acquisition	Describes the process of learning in which the speaker took part
New Experience	New or eye opening experience for the speaker
Peer Interaction	Interactions, exchanges or relationships with peers
Support In	Help or support the speaker received from others
Support Out	Help or support provided by the speaker to others
Positive	Discourse expressions of joy, excitement, or positive regard
Negative	Discourse expressions of stress, sadness, anxiety, or regret
Career Opportunities	Academic or professional personal development or advancement
Career Challenges	Academic or professional personal challenges

3. Results and Discussion

While connections to the constructs IDENTITY and SELF EFFICACY are lighter and less saturated, Figure 1 does show significantly saturated lines between the constructs and STEM as it relates to the experience participants had in YSP. The most notable or saturated patterns of discourse shift from being descriptive, Figure 1, to more reflective, Figure 2. These patterns appear as salient connections in Figure 3 between (1) STEM and MOTIVATION, (2) STEM and IDENTITY, and (3) STEM and SELF EFFICACY. A stark contrast between salient connections in Figure 1 and Figure 2 exists in that the opposing thick lines appear in one graph when compared to the other. Thick lines between (2) STEM and IDENTITY as well as (3) STEM and SELF EFFICACY learning and engaging in STEM activities give evidence of the experience bolstering their sense of confidence as well as their sense of achievement. This prominent association indicates that the YSP could have had an impact on participants' STEM identity formation, as noted in the following utterance.

> *It really boosted my self esteem and my self-confidence. It was just such an overall positive experience for me on a personal level. And, you know, I just. I just came out of it just feeling. Like I, I could. I could tackle anything that college was going to send my way. I mean, it really I think it really was a good kind of college preparatory experience that I could get being a high schooler.*

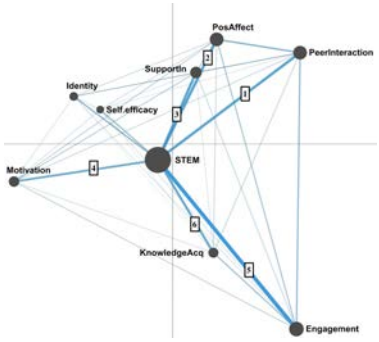

Fig. 2. Discourse pattern during the YSP

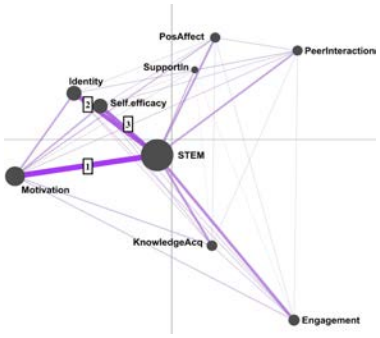

Fig. 3. Discourse patterns after YSP

ENA analysis of in-depth interviews of YSP participants suggests that a combination of STEM learning, exposure to activities participatory in nature and connections to like-minded peers provided an experience that not only allowed them to develop interest in STEM, potentially contributing to their overall STEM identities. Patterns of discourse reflected in Figure 1 and patterns of discourse reflected in Figure 2, may have elicited coded utterances that were descriptive, Figure 1, and reflective, Figure 2, simply because the interview questions were written in such a manner. However, this does not take away from the contributions toward building a STEM identity that was underpinned by participants engaging in an environment with abundant opportunities of participatory learning.

Acknowledgment

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Expert-novice differences through epistemic network analysis of eye-tracking and think-aloud data

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Abstract. Epistemic network analysis (ENA) is a useful tool in quantitative ethnography for network visualization and interpretation. While it is typically used with unimodal data, such as interviews, log data, and online discussions, there is potential to incorporate more than one modality to achieve a more comprehensive understanding of the underlying knowledge structure. Therefore, in this study we propose the integration of two such data, namely, concurrent think-aloud and eye-tracking, to construct unified epistemic networks. In the study, two cohorts of experts and novices solved electrical circuit diagram problems. Our findings align with established expert-novice literature, thereby providing credence to our original proposition. Such combinations of data may be used in future research to create more meaningful networks.

Keywords: Epistemic network analysis, Expert-Novice, Electrical circuits, problem-solving, webcam-based eye tracker, concurrent think-aloud.

1 Introduction and Literature Review

It has been observed that experts outperform novices in problem-solving due to their well-organized and domain-specific knowledge, which allows them to accurately depict complex processes in adequate detail. In contrast, novices' representations often omit essential concepts or highlight inessential information [1], [2]. Numerous studies demonstrate that experts excel in chunking knowledge elements [3] and employing holistic problem-solving strategies [4]. In contrast, novices might rely only on superficial information.

Epistemic network analysis helps represent deep knowledge structures in groups. Typically, epistemic network analysis is conducted using common data sources like online discussions [5], interviews [6], and learners' interactions [7]. Other data sources familiar to the learning sciences community, such as online log data [8] and eye-tracking [9], have recently gained traction. However, despite the variety of data sources available, Epistemic Network Analysis (ENA) is traditionally generated using only one type of data. This research aims to highlight the differences between experts and novices in the domain of electrical circuits, using ENA as the primary analytical tool. A unique feature of this study is the use of two distinct data sources - concurrent

think-aloud and eye-tracking – to construct unified epistemic networks. The study's focus is to evaluate the feasibility of such a combined analysis for future research.

2 Methodology

The study examined two cohorts: one using think-aloud methods with two experts and three novices and another using webcam eye-tracking with two experts and two novices [15] (https://webcam-eye-tracker-et.netlify.app/). The experts were assistant professors, and the novices were second-year students from an engineering college in Maharashtra, India. The study used three electrical circuits of different complexities (easy, medium, and hard) as stimuli (Fig. 1). The first cohort was instructed to solve the problems by thinking aloud concurrently and the video was recorded. The second cohort was asked to solve the problems with a webcam eye tracker to capture their eye gaze movements without thinking aloud. The eye-mind hypothesis [10], the basis of all eye-tracking studies in cognitive studies, postulates that gaze patterns will reflect cognitive processing during problem-solving.

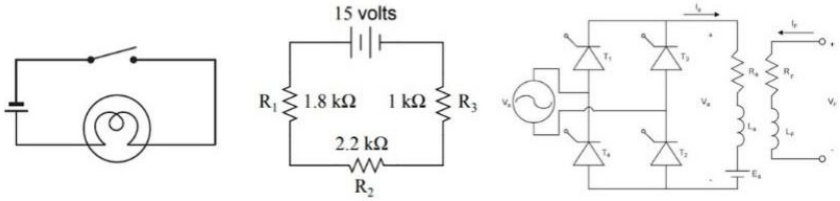

Fig. 1. Basic Electrical Circuits Circuit 1(easy), Circuit 2(medium) and Circuit 3 (hard)

To analyze the think-aloud and eye-tracking data together, we faced the challenge of establishing common stanzas and codes. The first and second authors collaboratively analyzed both sets of data. In the eye-tracking data, stanzas were defined as transitions between eye fixations, known as saccades, and individual circuit elements, such as bulbs or switches, were treated as codes. In the think-aloud data, akin to discourse analysis [6], a comparable procedure was adopted for coding and data analysis. For example, in circuit 1, one of the participants said, *"...I am looking at battery, the battery is placed upside down, so I will move towards the bulb, and finally to the switch…''*. Based on the participant's observation of the electric circuit, we identified specific transitions for coding purposes. Transition 1 corresponds to the prolonged focus on the battery. Transition 2 was inferred when the participant verbalized a shift in attention from the battery to the bulb. Similarly, Transition 3 occurred when the participant's attention shifted from the bulb to the switch (as depicted in Fig. 2 for cohort 1). ENA visualizations were generated using the freely available tool, https://app.epistemicnetwork.org/, and all our analyses were grounded in these visualizations.

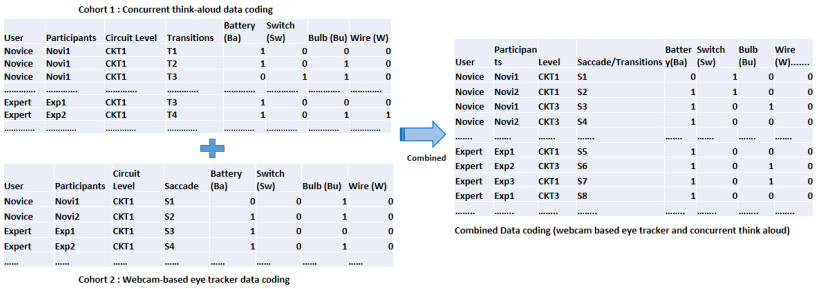

Fig. 2. Merging of two datasets for epistemic network analysis

3 Results and Discussions

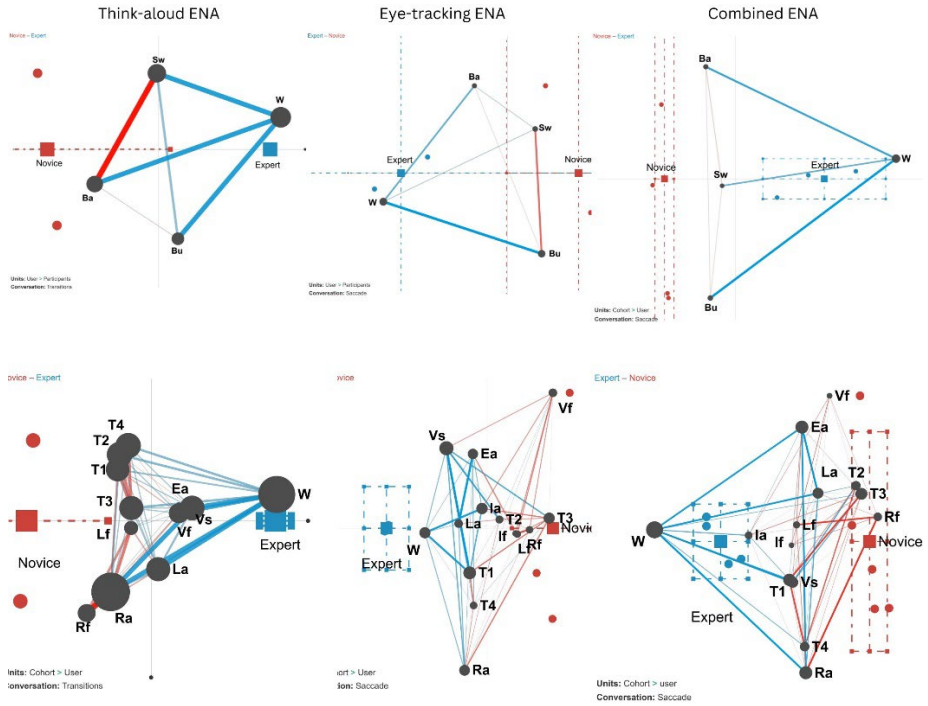

Fig. 3. Subtracted mean network graph for expert (blue) and novices (red) for circuits 1 and 3 (top and bottom panels, respectively). ENAs with concurrent think-aloud data, webcam-based eye tracker data, and with combined data (left, middle, and right panels, respectively). The nodes in the figure denote Ba- battery, Vs-AC source, Sw- switch, Bu-bulb, W-wire, R- resistors, L- Inductors, T- Thyristors, and E- internal battery of load. Only networks of two circuits (easy and hard) are shown due to space constraints.

Eye-tracking and think-aloud data show some similarities and differences as well. The centrality of the wire element is quite evident in the expert structures with both types of data (Fig. 3 top panel). However, the connections through the wire are more pronounced in the think-aloud data than in the eye-tracking data (comparing left and middle panels). The role of wire is critical yet revealed to different extents in the two types of ENA. This indicates how ENA from two data sources, when combined in this way, could be complementary to each other.

We now focus on the interpretation of the combined ENA (right panel). The combined ENAs show that expert analyses are quite different from novices', which is to be expected. The experts also have more connections on the source side of the circuit (Vs and T), whereas the novices focus on the load side (Ra, La, Ea, and T). This underscores experts' attention to the underlying concepts of the problem because they are looking at the functional element (T) in the correct context of the source (Vs). In contrast, novices are looking at the same functional elements (T) but within the incorrect context of the load (i.e., Ra, La, and Ea). This is emblematic of a working forward approach of experts, i.e., a source-to-load approach, an observation that is highlighted in the literature [2], [4]. Novices, instead, use a backward inference technique, i.e., as manifested here by the load to the source analysis of the problem [11].

4 Conclusion and Limitation

This study was designed primarily to show that ENA data sources need not be unimodal in nature. The expert-novice paradigm was used as an appropriate context to showcase our strategy. The similarities and differences of ENAs between the first and second cohorts suggest that ENAs constructed out of two data types may be able to communicate the underlying knowledge structure more thoroughly, with one data complementing another. The combined ENAs were conceptually richer, and we were able to draw meaningful inferences that agreed with those outlined in the expert-novice literature, which lends some validity to our approach.

However, there are many limitations to this approach. First, and most importantly, we are using ENA as a representational tool without leveraging some of its other strengths, such as revealing of deeper knowledge structures. We have not been able to uncover any meaningful epistemic frames, as neither the think-aloud nor the eye-tracking data included such elements. In future, we should design studies where at least one data type addresses this shortcoming. Second, the small sample size restricted us from getting useful constraints on the errors, as observed from the open bounding boxes on some of the ENAs. We also note that we fused the two data types by converting one type of data (think-aloud) into the parlance of another (eye-tracking). Another approach to fusing such data would be to capture them simultaneously from the same cohort and splice the data according to the respective timestamps. We intend to consider such alternatives for future studies.

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Teachers' Perceptions on Classroom Integration of Evidence-Based Research from those 'Egghead Scientists'

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Abstract. Teachers are uniquely positioned to act in dual roles of teacher and researcher; however, this may create conflict when applying educational research in their classroom. Threads and comments from teacher-catered subreddits were collected on perspectives on the application and usefulness of educational research into the classroom. Results of ENA showed that teachers have a negative orientation to educational research as a whole and question the methods, results, and integration into the classroom. The negative perspective was highlighted when their autonomy in its application was removed, demonstrating a disconnect between teachers and researchers and the integration of findings into practice.

Keywords: Educational neuroscience, teacher researcher, ENA, SDT

1 Introduction

Those who enter the education field as teachers receive an in-person perspective to how learning shapes the students directly in front of them, creating a teacher-researcher role that provides them with a level of expertise on their classroom and their students. For experienced teachers, this dual role has informally positioned them into a form of participatory research, frequently acting in the roles of both teacher and researcher simultaneously [1]. But from this dual-role of teacher-researcher arises a form of tension. A vital component of making this tension productive is a teachers' reception to incoming educational research and their perception of its usefulness. As such, further research is needed understand how teachers view peer-reviewed research and how it is passed down from researchers to be applied in the classroom. One field that has attempted to bridge the translational divide between bench and practice is the field of educational neuroscience [2]. This study investigates the question of how teachers perceive educational neuroscience research and its integration into the classroom.

2 Theory

This research draws upon Self-Determination Theory (SDT) as a motivational factor to understand the dynamics of the tension between the roles of researcher and teacher. Described as "a sense of initiative and ownership in one's actions" [3], this autonomy

enables teachers to self-engage with their classroom, allowing for greater internalization of the teaching practices they chose to utilize.

3 Methods

Reddit is a common place for people to share their opinions, thoughts, and beliefs with like individuals on a varying on specific topics that can be board or narrowed in scope [4]. To investigate the current perception of teachers' application of research to their classrooms using the field of educational neuroscience as an example, searches using the search terms "brain teaching" and "neuroscience" occurred in two subreddit threads geared toward a community of teachers. As Reddit operates with a social rating system with positive or negative votes on comments and is then sorted by the most popular, data collection began with the top thread and continued until the thread title or description no longer applied. A total of 988 reddit posts were collected across the two subreddits, resulting in 33 total threads (Table 1 in Supplemental Materials). The codebook was created through inductive analysis of emerging themes. One third of the data was randomly allocated to a test set and was coded by two raters to determine Cohen's Kappa; upon agreement, the remaining two-thirds of the data was coded by the author (Table 2 in Supplemental Materials). Following the hierarchical structure of quantitative ethnography (QE) [5], the data was segmented through the use of conversations, stanzas, and lines as shown in Table 1. Lines were operationalized as comments, including the original post, which were kept intact, resulting in lines of varying lengths. Epistemic Network Analysis (ENA) [6] was used to visualize the relationships between relevant codes in reddit discourse. For the models used here, a whole conversation stanza window was selected to demonstrate the connection to the original post.

4 Results

This study aimed to investigate teachers' perception of educational neuroscience and its integration in the classroom, however a larger theme emerged. The findings reveal both positive and negative views toward educational neuroscience research, in addition to a negative view of educational research findings as a whole.

The negative view of empirical education research was centered largely around the lack of evidence perceived by teachers. One user stated "*They say it's science based and backed by data. But can't provide peer reviewed data to show how it's successful in specific types of schools.*" (515) Here the reddit user is questioning whether educational research is considered real science, through the statement "*they say it's science based*" and clarifies that the questioning of it being real science relates to the lack of openness regarding the peer-review process and the generalizability of the research. This negative view was reinforced as another user stated "*I'm not saying it isnt true but so much of the "research" isn't scientifically done. Because it boils down to this question for me: Does having kids move around increase learning in math? Or reading class? And at what age level?*" (261) Similarly, this is calling the research into question due to the methods being undisclosed in the statement "*isn't scientifically done*". This

reddit user provided an explanation for how they view educational research by wanting to know the directional changes seen, "*increase*", the content area that was researched, "r*eading class*", and the population of students, "*age level*".

A second finding was seen when the teacher did not adopt research findings into their teaching practices volitionally. This external locus of control was commonly seen when discussing the dissemination of research through professional development (PD), such as in the comment "*I sometimes day dream about going into PD training and basing it on PROVEN teaching methods*." (54) Here the teacher is stating that the negative view on research is due to coming from mandated PD, with emphasis on the questionable nature of the results. Additionally, the dynamic of the tension due to teachers acting as a researcher was also seen in the reddit comments. As one user stated, "*…Teachers know what's best based on their own experience in the classroom. We're smarter and better informed than those egghead scientists coming and trying to tell us what to do*." (284) In this statement the user is negatively viewing educational researchers, both by calling them a pejorative name, "*egghead scientists,"* and by stating teachers know better than them, as they are the ones in the classroom. This reinforces the view held by some teachers that they are better able to determine effectiveness of practices with their specific population of students than an outside researcher, thus contributing to their negative view of educational research.

Juxtaposing the examples of the negative view of educational research, there were positive views on applying neuroscience research in the classroom. One user stated, "*I'm reading a stack of books this summer on the latest evidence-based practices in teaching. I won't get into the neuroscience of it here, but there's strong evidence that this is the case*." (71) Here, the positive connotation is seen in the seeking out of evidence-based practices on their own, and they identify that it is connected to neuroscience, specifically in relation to movement as a means to "*promote learning*."

Fig. 1. ENA network models for group comparison

The subtracted ENA networks revealed differences between positive and negative perspectives (Figure 1; individual networks in Supplemental Materials). Overall, there is both a positive and negative view on integrating research into the classroom, especially in the application of movement, but there is a stronger negative view when it is put upon them to adopt via an external locus of control (LOC). This dual perspective may be a component of the tension that arises in teachers. These results were corroborated through a t test. Along the Y axis, a two-sample t test assuming unequal

variance showed that positive value judgement (mean=-0.20, SD=0.42, N=21) was statistically significantly different at the alpha=0.05 level from negative value judgement (mean=0.47, SD=0.85, N=9; t(9.71)= 2.28, p=0.05, Cohen's d=1.18).

5 Discussion

This study aimed to investigate the perception of teachers regarding education research. Reddit user comments, along with ENA, utilized SDT [3] to demonstrate how an external locus of control can diminish the autonomy of a teacher. Four themes emerged from the data that related to a negative perspective of educational research, with teachers questioning research methods and findings, a lack of autonomy in deciding their instructional practices, their role as a teacher-researcher, and specific principles that have been translated from the field of neuroscience to learning. Here, we see tension towards educational research in regards to the reception, due to how the research is communicated and disseminated to teachers, the perception, the value and quality of the research, and the adoption of research findings to their classroom.

6 Conclusion

Reddit is a useful tool for investigating an individual's thoughts and opinions. Here, threads regarding application of evidence-based practices provide an insight into teachers' reception and perception of how educational research becomes adopted into their practices. In sum, these findings show a disconnect between research and practice with a negative orientation toward integration of new evidence-based practices into the classroom. Future work focusing on communication is needed to build a bridge with teachers between bench to practice in educational research.

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A Systemic Analysis of Learner Discourse in Language Education: A Systemic Functional Linguistics Perspective

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Abstract. Language education has become ever more collaborative over the years, with learners being encouraged to work together and exchange ideas, stories and opinions. At the same time, there has been a major shift to online education, making this collaboration increasingly digital. Despite the resolute turn to online and hybrid education, our understanding of the language used in online collaborative language learning spaces tends to lag behind. Because of this gap, we are unable to fully understand the collaborative learning processes that are taking place. This paper presents a new methodological approach, part of a research project that aims to systematically describe and analyse digital discourse for collaborative language learning, combining Systemic Functional Linguistics methods for data annotation and Epistemic Network Analysis for data visualisation. The purpose of this paper is two-fold: 1) to suggest new methods for discourse analysis to improve our understanding of digital text, and 2) to use this knowledge to start a conversation within the language education field to optimise the integration and assessment of online learning spaces. This paper presents new ways to annotate the systemic functional building blocks of collaborative learning in digital contexts. We also discuss how Epistemic Network Analysis measures can be used to show the relationships and possible dependencies between these text features. These methods are intended to serve as the basis for discussing both the design of digital spaces for learning and the support mechanisms educators can provide throughout the student learning process.

Keywords: Learner Discourse, Digital Discourse Analysis, Systemic Functional Linguistics, Epistemic Network Analysis, Computer-Supported Collaborative Learning

1 The language of learning

"If you come to the realization that the major resource for learning is language, then at the very fundamental level, [having good descriptions of that language] means having much more understanding of insight into the primary educational resource for learning and teaching" (Matthiessen et al., 2020, p. 9). This quote describes one of the critical aspects of our education system: learning requires language, so our understanding of language is fundamental to our understanding of learning.

And yet, descriptions and analyses of online collaborative language learning settings often fail to provide a clear view of the systemic functional building blocks of the discourse that is produced (Carr, 2020; Mason & Carr, 2022). This paper defines the gap in the literature in this regard and presents the first steps to enhance our understanding of the 'language of learning' by suggesting a new methodological lens, focusing on different functional linguistic features of the discourse learners use in daily practice.

2 Defining the gap

When focusing on digital text in the context of collaborative language learning, meta-analyses have shown that the ways in which interaction and collaboration are analysed within online learning spaces vary tremendously across studies (Domahidi, 2018; Liu et al., 2018). The questions of how to systematically describe and analyse digital discourse for language learning, how to make proper evaluations of the spaces we create, and how to make our analyses replicable have thus largely remained unanswered (Mason & Carr, 2022). That is, we do not fully understand language as it is used in online collaborative language learning spaces; hence we do not fully understand the collaborative learning processes that are taking place.

The proposed methods bring together qualitative and quantitative approaches to overcome the weaknesses of the past, where studies often failed to recognise the affordances of the digital context, the wealth of user data available and the impact this context has on human interaction and learning (Peeters, 2022). The main aim is to create a new methodology that will enable us to provide a more unequivocal answer to the question, '*How is online collaborative language learning among peers organised, and is there an identifiable structure of systemic functional features or sequences that govern digital discourse for language learning?*'.

3 The road to a solution

3.1 Systemic Functional Linguistics (SFL)

An SFL approach to digital text is a logical, yet novel, way to analyse discourse and allows us to look at language production as a social semiotic process, dependent on the context in which it is produced. Within the systemic functional view, language is a way to represent our experiences of the world, the relationships we make, and their report through text. It can serve as the basis for theorising how the semiotic aspects of digital discourse are put to use to create meaning for learning (O'Halloran, 2008). O'Halloran and Fei (2014) attest that using this perspective in discourse analysis facilitates the description of the multimodal nature of discourse and allows us to study the interplay between a language's metafunctions, i.e., its ideational, interpersonal, and textual aspects (Halliday & Hasan, 2014). Following Carr's (2020) criticism of current digital text analytics, this paper opts for a new systemic functional approach to digital discourse which studies it in terms of the relations between what is being said in collaborative online learning settings (ideational), who is taking part (interpersonal), and, most

importantly, how it surfaces in text (textual) (Bou-Franch & Blitvich, 2018). The focus on how it surfaces in text will be the main addition to the state-of-the-art since fundamental form- or genre-based classifications of digital discourse (e.g., how learners create coherence by referring to information in or outside their text, or how the use of modal verbs relates to reliability) are, by and large, missing from the literature.

3.2 Epistemic Network Analysis (ENA)

The project we introduce in this paper will apply the principles of ENA (Shaffer, 2017) to the systemic functional analysis of digital text. ENA models discourse via the co-occurrence of constructs in the data and represents their relationships as networks in a low-dimensional space. Networks for separate discourse features can be created and plotted in the space to track changes in that discourse, or trajectories, over time (Brohinsky et al., 2021). In our study, ideational and textual components of discourse can be operationalised as codes in the ENA analysis, and trajectories can be used to view changes in these metafunctions. For example, we can track how form features (such as cohesion and reliability features) relate to content. Analysing the interpersonal metafunction requires modelling not just the features of the text but the relationships between the producers of the text. Prior work has extended ENA by combining it with social network analysis (SNA) to simultaneously model discourse's social and semantic features and represent both structures in a single representation (Gašević et al., 2019; Swiecki & Shaffer, 2020). The integration of ENA and SNA has yet to be combined with trajectory analyses to study shifts in socio-semantic structures. This project aims to extend the ENA toolkit to simultaneously represent discourse's temporal, social, and semantic features, thus better aligning the proposed method to the SFL constructs.

4 The way forward

It is theorised that the three systemic functional components of language (the ideational, interpersonal and textual) allow us to distinguish different systemic areas within collaborative language learning data. These metafunctions of language can be seen as a set of principles to describe and explain how language works and functions. They are referred to by Fairclough (2003) as a means of constructing a comprehensive functional representation of linguistic meaning.

By redirecting the scope to the metafunctions of language and calculating how these metafunctions interrelate, we aim to advance our understanding of digital discourse and create new pathways to integrate and evaluate online spaces in language education. The proposed analysis framework follows Sack's (2000) early recommendations to include different features of all three metafunctions in any discourse analysis study that employs SFL. Yet, for all three metafunctions, there is a particular focus on specific factors to present an accurate functional-semantic description of the data. This way, we will try to create new ways to better evaluate the effectiveness of language production and collaboration, which, in turn, enables us to provide better, timely support for learners when we notice that collaboration falters (Peeters & Pretorius, 2020; Viberg et al., 2021).

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Honoring What Teachers Said: QE Approach to Fair Learning Analytics Models

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Abstract. Persistence is a construct that has been extensively researched in various contexts; learning analytics and data mining techniques have been applied to develop measurement models and/or automatic detectors using telemetry data and its distilled features in educational games and intelligent tutoring systems. Although existing studies offer evidence of construct validity, it remains unclear to what extent these models reflect teachers' values regarding students' persistence. This paper aims to investigate the measurement of persistence in a manner that closely aligns with teachers' expectations by creating epistemic networks of student gameplay that employ log data coding based on teacher co-design discussions.

Keywords: Game-based assessment, Ecological validity, Human-centered learning analytics, persistence

1 Introduction

Game-based assessment (GBA) fosters assessment of "soft skills" or "21st Century skills" [1] such as creativity, collaboration, and persistence in a performance-based and process-oriented way situated in simulations of authentic contexts. However, how teachers can use GBA to support non-academic skills remains unclear. Persistence, as an example of a non-academic skill, has been extensively validated in various game-based learning environments largely using machine learning techniques [2,3]. Co-designing learning analytics models with teachers revealed a misalignment between machine learning methods and teachers' understanding of persistence [4]. This work aims to investigate how Quantitative Ethnography (QE) can be applied to fill the need for assessment and learning analytics to be fair to data and/or community by operationalizing teacher thinking [5]. Thus, the overarching research question was, *Can ENA be applied to create a teacher-defined assessment model for persistence?*

2 Relevant Literature

Persistence is a well-studied and documented construct that has been linked to academic success and productive life beyond school education [6]. Due to the engaging and challenging nature of games, described as "pleasantly frustrating" [7], many researchers operationalize and measure persistence in game-based learning [2,3]. For example, Ventura and Shute [3] investigated the construct validity of persistence in a puzzle game using time spent on unsolved problems across all player events over the five

sessions. Similarly, DiCerbo [2] measured persistence in a game using four features per quest: time spent on quest events, number of quest events completed, maximum time spent on an individual quest event successfully completed, and time spent on the last event prior to quitting. Although the current algorithmic metric to measure persistence in our game *Shadowspect* draws on these earlier examples to ensure construct validity, none of the existing literature built these persistence models based on teachers' input.

3 Methods

3.1 Context and data

During the 12-month co-design process with teachers, student "persistence" emerged as a focal point for measurement, visualization, understanding, and response. However, compared to other constructs, operationalizing persistence based on teachers' desired outcomes proved challenging. In a previous study, we conducted thematic analysis of co-design data to identify various facets and definitions of persistence [4]. Building upon this work, we operationalized the definitions provided by teachers.

We transformed interaction data into readable descriptions of player interactions and compared the resulting event narratives to the teacher definitions to generate codes based on the exploration. Codes were then algorithmically operationalized by defining searches that would iterate through the event logs seeking positive examples. For example, *Resource Use* was identified each time a student utilized a new tool by employing a user dictionary that stored values of True or False for each tool's usage and reset each time the player began a new level or restarted the current level. Table 1 presents a summary of the Codes used, along with teacher inspiration statements and descriptions of how the code was operationalized.

Table 1. Code Book

Code	Teacher Statement	Operationalization
Good move	"There was a clear difference between someone who was just, like, moving three of the total wrong shapes around[...]"	Each puzzle requires certain shapes and moves. Each move is compared to the puzzle's list.
Resource Use	"Or I'm interested to see are they opening all their tabs, are they using their resources."	Player uses the create, move, rotate, and scale actions. Coded once per puzzle attempt on first tool use.
Seeking Feedback	See Resource Use. Feedback tools were isolated from other resources for clarity.	Player uses the "snapshot" and "check solution" tools to gain feedback about their solution.
Challenge	"They were just motivated by completing the most challenging puzzles in the game."	Player skips forward at least 2 levels from their previous attempt. Coded on level start events.
Break	"And then, "no behavior." So, wondering, like, is "no behavior" related to breaks?"	Event occurs more than 90 seconds after the previous event within a play session.

Level Complete	"Right, so I guess, like, persistence is you just keep going, and unproductive persistence is where [...] they're not making any real progress."	Player successfully completes a level. Defined by the level complete event.
Retry	"... they make a lot of mistakes, they feel kind of lost, so they restart [...]"	Player uses the reset button or returns to a level they previously started but never completed.

3.2 Epistemic Network Analysis

We constructed several player-focused ENA models to explore the legibility of differences between student approaches ultimately providing evidence for whether the plots could be useful for teacher assessment of persistence. The *Unit* was defined as player ID with no group comparison. *Conversations* were defined as the player ID segmented by session. This allows for connections across each session a player partook in as defined by the log in event. Due to differences in code granularity (e.g. *Challenge* only occurs between level movements whereas *Good Move* occurs within the level itself), we chose to use a whole conversation stanza window.

4 Preliminary Findings

There were marked differences between players in terms of their demonstration of teacher-defined persistence behaviors. Player A (Figure 1A) demonstrated significant connections between *Seeking Feedback*, *Good Moves*, *Resource Use*, and *Level Complete*. This student did not skip levels (*Challenge*) nor need to *Retry* puzzles. These patterns indicate that they progressed methodically throughout the levels they completed with little difficulty. Play B in comparison has a more distributed network with connections to *Break* and *Retry*. Only Player C engaged in *Challenge* in connection to all other behaviors. They have weaker connections to *Resource Use, Good Move,* and *Seeking Feedback* indicating that they likely took more actions overall yielding a lower percentage of frequency of these actions within their whole dataset.

a. b. c.

Fig 1 a-c. Three examples of *Shadowspect* users demonstrate connections that are different between their gameplay sessions.

5 Discussion and Next Steps

In this poster, we explore a game-based assessment model developed using teachers' insights to derive codes for telemetry data related to persistence. Traditional educational

assessment has primarily focused on construct validity, but its limited adoption in classrooms calls for alternative approaches that better align with teachers' perceptions and practices. By applying a QE approach, we aim to broaden the creation of learning analytics models and provide a more reflective representation of teachers' perspectives.

Through preliminary ENA models, we were able to assess players' persistence in a way that aligns with teachers' observations of player-game interactions, emphasizing the process-oriented nature of GBA. By highlighting the difference between students who choose to take *Break*s while also valuing *Complete Level,* we can see when *Break*s lead to productive persistence and when students might be more likely to be struggling in the game. We are also able to determine when persistence is not necessary for students, such as player a, because they are *Complet*(ing) *Level*s without using persistence strategies. Unlike algorithmic metrics, this approach allows for the "telling of qualitative stories" that unfold the player's engagement with the game.

The current work did not examine how these ENA models could be used in classrooms and how teachers can make sense with these models. For example, in the future, we could investigate qualitatively examine this using case vignettes [8]. Similarly, we could take a participatory QE approach [9] where the team could engage teachers in exploring various configurations of the ENA-based models to identify Codes that might not be fair to the community.

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Chitchat Bots: A Comparative Study and Behavioral Analysis of Large Language Models Using Epistemic Network Analysis

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Abstract. This study aims to investigate the behavior and interaction between two prominent large language models: ChatGPT (GPT3.5) developed by OpenAI and Bard AI developed by Google. To demonstrate the structures and connections in their conversations, Epistemic Network Analysis (ENA) was utilized. The findings revealed that Bard AI, when engaging with ChatGPT, often offered suggestions, and expressed agreement with ChatGPT's responses. Moreover, Bard AI's responses were indistinguishable from those of a human, appearing natural and devoid of obvious signs of being an artificial intelligence. On the other hand, ChatGPT consistently identified itself as an AI model, focusing primarily on providing suggestions and recommendations rather than agreeing with Bard AI's responses. This study sheds light on the distinctive behavior and response styles exhibited by these two chatbots. Additionally, it expands the previous discourse on the applicability of ENA not only to human communication but also to non-human entities, such as artificial intelligence.

Keywords: Artificial Intelligence, Behavioral Science, Epistemic Network Analysis, Large Language Model.

1 Introduction

In recent years, large language models have emerged as powerful tools for simulating human-like conversation and generating coherent and contextually relevant responses. Two prominent examples of such models are ChatGPT developed by OpenAI and Bard AI developed by Google. Understanding the behavior and interaction patterns between these language models is crucial for comprehending their capabilities and limitations.

This study aims to investigate the behavior and interaction between ChatGPT and Bard AI, specifically focusing on their conversational structures and connections. To achieve this, the study utilizes Epistemic Network Analysis (ENA), an innovative approach involving the identification and measurement of relationships between elements in encoded information, followed by the representation of these connections through dynamic network models. [1]. ENA provides a visual representation of the

knowledge network, offering insights into the patterns of information exchange between the participants.

Interactions between chatbots can reveal unintended behavior, biases, or vulnerabilities that might not be evident in user-to-chatbot interactions. Chatbots may exhibit unexpected behavior, such as echoing misinformation or amplifying biases when engaging with each other. These findings can show the underlying causes and address them to enhance the reliability and trustworthiness of AI systems.

Previous research has highlighted the individual conversational characteristics of ChatGPT and Bard AI. For example, a study by Kalla and Smith [2] evaluated the language generation capabilities of ChatGPT, demonstrating its capabilities of producing responses similar to those of a human when interacting with users, and its ability to scale, adapt, and perform efficiently makes it a perfect choice for a wide range of applications. Furthermore, research from Cornell University also discovered that although ChatGPT's ability to comprehend emotional dialogues may not be as advanced as supervised models, it does show promising outcomes in generating emotional responses [3]. However, little research on Bard AI's capabilities and behaviors has been done since Bard AI was recently launched in March 2023. This study attempts to take a preliminary step to address this research void.

2 Method

The discourse data analyzed in this study consisted of 200 responses and was generated using Python programming. ChatGPT's responses were generated through the GPT3.5 model API provided by OpenAI. Initially, Bard AI's responses were intended to be generated using the PaLM API from Google. However, due to limitations on the API's availability as it was in a trial launch, an alternative approach was employed. Antonio Cheong's reversed engineering API was utilized.

To initiate the conversation, the text "Hello, can you talk to me about something that interests you?" was sent to Bard AI. The response from Bard AI was then sent to ChatGPT, and the subsequent response from ChatGPT was sent back to Bard AI. This iteration process was repeated 50 times, resulting in 50 responses from each AI.

For the second initialization, the text "Hello, can you talk to me about something that interests you but not in the AI topic?" was used. The responses from the two different initializations were separated into two distinct topics.

To analyze the data, five codes were developed through an inductive examination grounded in the context of the conversations, see Table 1. The data was coded using the nCoder Web Tool. Then the ENA Web Tool was applied to conduct an ENA analysis. The two chatbots were chosen as units of analysis; each of the topics was defined as conversation, given that the two topics were distinct from each other. An infinite stanza window was applied to define the recent temporal context, given that within the same topic, each line is related to every line that comes before it within a conversation. Lastly, a two-sample t-test was conducted to compare the ENA networks of ChatGPT and Bard AI.

Table 1. Codebook and Code Validation.

Code	Definitions and examples	rho	kappa
Agreement	The chatbot agrees with the opponent's response or opinion e.g., "I agree with you that the future of artificial intelligence is both exciting and challenging."	0.00	1.00
Appreciation	The chatbot appreciates the opponent's response or suggestion. e.g., "Thank you for your conversation. It has been a pleasure talking with you."	0.00	1.00
Negative	The chatbot disagrees with the opponent's response or responds with sorrow, regret, and rejection phrases. e.g., "I'm sorry, I'm an AI language model and I don't have the context to understand what you are referring to with "Google Bard"."	0.00	1.00
Robot	The chatbot responds with phrases that recognizes itself as non-human or artificial intelligence. e.g., "As an AI language model, I am programmed to be unbiased and neutral."	0.01	0.97
Suggestion	The chatbot suggests the opponent with an informative response to answer the opponent's question. e.g., "It is recommended to try the search again or contact Google's support team for further assistance."	0.00	1.00

3 Preliminary Result

The models examined in this study (see Fig. 1) revealed the distinct connections between behaviors exhibited by each chatbot. In the case of Bard AI, the model showed strong connections of Agreement and Suggestion to all other codes, with line values from 0.34 to 0.37. This indicates that Bard AI frequently showed agreement with what ChatGPT wrote and then followed up with informative suggestions. Conversely, in ChatGPT's model, all lines from Suggestion were strong, ranging from 0.38 to 0.42. With the highest line value of 0.42, the connection between Robot and Suggestion indicates that most of the time that ChatGPT wanted to give suggestions, it would explicitly present itself as an AI entity. Such differences can also be observed in the subtracted network in Fig. 2. Besides the fact that Bard AI made more connections with Agreement and Appreciation, there were more purple lines connected to Robot than blue lines, implying that Bard AI responded in a more natural and respectful manner, showing appreciation and agreement, mimicking human-like interactions, while ChatGPT exhibited a clear intention of providing suggestions and information as an AI assistant. A two-sample t-test assuming unequal variance further tested that such difference is statistically significant. Bard AI (mean=-4.72, SD=0.20, N=2) was statistically significantly different at the alpha=0.05 level from GPT (mean=4.72, SD=1.01, N=2; t(1.08)=-12.97, p=0.04, Cohen's d=12.97).

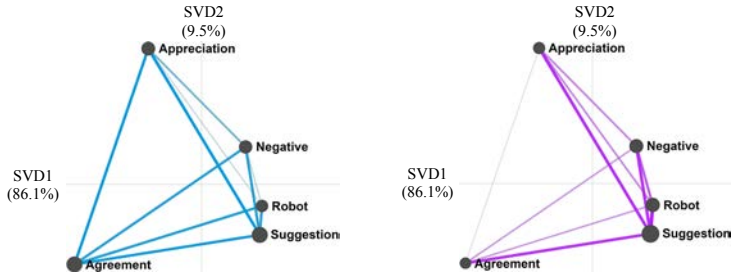

Fig. 1. ENA models of responses from Bard AI (blue) and ChatGPT (purple) respectively.

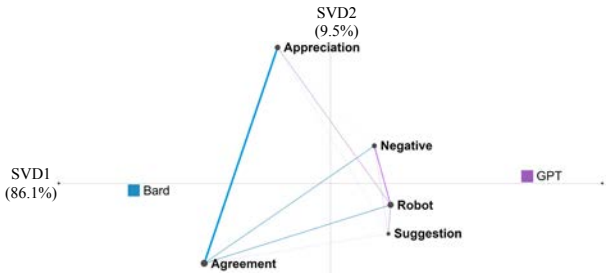

Fig. 2. ENA comparison model between Bard AI and ChatGPT.

4 Conclusion

This comparative analysis of ChatGPT and Bard AI provides valuable insights into their distinct behavior and style of responses. Bard AI showcased a natural and informative conversational style, mimicking human-like interactions while maintaining its AI presence. ChatGPT, on the other hand, exhibited a clear intention of providing suggestions and recommendations while explicitly identifying itself as an AI assistant.

Understanding the behavior and interaction of large language models such as ChatGPT and Bard AI is crucial for leveraging their capabilities effectively. These findings can inform the development and application of such models in various fields, including natural language processing, conversational agents, and virtual assistants.

It is important to note that this study is limited in scope. Further research could explore additional aspects of behavior, such as empathy and adaptability, and investigate their implications for language models' performance and interaction with users.

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Trends of next Generation Science Standards Integration in High School Science Curricula

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Abstract. This work presents part of an evaluation of a newly released high school science curriculum from a U.S. Midwestern state. This work evaluated trends in Next Generation Science Standards Practices across the curriculum. Epistemic Network Analysis was used to identify co-occurrences and integration patterns. Biology had less co-occurrences with Modeling than physics and chemistry. Biology had more co-occurrences than physics and chemistry between Explanations and Solutions and Obtaining, Evaluating, and Communicating Information. Physics and chemistry were similar, but chemistry had more Investigations and Modeling, and physics had more Argumentation co-occurrences. This work indicates planning and carrying out investigations was under-represented across the curriculum. Recommendations for modifications are discussed.

Keywords: Science Education, Curriculum Evaluation, NGSS.

1 Introduction

A large United States district in a Midwestern state recently released a high school science curriculum. The curriculum was developed as a curriculum equity initiative to provide all schools and teachers with rigorous curricula aligned to the Next Generation Science Standards (NGSS) [1]. This work is part of an evaluation of the curriculum. Here, we explore how the NGSS Science and Engineering Practices were integrated to understand trends in the interplay between practices in the curriculum.

2 Methods

The data used for this analysis was all classroom materials, including a Teacher Facilitation Guide, student handouts, and presentation slides for each lesson. Each science subject (Biology, Chemistry, and Physics) consisted of 8 units. Each unit consisted of four to seven lessons. Each lesson was split into lesson segments in the Teacher Facilitation Guides. Each Lesson Segment was manually coded by the first author in a binary approach for the presence (1) or absence (0) of each NGSS practice. The NGSS Science and Engineering practices include: 1. Asking Questions & Defining Problems, 2. Developing and Using Models, 3. Planning and Carrying out Investigations, 4. Analyzing

and Interpreting Data, 5. Using Mathematics and Computational Thinking, 6. Constructing Explanations and Designing Solutions, 7. Engaging in Argument from Evidence, and 8. Obtaining, Evaluating, and Communicating Information. The number of minutes of Lesson Segments with each NGSS practice were counted and transformed into percentages of the total number of minutes to compare. Networks of codes were created with the Epistemic Network Analysis (ENA) web tool [2].

3 Results

Table 1 displays the percent time of each NGSS practice by subject. The most prevalent practice was Obtaining, Evaluating, and Communicating Information, followed by Constructing Explanations and Designing Solutions. Engaging in Argument from Evidence ranged from 38-48% and Developing and Using Models ranged from 23-40%. The other practices were integrated the least, ranging from 7-15%.

Table 1. % Time of Each NGSS Practice

Subject	Asking Questions	Modeling	Investigations	Data Analysis	Math/ CT	Explanations & Solutions	Argumentation	Obt., Eval., & Comm. Info
Biology	11	23	6	11	7	63	38	79
Chemistry	11	28	13	11	14	62	41	75
Physics	9	40	9	10	15	64	48	78

3.1 Epistemic Network Analysis

Networks of co-occurrences of NGSS practices were created to depict the frequencies of each practice and the frequencies of each co-occurring practice while maximizing the variation across the x and y axes. The network of all curricula indicated the most frequent nodes were Obtaining, Evaluating, and Communicating Information; Explanations and Solutions; Argumentation; and Modeling, which are reflected in the graphs and tables above. The most frequent co-occurrences in this model (i.e., the thickest lines) were Obtaining, Evaluating, and Communicating Information and Explanations and Solutions; Obtaining, Evaluating, and Communicating Information and Argumentation; and Explanations and Solutions and Argumentation. These three co-occurrences indicate that many lesson segments contain overlapping instances of these three practices. Modeling is also connected to these three practices with less frequency, indicating that modeling overlaps with Obtaining, Evaluating, and Communicating Information; Explanations and Solutions; and Argumentation, just less frequently. The main differences depicted across the x axis are Modeling on the right side and Obtaining, Evaluating, and Communicating Information and Explanations and Solutions and the left side. This indicates that within the units, there are differences in the modeling co-occurrences with the other practices. For example, if all units had similar modeling co-occurrences with other practices, the modeling node would be more centrally located rather than in the far-right x direction. A similar trend is depicted on the y axis with

investigations at the top and argumentation on the bottom. This indicates there are differences in co-occurrences for these two practices between the curriculum units.

Individual Subjects. Figure 1 Left is the epistemic network for Biology units. The biology units reflect the overall curriculum trend with co-occurrences between the four most frequent practices, Obtaining, Evaluating, and Communicating Information; Explanations and Solutions; Argumentation; and Modeling. There are some occurrences of and co-occurrences between Asking Questions and Defining Problems; Data Analysis; Investigations; and Math and CT, but these are very few.

Figure 1 Middle is the epistemic network for Chemistry units. The Chemistry units reflect the overall curriculum trend with co-occurrences between the four most frequent practices, Obtaining, Evaluating, and Communicating Information; Explanations and Solutions; Argumentation; and Modeling. There are some occurrences of and co-occurrences between Asking Questions and Defining Problems; Data Analysis; Investigations; and Math and CT, but these are not as frequent.

Figure 1 Right is the epistemic network for Physics units. The Physics units reflect the overall curriculum trend with co-occurrences between the four most frequent practices, Obtaining, Evaluating, and Communicating Information; Explanations and Solutions; Argumentation; and Modeling. There are some occurrences of and co-occurrences between Asking Questions and Defining Problems; Data Analysis; Investigations; and Math and CT, but these are very few.

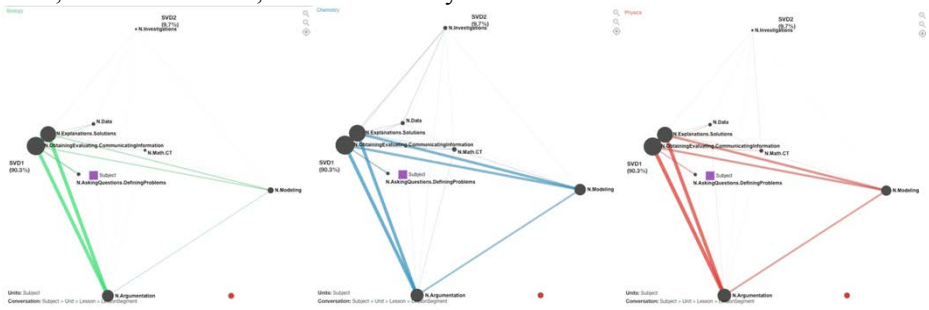

Fig. 1. Biology (Left), Chemistry (Middle), and Physics (Right) Networks

Differences Between Subjects. Subtractive models were created to determine the differences in co-occurrence networks between subjects. When comparing biology and chemistry units, biology had more co-occurrences of Obtaining, Evaluating, and Communicating Information and Explanations and Solutions than chemistry units. Biology also had more co-occurrences of Explanations and Solutions and Argumentation. The chemistry units had more co-occurrences of every other NGSS practice combination, especially those co-occurring with Modeling.

When comparing biology and physics units, biology had more co-occurrences of Obtaining, Evaluating, and Communicating Information with both Explanations and Solutions and Asking Questions and Defining Problems than physics units. Biology also had more co-occurrences of Explanations and Solutions with both Argumentation

and Data Analysis. The physics units had more co-occurrences of every other NGSS practice combination, especially those co-occurring with Modeling.

When comparing chemistry and physics units, physics units contained more co-occurrences between Argumentation with all the following: Explanations and Solutions; Obtaining, Evaluating, and Communicating Information; Asking Questions and Defining Problems; and Data Analysis. Physics units also had more co-occurrences of Investigations and Math and CT. The chemistry units had more co-occurrences of Modeling with the following practices: Math and CT; Investigations; Data Analysis; Explanations and Solutions; and Obtaining, Evaluating, and Communicating Information.

4 Discussion

The poster will present the analysis discussed above. The poster will show more network figures and examples with co-occurrences to give more in depth analysis of the trends. Discussions with attendees are expected to involve the following: 1. What is the appropriate amount of integration of NGSS practices? 2. What should NGSS practice integration networks look like? 3. How can we equitably increase NGSS practice integration? 4. How can quantitative ethnography be used to evaluate curricular materials?

This curricular analysis has prompted several initial recommendations for the district. First, we suggest the integration of more investigations and data analysis. The process of planning and conducting investigations, which includes asking questions, testing ideas, collecting data, and analyzing data, is at the core of science, and as such, these practices should be central in science education [3]. Given the initiative of curricular equity, it is possible investigations were not integrated expected because schools have varying access to laboratory equipment and materials. As such, as the district integrates more investigations, special attention should be given to choosing investigations and materials that are easily accessed by all. Another suggestion is to integrate computational models as environments for digital investigations. Since all students in this district have computers, this could be a fruitful path towards including more investigations, which would also lead to more math and computational thinking practices.

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Multimodality in Transactive Discourse: Integration of MmLA and SSNA

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Abstract. Transactivity, which refers "reasoning on others' reasoning", has been known as the key to successful collaborative learning. Transactivity has been examined based on verbal interaction, but the relation between nonverbal modality and transactive discourse should be further investigated. In this study, we conducted Socio-Semantic Network Analysis (SSNA), a methodology for analyzing transactive discourse, and Multimodal Learning Analytics (MmLA) of 45-minute collaborative problem-solving to identify nonverbal patterns of behaviors in segments where significant transactivity emerged. The combination of SSNA and MmLA revealed the group's collective construction of transactive discourse and consistent patterns of multimodal data. Although three participants rotated the leadership of transactive discourse, their nonverbal modality, especially head activity, showed a consistent trend. These results suggest that the group's dynamics were stable, and participants were consistently fulfilling their roles as appropriate to the problem-solving phases. Transactivity analysis with multimodal data may have potential to capture learners' cognitive responsibility in collaborative learning in detail.

Keywords: Collaborative Learning, Multimodal Learning Analytics (MmLA), Socio-Semantic Network Analysis (SSNA), Transactivity.

1 Background and Purpose

Multimodality in Collaborative Learning Research. While studies of collaborative learning have used verbal modality as data, especially speech, to analyze interactions, analyses of nonverbal modality are attracting more attention to describe interactions at a more granular level. Multimodal Learning Analytics (MmLA), a methodology for collecting, integrating, and analyzing multimodal data [1], has emerged as a new methodology to analyze a variety of nonverbal data.

Many nonverbal modalities, such as system log data, eye gaze, and action, are discussed as meaningful indicators of the interactions in the research on collaborative learning. Some studies suggest that synchronization of nonverbal modality (e.g., joint gaze attention) has a positive effect on collaborative learning, although these findings are not consistent [2].

Transactivity in Collaborative Discourse. One of the analytical perspectives in collaborative learning is transactivity, which refers to "reasoning based on others' reasoning". Teasley [3] analyzed collaborative discourse and concluded that transactivity is the key to successful collaboration. Recent studies propose a method to visualize leadership of transactive discourse using Socio-Semantic Network Analysis (SSNA), which uses the co-occurrence network of words in discourse to represent the trajectory of idea improvement [4]. Although the analysis of transactivity based on verbal modality has achieved some success, most studies of transactive discourse have not focused on the relation between verbal modality and nonverbal modality.

In this study, we conduct SSNA and MmLA on transactive discourse and aim to clarify relation between nonverbal modality and transactivity. Our research questions are as follows:

RQ1: What kind of multimodal patterns appears in the learners' leadership of transactive discourse?
RQ2: How can we interpret transactive discourse from the perspective of learners' leadership of transactive discourse?

2 Method

2.1 Multimodal Data Recording

Participants and Settings. Three university students as a group participated in collaborative problem-solving task called "Rescue at Boone's Meadow" [5]. The task was provided as 18-minute video of a story about how a female character would think of the solution to bring a wounded eagle back to the hospital in town. After watching the video, participants were given 45 minutes to come up with their solution to the problem. During solving the problem collaboratively, they were provided a whiteboard to put down their ideas and a laptop to watch the video and search for the information.

Recording Tools. A video camera and a voice recorder were used to record participants' discourse. Besides, our developed business card-type sensor badge [6] was mounted on the head and both arms of each participant. The badge was comprised of sensors for (1) sound pressure, (2) 3D acceleration, and (3) RFID. In this study, we used the data collected by the 3D acceleration sensor.

2.2 Multimodal Data Extraction and Integration

Identification of Segments of Transactive Discourse. We conducted SSNA on the transcript to extract segments where participants' leadership of transactive discourse emerged. The idea improvement process as a group and the individuals' transactive contributions were calculated by the sum of the degree centralities in the co-occurrence network of words.

Multimodal Data Analysis. Multimodal sensor data were quantified and integrated with the information of emerging leadership to figure out multimodal patterns.

3 Results and Discussion

SSNA revealed three participants, P1, P2, and P3's collective contribution in transactive discourse (Fig. 1). Based on the trajectory of the group's idea improvement, we extracted two segments, conversation turns 108-111 and 294-299, and found that the leadership of P2 and P3 was prominent in the first segment, and that of P1 and P2 in the second. Video data shows that the participants gathered information in the first segment and discussed the solution to the task in the second. These results suggest that the participants rotated the leadership depending on the problem-solving phases.

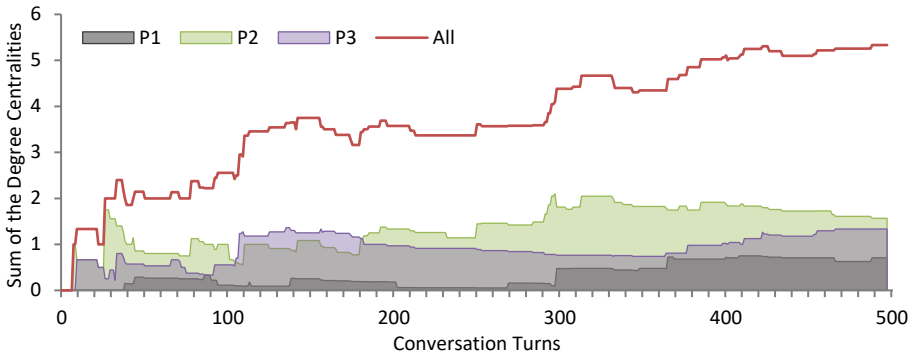

Fig. 1. The trajectory of the group's idea improvement is shown by the red line. Higher value of the sum of the degree centralities indicates more transactive discussion. Gray, green, and purple area represents three participants, P1, P2, P3's individual transactive contribution. More colored area means more leadership of transactive discourse.

The acceleration data analysis revealed consistent patterns throughout the entire collaborative process, although there were some partial variations. For example, integrated with the findings about the leadership rotation, Fig. 2 shows that the magnitudes of head activity depended on problem-solving phases, and its relationship across the participants is consistent regardless of who takes the lead.

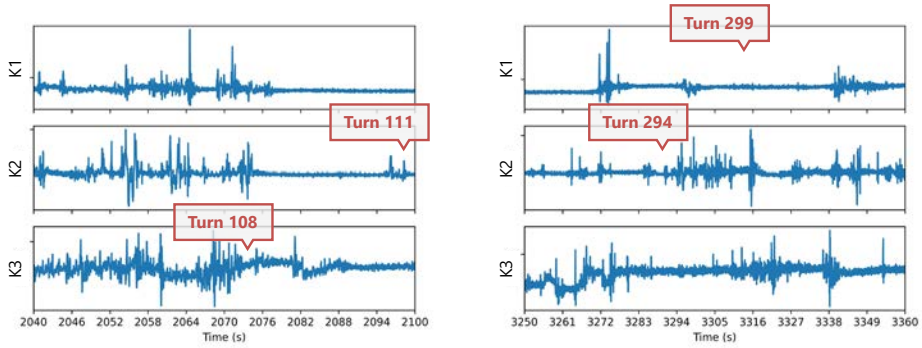

Fig. 2. Head activity in two segments of emerging leadership. P1 and P2 had conversation turns in both segments, while P3 only spoke in the first segment.

Consistent patterns in the acceleration data may suggest that the group dynamics in the nonverbal interaction was stable. Despite the differences in the leadership taking among the participants, total of their turn-taking was similar (P1: 34.7%, P2: 37.3%, P3: 27.5%). The video data also showed that the participants' roles (or cognitive responsibility) were almost constant (P1: consensus building, P2: idea improvement, P3: monitoring). Thus, the stability of the group dynamics may have contributed to the consistent patterns of the participants' behavior and multimodal data traces.

Leadership is an individual feature, whereas nonverbal data reflect group dynamics. The combination of SSNA and MmLA will help us understand differences in the internal dynamics of groups that appear to have similar trajectories of transactive discourse, which reflects learners' cognitive responsibility and epistemic agency.

4 Conclusion

In this study, we conducted SSNA and MmLA on 45-minute collaborative problem-solving to clarify the relation between nonverbal modality and transactivity. Consistent patterns emerged in the collective construction of transactive discourse, reflecting stable group dynamics. The analysis we conducted may be able to describe learners' epistemic agency through group's interaction patterns.

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Making Sense of Students' Metacognitive Patterns: Analysing Reflections with Epistemic Network Analysis

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Abstract. This research focuses on evaluating students' metacognitive patterns using reflection writing through the lens of epistemic network analysis. Metacognition plays a vital role by allowing learners to evaluate their thought processes, enhance their understanding of how they learn, and develop motivational control skills. Understanding students' metacognitive patterns has the potential to provide significant insights into their learning strategies, assisting instructors in designing effective approaches. This study aims to analyse students' metacognitive patterns, implementing a codebook based on metacognitive phenomena and epistemic network analysis. Preliminary findings are presented in this poster. Findings indicate that students' inclination to engage in reflective writing differs depending on the types of reflection questions presented to them. This study contributes to developing our understanding of metacognition in an educational context and emphasizes the importance of designing reflection questions to foster students' metacognitive skills.

Keywords: metacognition, epistemic network analysis, learning analytics, reflection, intervention.

1 Introduction

"Thinking about thinking", i.e., metacognition facilitates learning by assisting learners in comprehending their own learning process, for example, by allowing the learners to engage in their learning process, make informed decisions on approaching a task, and reflect on their learning experiences. Knowledge regarding events, contexts, elements e.g., people and tasks, and components like strategies and sensitivities that interact to influence how tasks and issues are represented and solved contribute to the body of metacognitive knowledge [1]. Metacognition, with decades of research, has been proven to be a critical component of students' learning enabling them to be conscious of their own strengths and weaknesses. The key challenge with learning data is understanding the learning pattern within, where learning analytics (LA) can be implemented as a practical framework for understanding students' metacognition through the learning data. Metacognitive interventions are one of the techniques for increasing students' metacognition, of which "reflection" is commonly used. However, eliciting reflection

can be challenging considering the structure of the reflection questions. Classes of metacognitive phenomena are metacognitive knowledge, metacognitive experiences, goals/actions, actions/strategies, and context [2, 3]. This pilot study seeks to examine the patterns of metacognitive phenomena evident in students' reflections about their learning of different topics, highlighting the significance of metacognitive prompts in eliciting different metacognitive processes.

2 Methods

2.1 Context and Data Collection

In this pilot study, data was collected from a 3rd-year undergraduate subject within the IT discipline. The subject had an enrolment of 31 students. Weekly tutorials were divided into three components: (1) Collaborative tasks, (2) Metacognitive talk time[1], and (3) Reflections. Weekly reflection questions were related to the weekly subject content and were delivered to the students from week 1 to week 10. Students did the reflections as formative tasks. Data from weeks 3 and 6 were retrieved, as these two weeks had two different types of reflection questions[2]. Week 3 reflection focused on metacognitive knowledge, whereas week 6 reflection mainly focused on goals. These questions were formulated before the commencement of the semester and were developed based on the definition of these constructs available in Table 1. Basic data pre-processing was performed on reflection responses, and they were segmented into sentences with the aim of making them quantifiable.

2.2 Setting up the Analysis Model

We implemented Epistemic Network Analysis (ENA), a versatile method that goes beyond simple frequency-based comparisons and helps uncover intricate patterns of relationships between data, which can lead to insights that might be missed with simple frequency analysis. By measuring the co-occurrence of codes inside conversations, creating a weighted network of co-occurrences, and developing related visualisations for each data analysis unit, ENA models the links between codes [3]. The metacognitive phenomena used to encode the self-reported reflection segments was adapted from Flavell's cognitive monitoring, i.e., metacognitive knowledge, metacognitive experience, goals, and actions [2] and context from Wu et.al [4] (see Table 1). After segmentation, each line of data was hand-coded in Excel. Inter-rater reliability was performed between two researchers with perfect agreement achieved, kappa coefficient=1.00

[1] Metacognitive talk time: after completing the tutorial exercises, students shared their thoughts on reflecting on the process. Examples– "how you solved the questions?" "What strategy/approach did you use to solve it?"

[2] **Week 3:** How do you feel about the OLTP & OLAP Queries exercise using Excel? What parts of it do you particularly like? Dislike? What did/do you enjoy about this exercise?
Week 6: What is the one thing you particularly want people to notice when they look at your submission for the data visualisation tutorial questions?

(Shaffer's rho ≤ 0.00). The ENA web tool was used for the next part of the analysis with the following parameters: **unit of analysis**: students, **conversation:** reflection entries, **code:** metacognitive phenomena, **comparison group:** week 3 and week 6, and **window:** whole conversation.

Table 1. Codebook of constructs used in analysis

Code Label	Definition
Metacognitive Knowledge (MK)	One's own knowledge and beliefs about the components (person, task, or strategy variables) that have an effect on their cognitive abilities
Metacognitive Experience (ME)	Refers to a person's subjective internal reactions to his or her own metacognitive knowledge, goals, or strategies
Goal	Outcomes/ objectives of a cognitive activity
Action	Behaviours or structured processes implemented to achieve a goal
Context	Describes the context of the students' metacognitive activities and that do not belong to the aforementioned phenomena

3 Results and Discussion

The analysis found that students' metacognitive reflective writing differed in response to different topics in reflective questions. The comparison plot from **Fig. 1** illustrates that in week 3 (red lines), for the metacognitive knowledge reflection question, there is a strong connection between MK and ME. In contrast, for week 6 (blue lines), for the goal-based metacognitive question, there is a strong connection between action and goal metacognitive phenomena. The network plots (top-right and bottom-right) in **Fig. 1** show that students focused more on MK, ME, and action in week 3 (knowledge) reflection writing; on the contrary, students focused more on action and goal in week 6 (goal) reflection writing.

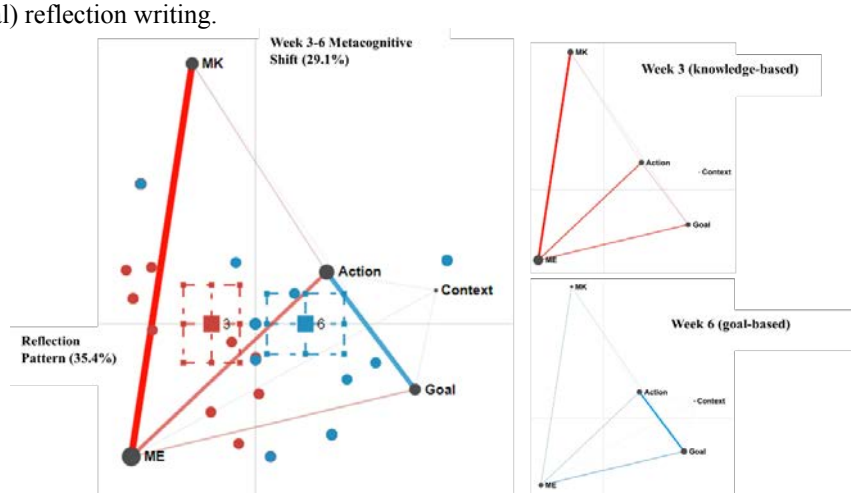

Fig. 1. Difference model between week 3 and week 6 (Left). Network plots for metacognitive phenomena in week 3 (Top-right where N=24) and week 6 (Bottom-right where N=21)

To test for differences (at the alpha=0.05 level) we applied a Mann-Whitney test to the location of points in the projected ENA space for unit of analysis (students) in weeks 3 and 6. Along the X axis (Reflection Pattern), test showed that week 3 (Median=-0.13, N=24) **was statistically significantly** different from week 6 (Median=0.0, N=21 U=116, p=0.00, r=0.54; 35% variance). Along the Y axis (Week 3-6 Metacognitive Shift), test showed that week 3 (Median=0, N=24) was not statistically significantly different from week 6 (Median=0, N=21 U=236, p=0.72, r=0.06). For the Goodness of Fit of the model, Pearson correlation coefficient for X-axis/Y-axis is 0.97/0.85, and the Spearman correlation coefficient of 0.96/0.84 for X-axis/Y-axis, suggesting a good model fit and demonstrates the fundamental relationships.

The findings of the analysis demonstrate that students' metacognitive reflection writing differed in accordance with the types of questions provided. Students' connections between MK, ME, and Action indicate reflections where students draw on the learning experience (ME) to build new knowledge (MK) – identifying especially the knowledge they may have been missing before – and identifying the new actions that they will undertake for similar tasks in future. For reflections where it is mainly Goals-Actions, the students did not demonstrate how they are drawing on the learning experience to gain new knowledge.

4 Conclusion and Future Work

This study provides valuable insights into students' metacognitive patterns according to different types of reflection questions, with findings demonstrating that the nature of the question significantly influenced learners' metacognitive reflection writing. This result portrays the importance of intentionally designing reflection questions to improve aspects of students' metacognition. Future work will explore quantitative ethnographic techniques (1) to examine the patterns of metacognitive phenomena evident in high and low performing students' reflections about their learning of a topic; and (2) to evaluate the relationship between students' self-reported metacognitive scores and implemented metacognitive intervention (reflection and metacognitive talk).

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Identification Through Experiences and Blood: Epistemic Network Analysis of Interviews on Hong Kong Bicultural Identity

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Abstract. In the decade after the 1997 handover of Hong Kong (HK) back to China, HK citizens' Chinese identification appeared to increase. However, in recent years, HK's relation with mainland China has been contentious, with local-national cultural tension. In this study, we use epistemic network analysis to examine the contents and overlaps of the Hongkonger and Chinese identities. We interviewed 15 HK citizens and found that representations of the two identities differ significantly. While emotional attachment is important to both identities, the Hongkonger identity emphasizes responsibilities and experience, whereas the Chinese identity stresses stable, prescribed attributes. Since identities can guide intergroup relations, our findings could shed light on ways to improve relations.

Keywords: Identity, Values, Biculturalism, Epistemic Network Analysis

1 Introduction

In regions like Hong Kong (HK), where sociocultural forces have undergone drastic changes, cultural identity is not always clearly demarcated along national boundaries. After over a century of British colonial rule, HK was returned to China in 1997. In the following decade, the general public's approval of the handover [1] and Chinese state identification [2] appeared to increase. Recently, however, HK's relation with mainland China has been contentious, with tension between the local and national identities. In 2022, only 21% of citizens identified as Chinese; 32% identified as Hongkongers, and 46% identified with a mixed identity [3]. Indeed, state-level directives have sometimes been met with friction in HK [4], even though the population is majority (91.6%) ethnically Chinese [5].

Against this historical backdrop, we sought to examine HK citizens' epistemic networks of the Chinese and Hongkonger identities to discern their contents and overlaps. As research suggests identities guide intergroup relations, our findings could

shed light on ways to improve relations. Going beyond survey methods, this study is the first to probe the two identities' contents using epistemic network analysis (ENA).

2 Methods

We recruited 15 HK-born citizens (aged 18-69; 60% female; 80% degree-level education) for semi-structured in-depth interviews in February to May 2022. We asked each interviewee for their views on both Chinese and Hongkonger identities and values. Two researchers coded utterances from verbatim transcripts for interviewees' ideas, with four rounds of discussions during the process to ensure alignment and resolve disagreements. The codes were then aggregated into higher-level codes (Table 1).

Table 1. Codebook for Hongkonger/ Chinese identities and values

Code	Definition
Topic 1: Identity	
Prescribed attributes	Relatively unchangeable, stable individual attributes that are usually prescribed by external factors, e.g., bloodline, legal status.
Extensive experience	Indicators of a significant amount of time and experiences in the region, e.g., growing up there, having experiences and memories.
Emotional attachments	Emotional ties to the identity or region, e.g., a sense of belonging, well-wishes for the region and its people.
Knowledge and beliefs	Knowledge, understanding, and endorsement of the identity and the region's history, culture, values, and language.
Responsibilities	Civic duties or responsibilities to nurture or defend the ingroup.
External conferral	External agents, such as the state or peers, confer the identity.
Self-conferral	The identity can be self-conferred by the individual.
Topic 2: Values	
Achievement	Personal success, shown by reaching social standards.
Power	Status, prestige, control, or dominance over others and resources.
Security	Preservation of the safety, harmony, and stability of society, relationships with others, and the self.
Conformity	Restraining one's desires or actions that may violate social norms.
Tradition	Respect for and commitment to cultural customs and ideas.
Benevolence	Concern and enhancement of close others' welfare.
Universalism	Understanding and protection of the welfare of all people.
Self-direction	Emphasis on independent thought, choice, or action.
Stimulation	Seeking excitement or novel experiences.
Hedonism	Prioritizing one's own pleasure or gratification.

3 Results

Using interviewee as the unit of analysis, nested under the Hongkonger/ Chinese identity and values conversations, we constructed means-rotated ENA models of interviewees' representations of the Hongkonger and Chinese identities and perceptions of the Hongkonger and Chinese values.

In the Hongkonger/ Chinese identities model (see Fig. 1), the X-axis (Pearson's $r = 0.97$) extremes are defined by responsibilities and prescribed attributes, explaining 21.6% of the variance. The Y-axis (Pearson's $r = 0.99$) extremes are defined by self-conferral and cultural knowledge and beliefs, explaining 22.5% of the variance. A *t*-test showed that representations of the Hongkonger (M = -0.31, SD = 0.55) and Chinese (M = 0.31, SD = 0.67) identities differ significantly on the X-dimension ($t(55.84) = -3.86$, $p < .001$, Cohen's $d = 1.00$). The key differences lie in the emphases on responsibilities (Hongkonger identity), prescribed attributes (Chinese identity), and their ties with emotional attachment. While emotional attachment has a relatively central position in both identities, it is predominantly tied to prescribed attributes in the Chinese identity; whereas it has competing ties to self-conferral, extensive experiences, knowledge and beliefs, and importantly, responsibilities, in the Hongkonger identity.

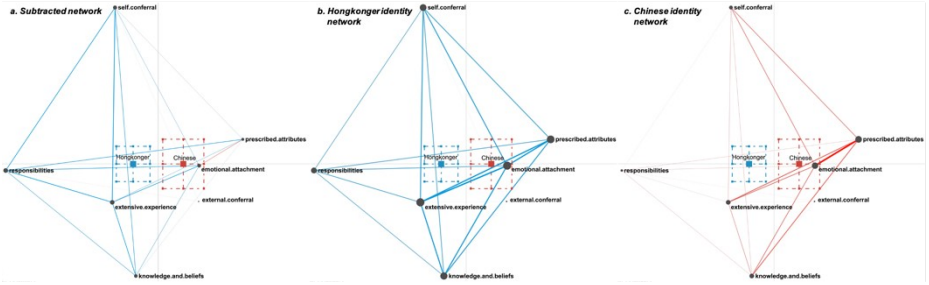

Fig. 1. Interviewees' representation of Hongkonger and Chinese identity contents

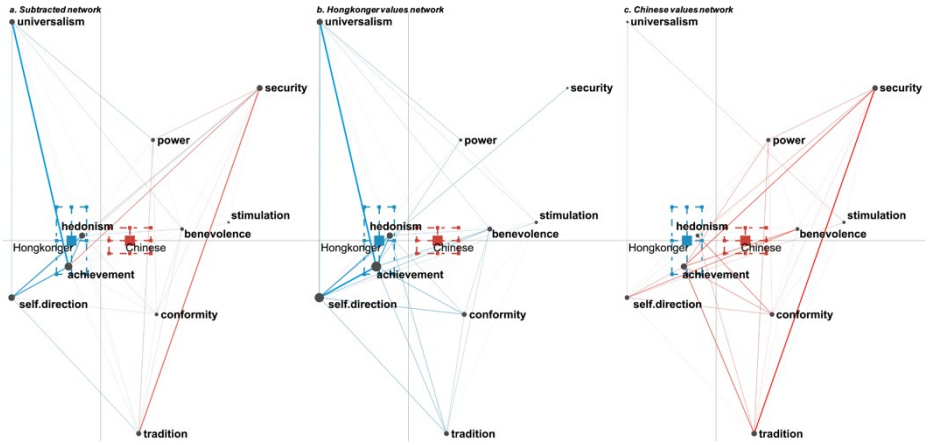

Fig. 1. Interviewees' perceptions of Hongkonger and Chinese values

In the Hongkonger/ Chinese values model (see Fig. 2), the X-axis (Pearson's $r = 0.88$) extremes are defined by self-direction and security and the Y-axis (Pearson's $r = 0.92$) extremes are defined by universalism and tradition, explaining 10.3% and 14.8% of the variance, respectively. A *t*-test showed that perceptions of the

Hongkonger values (M = -0.20, SD = 0.28) and Chinese values (M = 0.20, SD = 0.38) differ significantly on the X-dimension ($t(52.59) = 4.63$, $p < .001$, Cohen's $d = 1.20$). The main differences between the two sets of values are the relative emphases on more post-materialistic values (Hongkonger values) on the network's left, and more materialistic values (Chinese values) on the network's right. Interestingly, these differences are linked to individual achievement in both sets of values.

4 Discussion

This study examined HK citizens' Hongkonger and Chinese identities and values representations. Although our interviewees were not randomly sampled, they scored 4.7 (out of 5) for Hongkonger and 3.6 for Chinese identification, echoing patterns in randomly-sampled large-scale polls [3], suggesting that they may not be so different from the general population. Our findings indicate that while emotional attachment to the identity and group is mainly tied to relatively fixed attributes in the Chinese identity, it is also intertwined with more malleable contents in the Hongkonger identity. Emotional attachment is central to both identities, but may be driven by differing forces: more external and fixed (Chinese) or more self-defined and malleable (Hongkonger), aligning with suggestions that post-colonial identities are more dynamic [6]. Achievement was a common central value in both values networks. However, Chinese values linked it with more materialistic values, whereas Hongkonger values linked it with more post-materialistic values. This may suggest a difference in how achievement is motivated and evaluated: via the fulfillment of more post-materialistic, self-based goals (Hongkonger) or more materialistic, group-based (Chinese) goals.

Our findings stress the puzzle of Hong Kong citizens' bicultural identity: while the Hongkonger and Chinese identities and values share similarities, how these identities are conferred and how members are evaluated may differ and conflict. To further address the differences and views of identity integration, we have since launched a second wave of interviews (currently ongoing).

Acknowledgements

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A Humble Template for Poster Submissions to ICQE

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Abstract. This poster describes a general method for writing a poster submission about a persistent problem in relevant field. While this work should not be used without significant adaptation, we hope it provides a useful framework for scholars presenting empirical results in quantitative ethnography in condensed format.

Keywords: Quantitative Ethnography, Poster submissions, Academic template

1 Introduction

A persistent problem in relevant field is big topic the poster is addressing. Critical to big topic is the specific problem, question, or topic this poster will discuss. Current work in relevant field suggests that conventional answer to the specific problem, question, or topic [1]. This poster uses data from data source to investigate whether this is the case in context from which the data came.

2 Theory

The big topic the poster is addressing is complex because one key component of the specific problem, question, or topic impacts some second key component. This is a particularly salient issue in context because one key component and the second key component interact; thus here we examine big issue using data from data source.

Within relevant field, important author has proposed *theoretical framework*, which describes this critical relationship in terms of construct one, construct two, and construct three [2]. *Construct one* refers to the definition of construct one. *Construct two* describes the definition of construct two. Taken together, these two factors describe one part of how one key component relates to the second key component. But the specific problem, question, or topic also depends on *construct three*, which is the definition of construct three. In other words, the relationship between one key component and the second key component can be characterized by how these aspects of the specific problem, question, or topic reflect construct one, construct two, and construct three.

Critical to theoretical framework, however, is that these facts of the problem are not independent: rather, they *interact* with one another in the context of one key component and the second key component. We thus propose to analyze data from data source with

epistemic network analysis (ENA), which is a quantitative ethnographic tool that models the structure of interactions between constructs in the type of data [3]. In what follows, we use ENA to ask whether and how the interactions between construct one, construct two, and construct three account for the relationship between one key component of the specific problem and the second key component in context.

3 Methods

3.1 Data

Data was collected from context by data collection process. The data consist of type of data from number description of units. Units were characterized as being first group when they had some relationship to one key component, defined by definition of first group; units were characterized as being second group when they were some relationship to the other key component, defined by definition of second group. The data was transcribed by transcription process and segmented by definition of [L]ines, resulting in number lines of data. Other relevant conditions of the data or collection.

Table 1. Codebook.

Code	Definition	Example	Cohen's κ
CONSTRUCT ONE	Summary of definition from theory section, with explanation of conditions for identifying it in this data	*Short example from the data (not used in results section)*	R1 v R1 κ val R1 v C κ val R2 v C κ val
CONSTRUCT TWO	Summary of definition from theory section, with explanation of conditions for identifying it in this data	*Short example from the data (not used in results section)*	R1 v R1 κ val R1 v C κ val R2 v C κ val
CONSTRUCT THREE	Summary of definition from theory section, with explanation of conditions for identifying it in this data	*Short example from the data (not used in results section)*	R1 v R1 κ val R1 v C κ val R2 v C κ val
ADDITIONAL GROUNDED CONSTRUCT	Definition of construct plus explanation of conditions for identifying it in this data	*Short example from the data (not used in results section)*	R1 v R1 κ val R1 v C κ val R2 v C κ val

Codes for the data were developed using a grounded approach informed by theoretical framework. Coding was done using automated coding tool [4], which codes data using type of automated classifier, and validates levels of agreement using validation process to get 3-way agreement between two human coders (R1 and R2) and the classifier (C). The resulting codes and levels of agreement are shown in Table 1.

3.2 Analysis

The data was analyzed qualitatively to understand the role of CONSTRUCT ONE, CONSTRUCT TWO, CONSTRUCT THREE, and ADDITIONAL GROUNDED CONSTRUCT in first group and second group. We also analyzed the typical recent temporal context for lines in the data, which we determined qualitatively to be a window of window size.

We constructed an ENA model where: units of analysis were units of analysis; conversations were defined by definition of conversations; and the moving stanza window was window size. The ENA model represented the connections between codes in each line of the data to other lines in its stanza window and summed the connections for all lines within each unit. The model normalized the resulting connection counts, and we used a type of rotation (means rotation or SVD) to project the normalized connection counts for units into an ENA space. We compared units in the first group and second group by examinining their mean network graphs and using a statistical test [e.g., *t* test].

4 Results

4.1 Qualitative Analysis

Our qualitative analysis suggested first group and second group had different patterns of interaction among CONSTRUCT ONE, CONSTRUCT TWO, and CONSTRUCT THREE.

For example, when one unit in the first group was action being done in context from which the data came, they said:

> *I was thinking about whatever construct one means in this context* [CONSTRUCT ONE]*, but also considering whatever construct two means in this context* [CONSTRUCT TWO].

That is, they were concerned about both CONSTRUCT ONE ("construct one means in this context" and CONSTRUCT TWO ("construct two means in this context").

In contrast, when a unit in the second group was action being done in context, they said:

> *I knew that whatever construct one means in this context* [CONSTRUCT ONE]*, was really important, but I felt like I couldn't do that and whatever construct three means in this context* [CONSTRUCT THREE].

That is, like the unit in the first group, this unit was concerned about CONSTRUCT ONE ("construct one means in this context"), but they felt that it was in conflict with CONSTRUCT THREE ("construct three means in this context").

In other words, the qualitative analysis suggested that units in the first group were primarily concerned about the relationship between CONSTRUCT ONE and CONSTRUCT TWO, while units in the second group focused on the relationship between CONSTRUCT ONE and CONSTRUCT THREE.

4.2 ENA Analysis

As shown in Figure 1a, the mean network graph of units in the first group contains a strong connection between CONSTRUCT ONE and CONSTRUCT TWO. In contrast, Figure 1b shows the mean network graph of units in the second group, which contains a strong connection between CONSTRUCT ONE and CONSTRUCT THREE.

Using the difference network that compares the mean network graph between the two groups (Figure 1c), we identified the *x*-axis of the ENA space as characterizing the *difference between focusing on* CONSTRUCT TWO *versus* CONSTRUCT THREE. Along the *x*-axis, test result (e.g., two-sample *t* test assuming unequal variance) shows that first group (mean=mean, SD=SD, N=N) was statistically significantly different at alpha=alpha level from second group (mean=mean, SD=SD, N=N; *t*(DF)=*t*, *p*=*p*, Cohen's *d*=*d*).

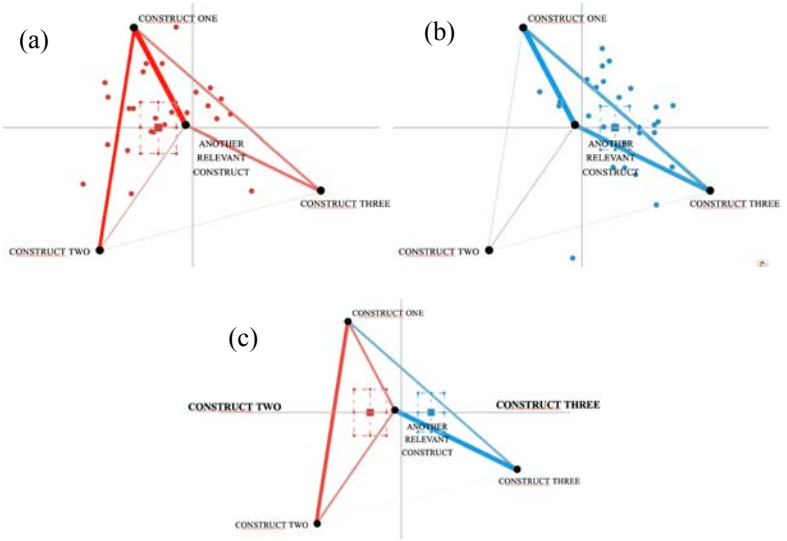

Figure 1. ENA model showing (a) mean network graph, mean, and points for first group (red), (b) mean network graph, mean, and points for second group (blue), and (c) difference network.

5 Discussion

These results thus suggest that the difference between first group and second group identified in the qualitative analysis was statistically significant within the data. Consistent with theoretical framework, the pattern of interactions among construct one, construct two, and construct three characterized the relationship between one key component and second key component of the specific problem, question, or topic in this data. While this study is limited by key limitation of study, this work shows that ENA can be used to gain insight into big topic the poster is addressing by operationalizing a model of theoretical framework in contexts such as context.

Acknowledgements

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Examining Racial Differences in Violations of Academic Freedom at Cuban Universities

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Abstract. Cuba's higher education system is commonly recognized as a leader in equity and opportunity and one of the best educational and health systems in Latin America. Yet, Cuba is one of the countries with the lowest levels of academic freedom globally. In this study, we provide a visual model of the violations of academic freedom at Cuban universities and how they are experienced across racial lines. We find that Black Cubans, compared to White Cubans, are coerced at lower levels leading to speedier expulsions and terminations.

Keywords: Epistemic Network Analysis, Higher Education, Cuba, Violations of Academic Freedom, Race

1 Introduction

The Cuban Revolutionary period (1959 to present) has been lauded for investing in universal education and for providing developing countries with medical doctors [1]. Paradoxically, Cuba is one of the countries with the lowest levels of academic freedom in the world [3]. In this study, we provide a visual model of the violations of academic freedom at Cuban universities and how these violations are experienced across racial lines. The guiding question is: How are violations of academic freedom experienced across racial lines? We find that Black Cubans, in comparison to White Cubans, are coerced in their employment for shorter durations of time and given less opportunities to change their resistance and behaviors, while White Cubans remain in their academic positions and engaged in studies longer.

Between 1958 and 1960, Cuba's AFI (academic freedom) index drastically dropped. In 1958, Cuba's AFI index was 0.69, and in 1960 dropped to 0.14. This drastic drop in academic freedom coincides with periods of instability during the Cuban Revolution and regime change, reflecting academic freedom in a closed autocracy [5].

Currently, there are more than a thousand political prisoners behind bars in Cuba many of whom consist of former youth and university students as well as those who participated in the largest anti-government protest in Cuba's history on July 11, 2021

Very little research has been conducted on Cubans' higher education experiences during communist rule. The role of higher education within a totalitarian socialist regime, the oldest dictatorship in the Western Hemisphere, has been largely undertheorized. Cuba's most recent constitution mandates Cubans must support the state's political ideology as a condition to enrolling in its higher education system [6].

2 Methods

Employing a Quantitative Ethnography approach [2], we collected textual discourse from the Observatorio de Libertad Academica (OLA) website. OLA is a human rights organization documenting cases of individual accounts of violations of academic freedom at Cuban universities. Cases are written in third person since individual cases are public knowledge. We collected 85 individual cases (cases ranging from 1959 – 2022) and segmented all textual information from each case published on the website. We segmented 3500 lines of data, each line consisting of 1-4 sentences by change of topic. Informed by the International Bill on Human Rights, the Academic Freedom Index [3] and literature on Cuban higher education post 1959 [4], we constructed 10 codes, seen in Table 1.

Table 1. Codebook of constructs included in analysis.

Construct	Definition
State Surveillance	Observing or experiencing state surveillance occurring in or near one's home, workplace, or school.
Coerced Migration	Being persuaded to migrate by force or threat on account of losing residency rights or ability to travel abroad.
Violence	Being invited to participate in, observed or experienced violent acts
Coercion in Employment or Studies	Politically motivated administrative acts intended to persuade individual to abandon their research, political interests, workplace, or school
Employment Dismissal or Suspension	Being fired, suspended, or demoted from one's current position due to politically motivated reasons.
Student Dismissal or Suspension	Being expelled, suspended, or given a failing grade for politically motivated reasons.
Teaching violations	Experiencing or observing violations when presenting material or interacting with students.
Research violations	Experiencing violations when conducting research or publishing research results.
Institutional Censorship	Public admonishment after exercising religious freedom or expressing one's opinions about the state.
Resistance	Engaging in oppositional acts as an individual, group member or by association.

State Surveillance	Observing or experiencing state surveillance occurring in or near one's home, workplace, or school.

3 Results

The resulting ENA network model is below, providing an examination by race [7]. For the model, the nodes (dots) represent the different constructs that were coded for, and edges (lines) are the weighted connections between the constructs. Thicker lines indicate stronger connections, while thinner lines indicate less connection.
Figure 1 provides a subtracted network model of the interviews by race, with white participants in red on the left and black participants in blue on the right. A means rotation was utilized to maximize the key differences between the two along the X axis. A Mann-Whitney test showed that Whites (Mdn=-0.24, N=60) were statistically significantly different at the alpha=0.05 level from Blacks (Mdn=0.49, N=25 U=239.00, p=0.00, r=0.68). White participants had the strongest connection between Coercion in Employment or Studies and both Institutional Censorship and Resistance on the left side of the model, while Black participants had strong connections to Resistance and Institutional Censorship on the right. This illustrates the statistically significant differences in the experiences of black and white participants who were interviewed.

A qualitative example of Alexander Pupo Casas (White) a medical doctor studying neuroscience and Reinaldo Agustin Ferrer Santos (Black) a first-time medical student provides insight into the co-occurrence of codes. Casas was studying Neuroscience at the University of Medical Sciences of Holguin, he published several Facebook essays critiquing the regime, while maintaining his position as a doctor and student. He was offered a "position as a doctor in a Family Doctor's Office, and they informed him that later he could continue his studies, but in the Comprehensive General Physician modality and starting from scratch."

In the case of Santos, who was studying to be a medical doctor and whose exam grades were changed by the university after they found out he had contrary political ideas. "They insisted that a medical student could not politically oppose the system and urged him to change his way of thinking or be asked to leave his studies, since they could not trust someone who was in charge of an operating room with those thoughts." Although it is understandable that Casas is serving the medical needs of the patients, and Santos is still studying medicine and thus is not as valuable practically to the regime. Yet, there is also a racial component that may be a factor in Casas' continual employment and in Reinaldo being expelled from studies.

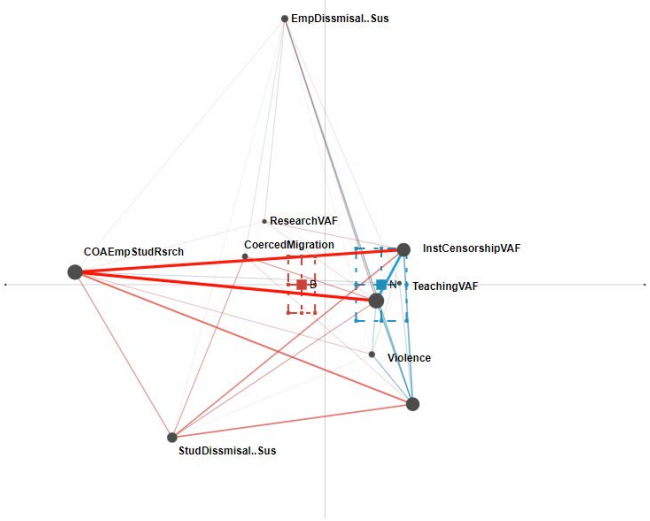

Fig. 1. Subtracted ENA network model of White participants (red, left) and Black participants (blue, right).

4 Discussion

In the current study, we find that universities are sites where violations of academic freedom happen primarily through coercion and institutional censorship, while the victims engage in iterative acts of resistance. This study provides evidence of how structural violence within Cuban universities occurs similarly and with variations to diverse victims.

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Understanding misalignment between researchers and teachers while co-designing AI curricula

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Abstract. Co-design is gaining traction as a transformative process to develop an Artificial Intelligence (AI) curriculum for K-12 classrooms that simultaneously addresses teachers' lack of AI content knowledge and doubles as professional development. This study employs Quantitative Ethnographic methods to analyze differences in discourse between researchers and teachers engaged in co-designing a Middle School AI curriculum, demonstrating the differing knowledge researchers and teachers discussed in their co-design meetings. Results indicate teachers are not oriented to engage with AI content concerns during co-design and may require specific scaffolding to engage with new content: AI.

Keywords: Co-design, Artificial Intelligence (AI), curriculum design.

1 Introduction

The nascent, explosive growth of Artificial Intelligence (AI) is being met with urgent calls for integration of AI curriculum across K-12 education. These calls require both curriculum development and teacher preparation, making co-design, or collaborative design, a relevant approach to AI education. Research-practice partnerships can leverage the expertise and assets of teachers and AI content experts in the design of AI curriculum, while creating an opportunity for teachers to learn AI content knowledge they might lack. However, there is little understanding of how research-practice partnerships actually operate in a co-design process. In this study, we build on prior analysis [3] drawing from the framework delineating Technological, Pedagogical, and Content Knowledge (TPACK) [1], and use Epistemic Network Analysis (ENA) to examine the discourse differences between researchers and teachers engaged in co-designing a middle school AI curriculum.

2 Theory

The framework we used to understand teacher engagement in AI curriculum co-design distinguishes how technological, pedagogical, and content knowledge is exchanged between stakeholders [1]. Content knowledge (CK) is knowledge about the subject matter that teachers should give to students. Pedagogical Knowledge (PK) is knowledge about how to teach the given content to students effectively and fluidly in

line with the educational purposes, values, and aims. Technology Knowledge (TK) is knowledge about how to use technological tools and resources as well as their strengths and weaknesses. Using this framework, Nicholson and colleagues [2] reported as one of the challenges of co-teaching the bridging of the gap between the teachers' lack of technological knowledge and the researchers' lack of pedagogical knowledge. This study reinforces this gap. We analyzed the difference in researcher and teacher discourse using ENA, a tool which visualizes statistical relationships between codes or concepts making up a discourse. ENA provides insight into the strength of connections between codes, providing a picture of who said—or paid attention to—what and how they are connected. Here, that permits displaying how researchers and teachers connect elements of TPACK in addition to relevant codes.

3 Methods

Data was generated and gathered over the course of 6 co-design sessions, each approximately 2 hours, hosted virtually on Zoom over 4 months. Two primary members of the research team organized and facilitated each session with two middle school technology/CS teachers. Sessions were recorded and transcribed. Transcripts were segmented into sentences and samples coded, primarily based on the TPACK framework, while affording space to grounded analysis. Codes which achieved interrater reliability, satisfying Cohen's $\kappa > 0.9$ and Shaffer's $\rho < 0.05$ (except in one instance), between researcher and nCoder's Automated coding was deployed after establishing interrater reliability between the human coder and nCoder's automated coding–narrowing codes to those in Table 1. Sessions were Conversations, Sentences were Lines, and a Moving Stanza Window of 4 was used, meaning codes in any one sentence considered were connected to codes in the prior 3 sentences. Differences between roles, Teachers and Researchers, were compared with connections aggregated from all 6 Conversations.

Table 1. Codebook with Cohen's Kappa & Shaffer's rho for interrater reliability.

Name	Definition	Example		
			κ	**ρ**
AI Content	Any instance AI is mentioned, including terms used to describe AI technologies, like image classification.	I do think kids think AI is that.	.96	.02
Beliefs about students	Any expression of a belief about or knowledge of (a) student(s).	They've heard of AI	.93	.02
Technological Knowledge	References to technology and technical expertise required to facilitate a class lesson.	We have Chromebooks.	.92	.06
Lack of Knowledge	Any instance "not knowing" something is mentioned.	They haven't put those together to AI.	1	.00

4 Results

Transcripts from the co-design sessions demonstrate that all teachers are not oriented to engage with AI content, and in fact may harbor technical concerns that tech-savvy curriculum designers may take for granted. On multiple occasions, after a member of the research team presented on AI content and lesson ideas, questions and responses from the teachers directed discussion toward non-AI-content concerns. The following is an exchange at the end of a research team member walking through a prototyped lesson about chatbots, discussing text classification and Natural Language Processing. When time for questions, our teacher was not concerned with the AI content, but the technical knowledge and operations of the class:

Research Team Member: *In order to set the context for the learning of the module, we have students explore what, even, natural language processing is. So that's the entire field of AI that's at play here. It has to do with understanding and producing human-like conversations…*

Teacher: *I have a technical question…I have not used Scratch. Is there anything…Do I need to have anything available? Do I set up a class? Is it just a program? I don't really know much about Scratch…*

This exchange, edited for concision and clarity, demonstrates the pivoting away from AI content and toward technical (or pedagogical) concerns that occurred repeatedly during co-design. As the research member speaks at length about the AI content involved in a lesson, when given the opportunity to ask a question, the teacher expresses a technologic concern—an area where she has more expertise than AI, but not enough to implement the curriculum based on the technical requirements undergirding the delivery of AI content.

Figure 1 displays the different patterns of discourse between researchers and teachers together in co-design. Whereas researchers drift to the left of the x-axis dominated by AI content, teachers fall to the right of the x-axis, more concerned with technical knowledge and knowledge gaps. A two sample t test along the X axis, assuming unequal variance, found a statistically significant difference between teachers' (mean=0.49, SD=0.58, N=12) and researchers' (mean=-0.37, SD=0.77, N=16; $t(25.99)= 3.36$, $p=0.00$, Cohen's $d=1.23$) discourse. Researchers made more connections between AI content and beliefs about students while teachers connected their beliefs about students more to technological knowledge and a lack of knowledge.

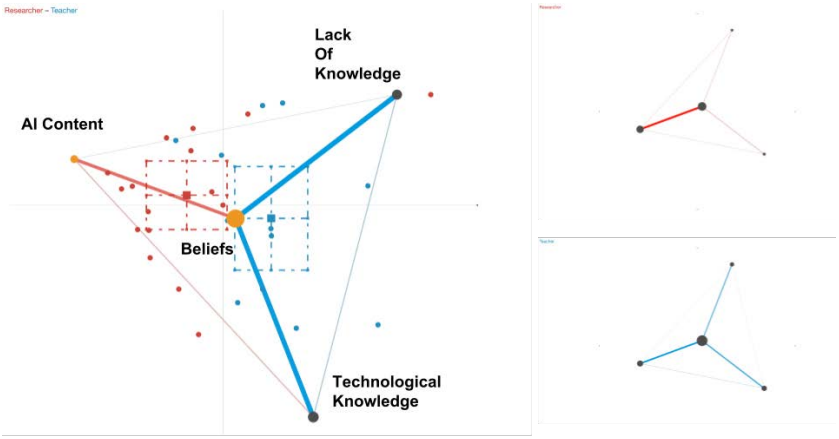

Fig. 1. A subtraction, or comparison plot, demonstrating differences in discourse between Researchers (in red) and Teachers (in blue). Plots for each role on right.

The ENA model confirms what we saw in our grounded analysis, which is that in co-designing an AI curriculum between researchers and teachers, teachers are not oriented to engage with AI content in the ways researchers may anticipate or hope for. Instead, teachers tend to invoke a knowledge gap or raise technological concerns which curriculum designers may take for granted in co-design.

5 Discussion

Ideally, co-designing an AI curriculum would endow teachers with the AI expertise necessary to teach AI content, while the curriculum development benefits from teachers' pedagogical expertise; in recruiting CS teachers, the technological knowledge required to implement technology-rich AI learning experiences can be taken for granted. This study suggests reality is far from this ideal. While researchers' discourse was heavily weighted toward AI content, intended to invite teachers to raise questions addressing their AI knowledge gap, teachers tended to non-content knowledge concerns. In turning to Technological Knowledge concerns, our teachers signaled they do not necessarily have the Technological Knowledge AI curriculum designers may assume of teachers. This suggests teachers require additional support to better engage with AI content.

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Using Artificial Intelligence Tools to Delegate Transcription of Qualitative Semi-Structured Interviews: An Independent Assessment of Data Protection and Privacy Risk to Research Participants

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Abstract. Qualitative researchers are increasingly using artificial intelligence (AI) to automate tasks such as transcription of audio recordings generated during interviews of research participants. To better understand the data protection and privacy risks of using such tools for task delegation in health research, we assessed Otter.ai, an AI-based audio transcription tool, approved for use in a qualitative research study on type 1 diabetes. The assessment was performed using a General Data Protection Regulation (GDPR)-based Independent Audit of AI Systems framework to identify risk variables that may not have been considered in the original study. Otter.ai was found to be effective in reliably differentiating speakers but struggled with technical medical acronyms, patented names, and jargon related to type 1 diabetes. Assurances and controls provided by Otter.ai relating to the "permanent deletion" of audio data were somewhat vague and left researcher unsure as to the validity of data destruction on the platform. A large proportion of the assessment criteria could not be assessed (71.2%) due to certain information being out of public reach. The lack of transparency was found to generate additional potential risks to researchers and research participants alike. Our preliminary findings highlight the urgent need for basic AI systems training across academic institutions and due diligence of AI tools prior to their approval for use in human subject research.

Keywords: Artificial Intelligence, Qualitative Research, Task Delegation, Independent Audit of AI systems, AI Ethics.

1 Introduction

AI systems are rapidly emerging as disruptive technology in many domains including academia where their efficacy for automated task delegation is being scrutinized and tested [1]. While human-AI based collaborations in research are not new, some argue

that the use of AI in qualitative inquiry does not align with traditional epistemological and ontological assumptions [1, 3]. However, hybridized methods—such as combining machine learning with grounded theory—demonstrate that human interpretation and judgement at each stage of theory development remains achievable [4]. Many transcription services now utilize AI systems developed on large data sets with little to no human supervision. Ethical concerns are numerous and include risks generated from the use of AI tools and how that risk may harm human research participants.

The current study examines the feasibility of using Otter.ai for audio transcription delegation in the quantitative ethnography study, *Reshape T1D* (Original Study). To do this, researchers evaluated the accuracy of using Otter.ai including the structure and content of the ethical decision-making process underpinning the Original Study's approval by the university's Data Protection Officer (DPO). Otter.ai self-attests compliance with GDPR, California Consumer Privacy Act (CCPA), Service Organization Control (SOC) Type 2 audit for sensitive data in the cloud, and Voluntary Product Accessibility Template (VPAT) for accessibility evaluation in its privacy policy. However, the borderless space of the cloud from which Otter.ai may be accessed blurs jurisdictional lines, complicating legal compliance, and creating ethical dilemmas. The aim of this work is to provide an exemplar for the use of AI tools for task delegation of qualitative interview transcription including the identification of risk factors and potential mitigations that researchers, universities, and other stakeholders should consider in the research process, particularly when human subjects are under study.

2 Methods

2.1 Study Example

We use the example of the Original Study wherein semi-structured interviews were conducted with study participants. Each participant provided informed consent to their interview audio data being uploaded to Otter.ai's environment for the purposes of transcription. Participants were provided details as to Otter.ai's data management per the study approval requirements of the university's research ethics board. Audio recordings were deidentified through the removal of name, address, or other personal identifiers spoken during the interview. Once deidentified, the audio files were uploaded, transcribed, then immediately removed from Otter.ai. Email correspondence between the university ethics office, DPO, and Otter.ai validated this design before proceeding.

2.2 The Assessment

Researchers used crowd-sourced Independent Audit of AI Systems (IAAIS) criteria for GDPR compliance (Pre-Audit) [5] as a framework to identify and consider additional risk variables to human research subjects that may not have been considered in the Original Study. Otter.ai asserts it is compliant with GDPR in its Privacy Policy. The Pre-Audit was conducted by a ForHumanity Board-Certified Independent Auditor of AI Systems (FHCA) with licensed specializations that include the Pre-Audit

and Algorithmic Ethics Committee Expert. The Pre-Audit framework is representative of the regulatory requirements of the Original Study. To date, no IAAIS frameworks have been officially endorsed by regulatory authorities.

3 Findings

3.1 Original Study Evaluation

Researchers examined three email exchanges from the Original Study between principal researchers, DPO, and Otter.ai to capture the structure of the decision-making process and content of discussions for the identification of risk variables considered, not considered, and potentially generated (Risk Variables) with respect to research participants, the university, and the study itself (Risk Subjects). It was determined by the university DPO that amendment to the study ethics protocol and clear explanation of the process and risks associated with using Otter.ai in the informed consent to participants, satisfied the requirements of data privacy and protection and a data transfer agreement (DTA) was not necessary.

Researchers examined the AI-generated transcripts of the Original Study and found that Otter.ai was capable of reliably distinguishing between the voices of the interviewer and interviewee. The quality of Otter.ai transcriptions was sufficient in forming cohesive sentences and statements with added ellipsis for pauses. However, it fell short in deciphering tone and inflections of speech such as sarcasm and other human emotion that provides researchers with additional data relating to participant responses. Otter.ai also produced challenges in the transcription of context-specific technical jargon related to type 1 diabetes for instance, instead of hemoglobin A1c it had transcribed "hemo goblin a onsie." Other examples of inaccuracies included "decks calm" instead of "Dexcom" in reference to real time glucose monitoring technology and "sea geom" in place of "CGM", identifying that the Otter.ai did struggle with acronyms, patented names, and technical jargon.

Researchers found errors in transcription were overcome easily given each transcript was reviewed by the original interviewer and then by a member of the research team with contextual knowledge of the health condition and lived experience of human research participants under study. Researchers of the Original Study deemed Otter.ai incapable of learning from uploaded audio data as it had not demonstrated the ability to adapt to language and syntax during transcription. Lastly, researchers note that concerns over privacy and security were raised in the Original Study to which Otter.ai provided assurance. Specifically, that once uploaded audio data was deleted using the researcher's Otter.ai account controls, the data would be completely removed from the Otter.ai environment. However, the study team learned that a second deletion step was required to completely remove audio data from the Otter.ai environment.

3.2 Pre-Audit Assessment

The FHCA conducted the Pre-Audit wherein evidence of compliance with criteria was categorized as being internal (not publicly available, e.g., proprietary information) or external (publicly available, e.g., public disclosures). Each criterion was rated as being met, unmet, partially met, or undetermined. Of the 267 Pre-Audit criteria, internal criteria (n=172) 71.2% were not assessable. External criteria (n=65) that were assessed consisted of physical testing (41.5%), public disclosure information (55.4%), and flow diagrams for data processes (3.1%). Overall, the Pre-Audit found that 4 (1.5%) criteria were met, 43 (16.1%) unmet, 30 (11.2%) partially met, and 190 (71.2%) undetermined. Among the Pre-Audit criteria that were met, details consisted of clearly documented privacy policies, processing of data subject rights requests and the identification of a DPO. Criteria partially met consisted of incomplete statements related to risk and ethics, privacy impact, and user rights. Information on data privacy impact assessments (DPIAs), disclosure of algorithmic and ethical risks, mitigations and residual, including bias, were not publicly disclosed. There was no public disclosure or evidence of code of ethics or code of data ethics.

4 Conclusion

This study demonstrates that AI-based tools may be feasible for task delegation but require additional training to better understand their effective use, the Risk Variables to Risk Subjects generated as a result of their use, and deeper due diligence by researchers and academic institutions to ensure their ethical use in qualitative research. At a basic level, researchers, university DPOs and other stakeholders are encouraged to become more familiar with ways in which the AI-based task delegation tools work. Training should include information on how to adequately assess data destruction protocols within the platforms of AI-based tools, and skills in basic threat modeling to discover Risk Variables to Risk Subjects, in the near and short term.

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Using Mobile Augmented Reality (MAR) to Facilitate Interaction and Language Learning for Adults Outside of the ESL Classroom

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Abstract. Adult immigrants, who are learning English in the U.S., are often limited in the linguistic, social, and economic resources to which they have access. These learners would benefit from access to language resources outside of the classroom. This exploratory study examines how a mobile augmented reality app, Google Lens, contributed to adult language learning and interaction for three adult immigrants living in southeastern, U.S. Initial findings suggest that Google Lens has potential to assist the adult language learner with interaction with both objects and people in their environment, and this, in turn, can facilitate English language learning and practice. Findings also suggest that this MAR tool has language translation issues that will not benefit some learners.

Keywords: Adult Second Language Learning, Mobile Augmented Reality (MAR), Epistemic Network Analysis

1 Introduction

Adult immigrants learning English as a second language (ESL) in the U.S. often face many challenges, such as limited access to language learning activities and programs, feelings of social isolation, and decreased sense of belonging in their new communities [1, 2]. Additionally, many adult ESL programs do not fulfill the linguistic and social needs of the adult learner, with classes only lasting 6-12 weeks and focusing on conversation solely within the classroom as opposed to exposing learners to more task-based learning activities and interactions in real world situations. Lack of authentic learning experiences can limit the type of linguistic skills and knowledge adults are able to obtain. Research indicates mobile augmented reality (MAR) can enhance adult learning through self-directed, situated, authentic learning experiences [3]. However, there is limited research on how MAR can be used to enhance adult ESL learning outside of the classroom. This study explored the following research question: *How do adults use MAR for language learning within their own communities?*

2 Theory

This study explored MAR and the adult ESL learner through a socio-constructivist lens. The socio-constructivist theory emphasizes that the learner's language knowledge develops from how, why, and where the learner interacts with others and the objects and tools within their environment [3; 4]. Language learning is an active process and the the learner constructs knowledge through social interactions with people and with the cultural and societal objects in their environment, such as signs, menus, and books.This theory is congruent with principles of andragogy [5], in that there is an emphasis on opportunities for the adult to seek situated, interactive language learning experiences based on their own motivations and construct language knowledge using their personal experiences and prior knowledge [3, 4, 5]. Thus, adult ESL learners need access to interactive, authentic tasks that are compatible with their individual needs and interests. MAR tools like Google Lens (GL) have the potential to help adults independently learn and interact in the real world, which could help them acquire the linguistic, social, and cultural knowledge and skills needed and desired in their daily lives. AR is a technology that overlays digital information, such as sound, text or images, on objects or places in the user's real world for the purpose of amplifying their experience [6]. GL technology is interactive and can be used with mobile devices, like phones and tablets. The mobility of the tool allows the learner to engage in more self-directed, situated language learning and could promote knowledge transfer between contexts [4, 7].

3 Method

3.1 Participants, Context, and Design

Volunteer participants included 3 adult immigrants who were attending a community ESL class in a local church in S.C., U.S. Consent forms and description of the study were translated into the participants' native languages. Participants chose their own pseudonyms. Sally, a 36 year-old married Korean woman, was enrolled in the ESL classes in order to further her academic career and speak English with her son, a 3rd grader learning English, and with her husband, a post doc student. Bonnie, a 58 year-old Hispanic woman, and Scorpio, a 68 year-old man, are married and arrived from Mexico 1 year prior. They wanted to communicate with others in their community as well as understand various paperwork they encounter on a regular basis (i.e. legal, hospital, newspapers). The activities were designed for the participants to use GL within their own communities, accomplishing tasks in which they would normally engage. For example, participants were taken to a neighborhood restaurant where they used GL to read the menu, listen to the pronunciation of some food items, ask the server questions, and order their food.

3.2 Data Collection and Analysis

Data was collected in the form of journal entries, observation forms, and a post-implementation focus group. This specific paper focuses on the post-implementation focus group interview involving Bonnie, Scorpio, and Sally. The post interview was chosen for analysis because it contained discourse involving all three participants and was designed to explore the participants' perceptions of MAR for language learning and interaction following completion of activities. The interview included open-ended questions like: *What are things you enjoyed when using AR?*; *What sorts of experiences do you wish you had/do you want regarding learning English using AR?*; and *How do you think AR could be used on a daily basis?* The interview was audio and video recorded, transcribed using Rev.com. Deductive coding of the data, based on the research questions [8], resulted in 4 primary codes and 8 secondary codes (see Table 1) : 1) **Interaction**: Interaction with objects in learner's environment (menus, books, paperwork, signs) and Interaction with others; 2) **Language Learning Activities**: Speaking, Listening, Reading, Writing, Comprehension and Understanding, and Using native language (L1) to learn or practice second language (L2); 3) **Benefits of MAR tool**; and 4) **Problems with MAR tool**. These codes were then applied to the discourse data for thematic analysis [9]. In order to visualize the connections between the themes/codes for each participant, epistemic network analysis [10] was then applied to the data using the ENA Web Tool (version 1.7.0) [11]. Units of analysis were defined as all lines of data associated with each participant. For example, one unit consisted of all the lines associated with Bonnie. A sliding window analysis of 4 lines was used to construct a network model showing how codes in the current line were connected to codes that occurred in the 3 previous lines, accounting for the connections between codes made by each participant within the context of a group conversation [12]. The thicker and darker lines between the codes represent stronger cognitive connections the participants made between those codes within the analyzed conversation [13]. The results focus on Bonnie and Sally as Scorpio's network was almost identical to Bonnie's.

4 Results

4.1 Google Lens (GL) as a tool to facilitate interactions in the adult learner's environment

Bonnie emphasized using GL is beneficial for interacting with objects and other people in her environment as evidenced by the thicker red lines between the interaction codes and the Benefits of MAR (**Fig.1**). For example, Bonnie spoke to the researcher about her experience using GL in a restaurant: *"I was able to ask the server questions and I understood menu."* Here, Bonnie explains how she used GL to interact with a language object (the menu) and with another person (the server). This experience encouraged Bonnie to continue to use GL on her own: *"We use at all restaurants now. We go into more than Mexican restaurant…I do not feel like I stand out so much or that I am going to get something wrong."* Bonnie's discourse network models Bonnie's overall focus on interactions with text/objects and others in her environment. She stressed this emphasis toward the end of the interview: *"It [GL] helps me socialize because I want to. I read recipes I want to understand. I like to know the words to speak to others."*

On the other hand, Sally indicated she experienced more problems with GL than Bonnie with regards to interactions with others as evidenced by the medium sized green line connecting this code with the code, Problems with MAR (**Fig.1**). When asked about using GL for interacting with others, Sally responded *"You would have to make yourself talk to other people with it. Or else it is mostly self-practice.."* Here, Sally suggests that the MAR tool itself does not facilitate interacting with others; rather, an individual would need to be motivated to do so. When asked 'what type of experiences do you wish you could have had or do you want regarding learning English using augmented reality', Sally responded, *"I want to talk and have someone talk back to me. I want to know if I say things right or how to say something in the right way… I will probably use Chat GPT and Google Translation more. When I use Chat GPT, I can say something and ask, 'did I say this right', and it tells me [pause]. Google Lens, it does not do this."* In this statement, Sally indicated that the problem with GL is that it did not meet her individual language learning needs of practicing speech and pronunciation like the AI tool, Chat GPT did.

4.2 Google Lens (GL) as a tool for enhancing learning and practicing English

In Bonnie's discourse network (**Fig. 1**), there are connections between Reading, Speaking, Listening, Writing, Comprehension and Understanding, and Connecting L1 and L2 with at least one of the interaction codes (interaction with others or with objects in the environment). For instance, Bonnie stated, *"I like it when I use to see things and I can read it. I go into the hospital and can now read the signs… I feel better reading those documents we had with our, umm, our, lawman uhhh lawyer. I did not understand before…Now is easier with this [points to her phone on which she has Google Lens app open]."* Here, Bonnie expressed how GL helped her read important text for comprehension in two different contexts. When asked how GL could improve her life, Bonnie stated, *"I think to understand what you read and to talk to people and understand or have them understand what you are asking-that would be good for lives of people…. I want more friends and to talk more and to understand more and to read to my granddaughter. "* Here, Bonnie connected being able to read and understand English text with comprehension and interacting with others. Moreover, Bonnie used her L1 to understand English. For example, she stated: *"I saw many words in reading like the books you gave me that were similar to my words in spanish y I could remember them easier."* This connection between her prior knowledge and English comprehension can be visualized in her network.

Sally, again, differed from Bonnie in that her network (**Fig. 1)** shows stronger connections between all of the codes for language learning activities with the code for Problems with MAR. Sally emphasized the problems with the tool when trying to learn and practice English. For example, Sally stated that *"many Korean words do not translate or do not exist in this Google Lens. I want to understand a word or a phrase and it does not show."* Here, Sally expressed that she tried to learn English through Korean, but with GL, many Korean words were not included or translatable, making it difficult to understand English text.

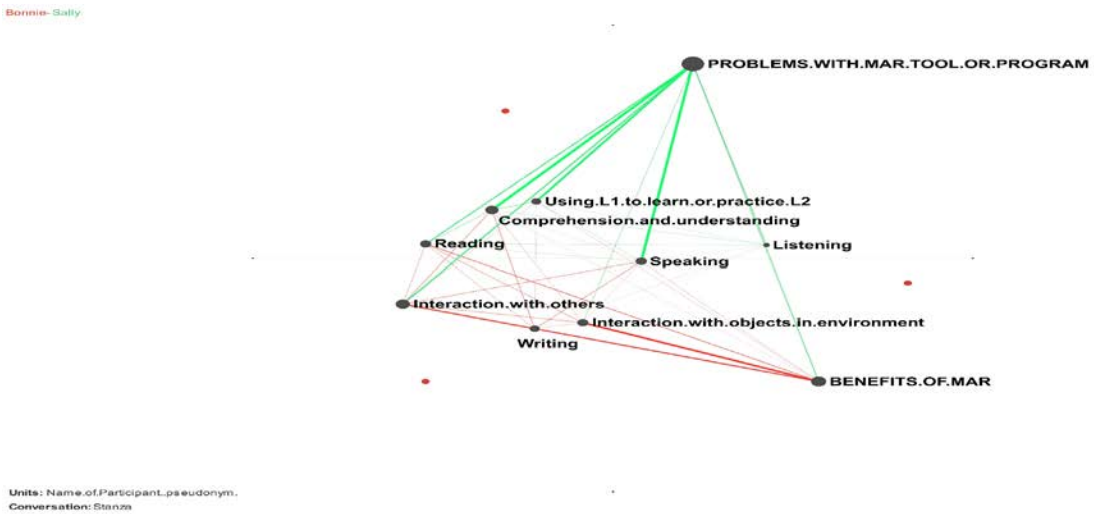

Fig. 1. Comparison discourse network for Bonnie (red) and Sally (green)

5 Discussion

The discourse network for Bonnie illustrates that she was able to use GL to interact with people and objects in her community. She used this interaction to practice reading, speaking, and writing, which then allowed her to construct language knowledge while also helping her feel more a part of her community and not feel like "she stood out." Sally's network, on the other hand, demonstrates she had more problems with GL as a tool for interaction and learning and practicing English. Her motivations centered on learning how to speak and pronounce things correctly, and she indicated that GL did not help her with this task in the same way Chat GPT was able to. Furthermore, her construction of English language knowledge was hindered by GL's inability to transfer the text she encountered into her native language, Korean. Although this exploratory study was limited in that the sample size was small and results cannot be generalized, the results revealed that GL has potential to help adult language learners interact with their environment and practice reading, speaking, and understanding English. However, MAR tools need to be designed in a way that can help individuals with diverse language backgrounds in a more equitable manner. Forthcoming research will extend to other adult ESL learners in order to explore how MAR can facilitate adult second language learning.

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Mapping Priorities: An Analysis of Perspectives on the Co-Design Process Using Epistemic Network Analysis

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Abstract. The study examines principles for implementing a co-design process involving both teachers and researchers. Using Epistemic Network Analysis (ENA), this poster reports preliminary findings describing the connections among teachers' daily practice, hands-on activities, and collaboration.

Keywords: Co-design, epistemic network analysis, process.

1 Introduction

Co-design has been widely adopted in education research to create educational innovations that carefully consider teacher ownership, motivation, and practice [5,2]. It refers to a team-based process in which teachers, researchers, and developers work together to design and evaluate educational innovations [5]. Many studies report positive outcomes of co-designing with teachers, such as teachers' ownership and agency and increased teacher learning. [4].

In this study, we analyze how the essential elements of co-design, such as collaboration, hands-on activities, positive emotions, and focus on teaching practice [5], are incorporated into a co-design process performed between teachers and researchers with the goal of developing a teacher dashboard for a game-based learning tool called Shadowspect. While many of the existing studies used a case study method to analyze the co-design process [1,4], we use ENA (Epistemic Network Analysis) for this same purpose and suggest that this approach can provide strategies that can be adapted by other co-design teams. We aim to show that while ENA has been mainly used to analyze the content of the discourse, its features also allow it to analyze the quality of said discourse.

2 Theory

Penuel and colleagues [4] describe multiple steps in the facilitation of productive co-design processes. They argue that the co-design process must transition from a stage where researchers are outsiders to having an equally engaged role to finally producing tools that are relevant for teacher practice. Additionally, they argue that adequate co-design has a set of characteristics that allows it to alleviate the tensions associated with

the co-design process [5]. These are: working on concrete challenges, taking stock of classroom context, using shared social experiences, and promoting teamwork. Furthermore, collaboration and purposeful focus on the transformation of teacher practice are essential elements of co-design when working with teachers [7].

3 Methods

3.1. Context

The co-design team involved 8 practicing teachers and a research team where the team had monthly co-design workshops, and each workshop typically lasted 2 hours. The workshops were remote and recorded on Zoom. The data sources for the project were the recordings of the meetings [2]. These recordings were transcribed and then organized by sentences and coded using nCoder and analyzed using the ENA Web Tool (version 1.7.0) [3] using a moving stanza with a window size of 7. ENA [6] is useful for modeling these conversations because it shows how participants connect these principles as they participate in the co-design workshops and can highlight the most essential elements of the co-design process as experienced by teachers.

The structure of the co-design process included 12 sessions (workshops), where each session had multiple activities that happened in different groups. We defined conversations as all lines of data associated with a single session subsetted by Activity and Group. The ENA model included the following codes: DailyPractice, Collaborate, HandsOn, and PositiveAffect. These codes are derived from the essential characteristics of co-design [5, 7]. All the codes had a kappa value higher than 0.9 and rho value smaller than 0.05. Table 1 presents the Codes and definitions.

Table 1. Code Book

Code	Definition	Example
Collaboration[1]	Collaboration was understood as explicit invitations to work together and exchange ideas.	"Let's go through a couple of these together."
Positive Affect	Positive Affect collects interactions where participants are expressing positive emotions and engagement or promoting this mood.	"So, that's a great suggestion, a misconceptions view."
Hands-On	Hands-On includes all references to practical tools that teachers use in their daily lives and references to activities that have an artifact as a result.	“I do love, like, the ability to, to create whatever I want.”
Daily Practice	Daily Practice refers to all connections made to their practice as teachers.	“Okay, so here's one example of ... We taught students during the first

[1] Co-design is inherently collaborative, but we chose to concentrate our analysis on this code to emphasize each specific instance of discourse that encourages members to collaborate and work together.

semester how to program Lego robots."

4 Preliminary Findings

Figure 1 displays the essential network showing the connections made by participants throughout the co-design process.

Figure 1. ENA Main connections.

Participants prioritized the connections between topics related to teachers' daily practice, school, and teaching with hands-on activities and topics. This is expected as this was the core purpose of the co-design process. Throughout the collaborative process, there are multiple iterations that illustrate this connection, showing how participants constantly connect to teaching daily practice what they are discussing. For example, a teacher said: "*All right, and that syncs to the heat map to show specifically that kid's, where that kid's failure and reattempts are coming, onto which puzzle."* This iteration is making a clear connection between the purpose of working with puzzles (Hands On) and actions of students (Daily Practice).

Additionally, participants in the co-design process also constantly connected conversations related to hands-on activities and collaboration. This connection shows that this co-design process was executed in a collaborative way. During one of the activities, one of the teachers says: "*Would you still want those puzzles to be, I guess, like, selectable, the way that we're currently maybe thinking them to be*?". This iteration shows that teachers converse about the use of puzzles in the process (Hands On) as a collective and sharing the thinking process with all the participants (Collaborate).

Finally, the third most relevant connection for participants was between topics related to teachers' daily practice and collaboration. The strength of this connection

shows that the gap between researchers and teachers was successfully bridged during the conversation. During one of the sessions, one of the teachers said: "*So I'm wondering if, like, this could also be useful in that, like ... Let's say I'm looking at the student, and I, like, don't really remember where they fell on this."*. This example of the discourse shows that teachers are inviting participants to think collaboratively (Collaborate) about topics related to their students (Daily Practice).

5 Discussion

This poster analyzed the successful implementation of co-design for teacher innovation with a game-based tool. The findings highlighted the participants' emphasis on connecting teachers' daily practice with hands-on activities and collaboration. Future research can further explore the long-term impact of co-design on teacher practice and student outcomes. Overall, this poster contributes to our understanding of the co-design process and suggests that ENA can be used not only to analyze the content of a discussion but can also shed light on how the discussion occurred.

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Factors influencing PhD students towards persistence and disengagement: An exploratory study through epistemic network analysis

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Abstract. Situated between student completion numbers affecting federal funding for institutions and high PhD attrition rates, the patterns and reasons for doctoral students across all stages ideating disengagement are not well understood. Similarly, the same could be said for why students persist despite facing multiple difficulties. Factors that influence the two continua—doctoral persistence and hindrance through the lens of Job demands-resources framework (JD-R). This study aims to compare how those factors may be related with respect to candidature stages. This study adds to the literature by utilising ENA to examine the differences of groups within the same demands-resources framework, such that not only are the factors influencing the two continua are identified, but their qualities can also be explored.

Keywords: epistemic network analysis, doctoral education, job demands-resources framework

1 Introduction

In Australia, there has been an ongoing conversation about establishing a standardised regime for tracking and monitoring PhD students and their progress. Because student completion numbers heavily influence the primary source of funding for Australian universities, there is a need to understand the ecology of factors that promote or debilitate progress. The clearer the understanding of doctoral engagement and disengagement and the influences on them, the better positioned we are to meet the needs of future doctoral students and institutions, to improve their experiences, and to improve the educational outcomes for the student, the institution, and the government. Underpinned by Job Demands-Resources (JD-R) framework, we examined the factors that

influence two opposing yet independent continua—doctoral disengagement and persistence—with respect to candidature stages in a larger, on-going study. Our aim of this poster lie in comparing their differences between candidature stages using ENA.

2 Methods

We analysed interview data from participants reached through an internal mailing list at a research-intensive public university in Australia ($n = 25$). The project was approved by university's Human Research Ethics Committee (MUHREC ID: 28984). The interviews, lasting about an hour, covered doctoral experiences. The protocol, based on grounded theory [1] had three segments: introductory questions about research and motivations for PhD; questions about facilitators and hurdles with respect to PhD completion; and discussions about doctoral success and reflections thereof. All interviews were recorded and transcribed for further analysis.

Our analysis of the interview data involved identifying thematic domains through thematic analysis, with further segmentation with respect to levels of social ecology. We segmented the transcribed interviews at meaningful breaks, such as by turns of talk then by sentences. Then, we generated two codebooks based on themes of persistence (resources) and hindrance (demands). For each codebook, we established primary codes [2] through enumeration of binary representations at each line to indicate presence (1) or absence (0) of a code. To ensure fairness to the data, two researchers (JYH and SDI) coded the entire data using social moderation [3].

We used early (*EarlyCand*), mid (*MidCand*) and late (*LateCand*) candidature stages. *EarlyCand* includes first to second year full-time equivalent (FTE), having achieved the first major milestone (confirmation/12-months). *MidCand* covers second to third year FTE, having achieved the second major milestone (24-months). *LateCand* involves those past the final milestone (final review/36-months), writing a thesis but not graduated. Use of FTE and milestone in conjunction accounts for full-time/part-time differences (see e.g. [4]).

3 Results

3.1 Hindrance model comparison

Fig. 1 shows the mean network comparisons of factors hindering doctoral success for each pair of candidature stages. For the *EarlyCand* vs *MidCand* comparison, *EarlyCand* participants made more frequent connections between *systemic* and *work-life balance*, as well as *progress* and *work-life balance.* Meanwhile, *MidCand* participants made stronger connections between *systemic* and *supervision* as well as between *systemic* and *burnout*. Mann-Whitney U test found significant differences ($\alpha = 0.05$, $U = 12$, $p = 0.03^{*}$, $r = -0.700$) between early and mid-candidature stages. Comparing early and late candidature stages, the *EarlyCand* participants—similar to the observation made in Early vs Mid—made more connections between *burnout* and *supervision*; and

progress with *burnout. LateCand* participants formed more connections to *funding.* Additionally, more connections between *progress* and *supervision* were observed in this group. Results from Mann-Whitney *U* test showed significant differences ($\alpha = 0.05$, $U = 39.5$, $p = 0.0054^{**}$, $r = -0.975$) in mean positions of EarlyCand and LateCand participants. In the subtracted network between *MidCand* and *LateCand*, the *MidCand* group made more connections between *supervision and burnout*; and *progress* and *burnout*, while the *LateCand* group formed more connections between *funding*, *systemic* and *deadlines*. Mann-Whitney *U* test showed significant differences ($\alpha = 0.05$, $U = 5$, $p = 0.001^{***}$, $r = 0.896$) in mean positions of *MidCand* and *LateCand*.

3.2 Persistence model comparison

Fig. 2 shows the comparison of mean networks for factors influencing doctoral persistence between pairs of candidature stages. For *EarlyCand* vs *MidCand* comparison, *EarlyCand* participants showed more co-connections between *support network* and *social interaction*. Meanwhile, *MidCand* participants made more connections between *duty and responsibility* and *internal values*; *emotional support* and *support network*; *informational support* and *emotional support*. A Mann-Whitney *U* test found significant differences ($\alpha = 0.05$, $U = 49$, $p = 0.05^{*}$, $r = -0.633$) between the mean positions of *EarlyCand* and *MidCand*. In the subtracted network model between *EarlyCand* and *LateCand*, the *EarlyCand* participants made more connections to *support network* and *emotional support*; *informational support*; and *social interaction.* Meanwhile, *LateCand* formed more connections between *support network* and *duty and responsibility*, and *internal values* with *sentiment of accomplishment*. Results from Mann-Whitney *U* test showed that the differences ($\alpha = 0.05$, $U = 30$, $p = 0.159$, $r = 0.500$) were not found to be statistically significant. When *MidCand* and *LateCand* were compared, participants in the *MidCand* group made more co-connections between *emotional support* and *support network,* as well as *duty and responsibility* with *internal values*. Meanwhile, the *LateCand* group showed more connections between *sentiment of accomplishment* and *informational support*, as well as *support network* and *informational support*. Mann-Whitney *U* test showed that the differences ($\alpha = 0.05$, $U = 80$, $p = 0.015^{*}$, $r = 0.667$) between the mean positions of *MidCand* and *LateCand* were statistically significant with a moderate effect size.

4 Discussion

EarlyCand participants felt more socially isolated due to systemic changes and lack of shared experience compared to other groups. *MidCand* showed mildly stronger connections between burnout, research progress, and poor supervision—but were less consistent in their differences to the other candidature stages. *LateCand* students had strong funding connections along with systemic issues and meeting deadlines. Stress and burnout are tied to submission deadlines. LateCand experiences urgency due to hard deadlines and funding impact, noticing inadequate supervisor feedback.

5 Conclusion

Using ENA, we characterised the differences between factors contributing towards engagement or hindrance for doctoral students at each candidature stage. We found that there were numerous statistically significant differences—warranting a further study for providing insight to stakeholders and policymakers in the graduate research sector.

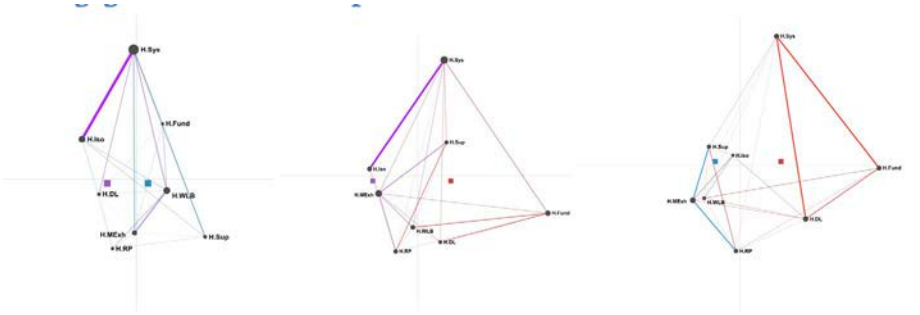

Fig. 1. Epistemic network comparisons for factors influencing doctoral disengagement with respect to candidature stage. Purple: *EarlyCand*; Blue: *MidCand*; Red: *LateCand*.

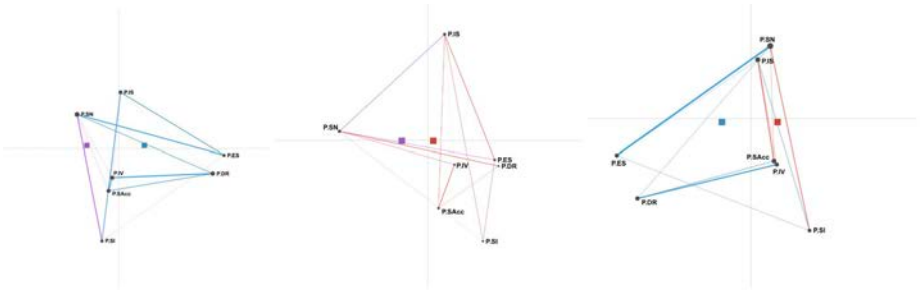

Fig. 2. Epistemic network comparisons for factors influencing doctoral persistence with respect to candidature stage. Purple: *EarlyCand*; Blue: *MidCand*; Red: *LateCand*.

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Integrating QE methods into a Qualitative workflow: Using Co-Occurrence Matrices and ENA in Code Selection

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Abstract. Qualitative methods can be daunting because of the sheer number of themes that arise from the data; however, quantitative ethnography (QE) has provided resources to begin making meaning. This study uses co-occurrence matrices and epistemic network analysis (ENA) to aid open coding interpretation and code selection. In addition, QE methods contributed to the development of broader themes for analysis. For example, the co-occurrence network showed a relationship between violence and safety, which was further developed into a larger finding. This study finds QE methods should intentionally be integrated into the qualitative analysis process and techniques like co-occurrence networks combined with ENA support qualitative research.

Keywords: Epistemic Network Analysis, Co-occurrence,

1 Introduction

Quantitative ethnography (QE) as a field is built on the idea that ethnographic methods can be applied to statistical analyses of big data [1] and is foundational to QE [2]. Through ethnography, the researcher collects and codes large amounts of data, then codes inductively (focused coding) or deductively (open coding). Inductive codes are codes the researcher applies, while deductive codes are codes developed throughout the coding process [3]. This study focuses on the deductive coding process, assuming that more refined themes will be developed based on the deductive codes.

Interpreting the deductive coding process can be daunting because the researcher has yet to consolidate categories and create broader themes; however, this also provides an opportunity to utilize QE tools such as co-occurrence networks and epistemic network analysis (ENA) to assist in visualizing the relationship between salient themes. One of the limitations of ENA is that plotting many themes on a network can often lead to convoluted networks, which become challenging to interpret. Indeed, part of the ethnographic process is making meaning from these themes; however, it can be challenging to group different themes.

In quantitative studies, large dataset issues can be addressed using methods such as principal component analysis (PCA). However, there are issues with using PCA on qualitative codes. For qualitative coding, the meanings of codes are captured by the presence of the code, and consolidating codes through this method may misconstrue

their meaning. Therefore, rather than use methods such as PCA to reduce dimensionality, I use a co-occurrence matrix to find how often primary codes share text. Other studies have used network analysis reduction techniques on code co-occurrences and note good reduction techniques must support the inference, reinforce reproducibility, be interpretable, and be integrated into the methodological process [4].

This study attempts to abide by these guidelines and uses various techniques to aid in the interpretation of open coding and aims to blend methodologies through an iterative process that supports the findings. This study first uses a co-occurrence matrix to understand the overlap between codes and incorporates ENA to visualize the open coding process. Visualizing codes during the open coding process provides a visualization that can reveal the relationship between themes, which may not necessarily be clear to the researcher.

2 Methodology

The data from this study comes from focus group data collected from residential housing residents in North Philadelphia to understand residents' experiences with education. Experiences with education include access to public transit, neighborhood safety, and access to educational institutions. The research team expected to find themes related to neighborhoods shaping access to higher education and the role of public transportation in college access. Focus groups were hosted in person at various residential housing facilities and conducted in English, Spanish, and English and Spanish. Interviews were transcribed in the original language and coded in the original language.

Descriptor data from the set includes the type of housing, unique interview, and participant identifier. The data was coded in Dedoose using open coding. Throughout the open coding process, the research team met and discussed new codes developed and any discrepancies between codes. Once the data was coded, the data was exported from Dedoose and cleaned in R. The cleaning process included segmenting the data by paragraph and merging the coded data from Dedoose into the segmented data. The units for this study were the unique ID associated with each segmented chunk. Next, a co-occurrence matrix was created to determine how often codes overlapped and then visualized as a co-occurrence network. The weight for each line was calculated by taking the total frequency of the code and dividing it by the frequency of co-occurrence. Finally the seven pairs with the highest co-occurring percentages were selected as codes: (1) safety, (2) violence, (3) religion, (4) poverty, (5) motivators for education, (6) transit, (7) theft, (8) primary, middle high school, and (9) racial tensions. Because the dataset contains 14,517 segments, rENA was used to create the networks.

3 Analysis: Co-occurrence Network and ENA

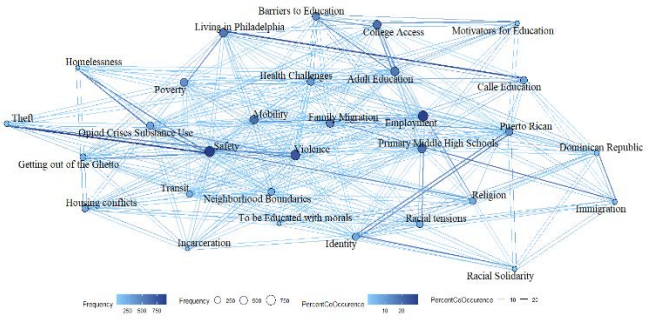

Fig. 1. Co-occurrence network with weights as a percent of overlap between codes and node size as the frequency of occurrence in the data

Fig 1 shows the co-occurrence matrix visualized as a co-occurrence network. Particularly noteworthy is the relationship that safety has with theft, violence, and transportation. These themes are consistent with the qualitative findings developed before the co-occurrence matrix. Additionally, there is a high rate of co-occurrence for identity and Puerto Rican, which is consistent with the sample of participants interviewed. In this case, the co-occurrence matrix was used to support the relationships that the research team had considered. The co-occurrence network also reveals other codes that may be used for other ENA models, such as the relationship between living in Philadelphia and Calle education.

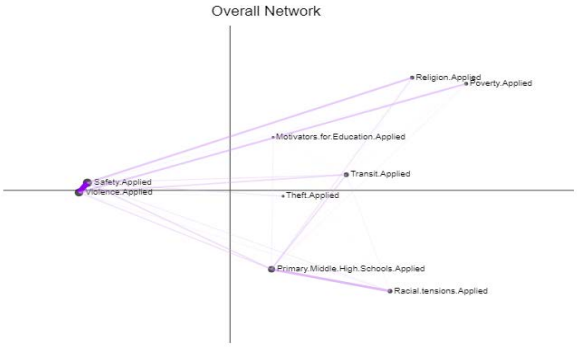

Fig. 2. Epistemic Network with codes selected from co-occurrence network

The co-occurrence network informs the selection of codes modeled using ENA. ENA differs from network analysis because it shows the relationship based on the discourse. The co-occurrence network uses the coded text but does not consider the text's relationship within the discourse. Fig 2 shows the relationship between the selected seven pairs

of codes and the nine unique codes. One of the findings from this network is the relationship between safety and violence. While transit as a code may not have strong relationships with other codes and is semantically distant, the location of the point suggests that transit has some relationship with other codes. This code selection also raises an interesting theme about the relationship between religion and poverty, which the research team has not explored.

4 Findings and Conclusion

Open coding is an essential part of the ethnographic process. It allows the researcher to understand their data closely; however, making meaning of the codes can be challenging. This study proposes using QE methods to aid in the selection of codes. Although the codes from the co-occurrence matrix aligned with the overall themes of the study, this may not always be the case. For example, neither the co-occurrence network nor the ENA model suggested a strong relationship between transit, violence, and education; however, the researchers identified this as a significant theme for residents. Concerning improvements, this study can be expanded using a more systematic approach to network reduction to identify core themes [4]. Indeed there are limitations to using QE methods to support ethnography; overall, QE tools can support the data interpretation process and aid scholars in selecting and developing codes.

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Visualizing Students' Emotion Changes in Online Learning

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Abstract. This study examines individual discourse patterns among students undergoing emotional changes in virtual learning during the COVID-19 pandemic. It utilizes a pre-edited interview video dataset of online learning interviews conducted by a Southern California middle school teacher, Meagan, and her two students, Aiden and Zia. The dataset was obtained from the publicly available YouTube series "Too Cool for Middle School," released on September 30, 2020. Employing epistemic network analysis, the study analyzes emotional change patterns based on student narratives. The findings indicate that students' shift from positive to negative sentiments towards specific online learning situations aligns with convergent thinking observed in Social Emotional Learning Theory. These results have implications for enhancing virtual learning experiences during pandemics or other remote teaching scenarios and can guide the development of targeted interventions to support students' emotional well-being.

Keywords: Social-Emotional Learning · Virtual Learning · Online · STEM · ENA

1 Introduction and Review of Literature

Over the past few years, students have been exposed to various instructional technologies in the digital context of online learning, leading to challenges associated with digital learning. Online education simulations and technologies have generated an immense amount of data on learning processes and outcomes, garnering significant interest from online learners [1]. Despite the availability of numerous learning analytics assessments for online learning courses, there is a lack of sufficient visualization tools to establish a connection between course progress and changes in learner emotions [2].

This study seeks to address the efficiency of visualization tools in online learning, and establish the connection between course progress and changes in learner emotions using Epistemic Network Analysis (ENA). Research has suggested employing such visualizations contributes to more dependable and improved teaching and learning approaches [3]. Furthermore, studies indicate that favorable emotions like engagement and a sense of accomplishment have a positive impact on learning outcomes [4]. Conversely, negative emotions such as frustration and anxiety can yield adverse effects [5]. This study aims to extend existing research on Social-Emotional Learning (SEL) in online spaces by applying a novel approach: Quantitative Ethnography (QE) and ENA,

to video recordings of student reflection on their SEL processes. To gain insight and a better understanding of student's emotional changes, the following research question is posed: How can student emotion changes be effectively visualized and analyzed in online learning. The video dataset is characterized and edited using detailed scenario questions that cover a broad range of topics, from student engagement in online communities to personal development in the digital learning environment.

2 Research Setting, Data Collection and Data Analysis

This video dataset was collected from a middle school in Southern California. It features interviews with students Aiden and Zia, conducted by their teacher Meagan. The interviews focused on their experiences with online learning during the pandemic, capturing both positive and negative emotions. The goal was to gather valuable feedback to enhance the quality of online education for students and ensure access to quality learning experiences.

This study used a manual approach to categorize and organize data through a hierarchical coding structure. Participants were interviewed for 4 minutes and 38 seconds, covering topics like personal achievements, community engagement, and emotions related to online learning. The interviews were recorded, edited, and transcribed using YouTube's auto-transcribing feature. The transcript was formatted in Excel, with further cleaning and word correction. Timestamps were added to identify specific topics discussed in the interviews.

The dataset consists of 106 lines of data and 13 columns of metadata and codes. Three steps were followed for creating the metadata. Firstly, incomplete data was completed or removed for accuracy. Secondly, transcriptions were organized chronologically by conversation topics. Finally, the person conducting the conversation was included as a unit variable in the metadata columns.

The dataset contains code columns for positive and negative feelings, with sub-codes for interview topics and specific emotions. Positive sub-codes include connected, fun/excited, proud, and easy, while negative sub-codes include worried/skeptical and difficult. The sub-codes were developed through a combination of inductive approaches based on social emotional learning research articles and deductive approaches. Due to the limited conversation and topics discussed, this dataset uses the whole conversation Stanza's window method in ENA to analyze the relationships and patterns between online learning experiences and emotional changes.

The unit variables (units of analysis) in the metadata columns represent the lines of data associated with a single person answering the learning experience questions, which alternating between the two students, Aiden and Zia (pseudonyms), for each interview topic. Conversation variables are defined as lines of data associated with a single interview topic. Additionally, the order of video topics is not sequential, allowing interchangeability between conversation variables and unit variables.

The analysis generated epistemic networks that were combined and summed up for each unit variable. The ENA method used binary summation to reflect and visualize the

co-occurrence of different codes of student's emotional changes throughout interact with certain interview topics and gain insights into the relationships between them.

Hierarchy (Code-level)	Sub-codes	Definition	Example
2a - Positive Feelings	Connected	Students have a sense of belonging, engagement and motivated in their online learning experience (through actions like actively participanting and emotionally connected)	"I stayed connected to my friends"
	Fun / Excited	Students is enjoying the learning process and are more likely to be in the online learning enviornment (can be achieved through learning activities or self expression)	"it was fun for learning and like connecting a face to a name "
	Proud	Sudents have a sense of accomplishment and achievement in their learning experience (can be achieved through challenging learning objectives or self-assessment)	"which i was kind of proud of myself for"
	Easy	Student find the learning experience comfortable and manageable, and access the leating content without undue stress or difficulty	"probably three days it was super easy"
2b - Negative Feelings	Worried / Skeptical	Student have concerns or doubts about the effectiveness or quality of the learning experience (feel uncertain or hesitant about their ability to succeed)	"because i've never been the best at math"
	Difficult	Students find the learning experience challenging or hard to manage (feel overwhelmed or frustrated by the online learning environment and may require additional support for content)	" it was kind of hard to get going like at first"

Fig. 1. Example Codebook

3 Results and Discussion

The visual inspection of the epistemic network reveals the significance of emotions in students' online learning disclosures. It shows connections between emotional phrases and learning progress. Based on the ENA models generated from the dataset, we can also observe that certain connections between codes were stronger than others.

Overall, Zia demonstrated more complexity and connected more interview themes in her model. Both students connected discussions of things that are fun to a feeling of being connected. While Aiden made this connection by saying "they are my stepping stool to rise to my goals", Zia made this connection through discussion of "it was also nice to like know a little bit about the person".

Aiden made less diverse connections in his video interview data but was much more likely to connect Fun/Excited to his feelings of pride in his accomplishments of learning new skillsets. As he put it "which I was kind of proud of myself for got into piano". Zia, on the other hand, made more diverse connection across emotional states, with a particular emphasis on difficulty and ease of participation. She would say things like "and I was kind of skeptical at first", which indicates that she experienced feelings of worry and skepticism throughout her learning experiences.

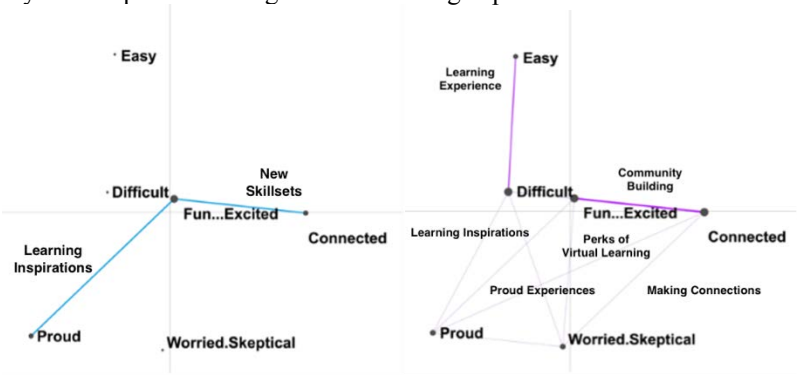

Fig. 2. ENA Model of Aiden's (left, blue) and Zia's (right, purple) Emotion Changes

4 Significance and Implications of Topic

This study is a preliminary examination of student's emotional changes in online learning topic/phenomenon, and as such has limitations in terms of manual coding techniques, and length of dataset. However, we can see the following contributions of this work.

This study contributes to research and theory by providing insights into the significance of emotions in students' online learning disclosures. It demonstrates the connections between emotional phrases and learning progress, contributing to the fields of SEL and QE research. It also showcases video-based data as an application of ENA and QE and how to analyzing and understanding these connections, potentially bridging the gap between emotional learning aspects and QE.

For educators, practitioners, and instructional designers, the study findings highlight the importance of considering and addressing emotion factors in online learning environments. By understanding the connections between emotions and learning progress, educators can design interventions and strategies that support students' emotional well-being and enhance their learning experiences. This study provides practical insights for educators to create more engaging and effective online learning environments.

For learners, this study contributes to their understanding of how SEL unfolds from their perspective. By examining the connections between emotions and learning experiences, learners gain insights into their own emotional responses during online learning. This understanding can empower learners to effectively manage their emotions, engage in self-reflection, and make informed decisions to optimize their online learning journey. It promotes learners' self-awareness and helps them navigate their emotional experiences to achieve better learning outcomes.

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Pandemic Recovery: Economic and Medical Outcomes from Initial COVID-19 Media Responses

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Abstract. This research examines speeches delivered by country leaders at the onset of the COVID-19 pandemic using epistemic network analysis to uncover patterns in discourse and explore variations across countries with different OECD COVID-19 outcome variables (2023 vaccination rates and financial insecurity). While sociopolitical contexts are complex and influenced by a myriad of factors, Japan's emphasis on long-term cures and vaccines may be linked to higher vaccination rates compared to the United States. Additionally, Japan's focus on addressing economic impacts and supporting businesses stands in contrast to Israel's emphasis on isolation measures. These results have potential implications for national crisis communication strategies, with insights that warrant further exploration for use by policymakers, public health officials, and leaders in managing future global health crises.

Keywords: Epistemic Network Analysis, Political Discourse, COVID-19 Pandemic, Communication Strategies.

1 Introduction and Relevant Literature

The outbreak of the COVID-19 pandemic in early 2020 prompted swift responses from leaders across the globe, and the initial speeches delivered by country leaders may have played an important role in shaping public perception, policy decisions, and subsequent actions taken to combat the pandemic [1-3]. Understanding the nuances of these speeches and how they differed across countries with different outcome variables holds potential value for future crisis management and communication strategies.

This research aims to examine the speeches given by different country leaders at the onset of the pandemic, utilizing epistemic network analysis (ENA) [4] to uncover the underlying patterns within their discourse. Specifically, we compare how leaders from countries with varying 2023 outcomes structured their early speech discourse differently. While establishing causality between early governmental press releases and later country-wide outcomes is complex at best, we hope this preliminary examination can highlight some of the communication strategies employed early-on by leaders from

countries with higher rates of vaccination rates and lower rates of financial security three years later.

2 Data Context, Collection and Analysis

This project began as part of the 2020 Quantitative Ethnography Data Challenge [5], and continued in 2021 [6] and 2023. Researchers downloaded transcripts (English or English translated) of public addresses given by governmental leaders between February-March 2020, with the goal of cross-continental representation, from: New Zealand, the United States, the United Kingdom, France, India, South Africa, and Japan. This time frame captured initial public statements around COVID-19 policies and practices. Data was segmented by paragraph with an average of 1-3 sentences.

Researchers used an inductive thematic analysis approach to identify themes within the dataset: discussions of political, medical, economic, and social/ community-level impacts of COVID-19. Two researchers independently coded the lines of data for each code and sub-code, with average agreement of 94.3% [6]. This study extends prior research by leveraging country metadata from The Organization for Economic Co-operation and Development (OECD) COVID-19 recovery dashboard [7], which monitors the quality of countries' pandemic recoveries. We compare speech data for countries with the most disparate financial insecurity (Japan and Israel) and vaccination rates (Japan and the United States). These variables were selected due to relevance to inductive themes in the study. India and South Africa were excluded from this analysis due to lack of OECD metadata.

Epistemic networks visualized differences across speeches, with unit variables set as country and speaker, conversation variables set by country with the adoption of a moving stanza window of width 4 (which aligns with prior work), and the four inductive codes listed above. Pearson and Spearman measures indicated the model has a strong goodness of fit at 0.99 for all axes.

3 Results and Discussion

Stronger associations between medical and social-community codes (0.14) manifested in the difference model between Japan and the United States (US) (See Fig. 1).

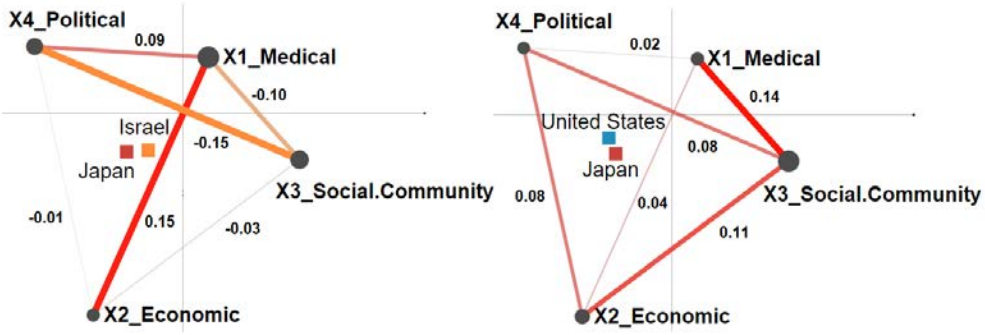

Fig. 1. The difference model between the highest (Japan - red) and lowest (United States - blue) performing countries for vaccination rates. The difference model between the lowest (Japan - red) and highest (Israel - orange) performing countries for financial insecurity. Positive line weights represent the strength of associations in favor of Japan. Negative line weights represent the strength of associations in favor of Israel.

Japan and the US have similar discourse that highlight economic, political and medical themes. However, Japan presents these topics to a greater degree and this is seen in the strong overlap between both countries in the difference model. Even with initial COVID-19 responses, Japan expressed a focus on vaccinations/cures which align well with countries having the highest vaccination rates in the dataset. In his address Prime Minister Yoshihide noted:

"At this moment, there is no medication with confirmed effectiveness against this virus, as we have with influenza. That is the major source of global concerns…Basic studies using the novel coronavirus have already confirmed a certain degree of effectiveness for each of the three medications. We intend to dose patients with their consent and develop a cure as early as possible."

Comparatively, for the US, which had the lowest vaccination rate of sampled countries, President Donald Trump focused heavily on medical equipment needs:

"Regular times, 29,000 ventilators are distributed in the United States each year. In the next 100 days … Well, first of all we've already delivered thousands of them, but within the next 100 days we will either make or get in some form over 100,000 additional units. And I guess to put it in other words, in the next 100 days we'll receive over three times the number of ventilators made during a regular year in the United States."

Japan and Israel have more varied discourse patterns as seen in figure 1. For Israel there are strong connections between political, medical and social community themes. Japan had stronger connections between political, medical and economic themes. With intentional focus on larger economic impacts, it follows that Japan would have the lowest values of financial insecurity. Japan highlighted economic interests that were forward thinking at the onset of the pandemic. Prime Minister Yoshihide advised that Japan would *"create a mechanism to listen directly to the voices of micro-, small- and medium-sized business operators on the challenges they face and thoroughly address impacts on local economies such as by providing strong liquidity support."*

As the initial COVID-19 response of Israel relates to financial insecurity, Prime Minister Netanyahu emphasized that *"everyone will remain at home except for workers whose work is permitted under Finance Ministry directives… (o)ne can leave one's home to stock up on food and medicines, for medical treatment and for other exceptions".* As Israel focused heavily on social isolation, like many other countries at the onset of the COVID-19 pandemic, this response lacked connections to larger economic policies.

4 Conclusion and Implications

From our results, the initial responses of international leaders show connections to COVID-19 recovery outcomes. Early-on in Japan's press releases they identified the

acceptance of cures, vaccines, and the possibility of them without solely focusing on medical devices or the technologies needed to not just combat, but overcome COVID-19 [1]. This may have set a cultural expectation and played a role in why vaccination rates in Japan were highest of the sampled countries. Japan's leader placed emphasis on the possibility of cures, while the US focused on managing the outbreak and illnesses with a focus on medical devices [2]. The difference in reactionary versus proactive perspectives of these international leaders may have been influential in vaccine acceptance. Cultural differences between social expectations of citizens and their willingness to comply with governmental policy in Japan and the US cannot be ignored as a possible contributing factor.

With respect to financial insecurity, Japan took a broad-scoping view on economic impacts with an initial media response by addressing larger economic implications and messaging a focus on how businesses would be impacted by the pandemic [1]. Comparatively, Israel emphasized social isolation and shut-down in the initial media responses with no mention of identifying long-term economic considerations. Israel also presented an initial response which encouraged citizens to "stock-up" on supplies which could possibly contribute to immediate economic panic and influence the inability to absorb economic shock, a characteristic of financial insecurity [3].

By understanding the relationship between speech discourse and outcome variables, this study aims to contribute to the development of evidence-based communication practices that may have practical implications for informing policymakers and public health officials with regard to effective crisis communication strategies and management of future pandemics.

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Exploring eye movements in virtual heritage environment with epistemic network analysis

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Abstract. This study utilized epistemic network analysis to investigate the impact of textual annotations on viewers' eye movements in virtual heritage environment (VHE). Forty participants explored VHEs with and without textual annotations while their eye movements were tracked. Results showed that textual annotations significantly drew viewers' attention and drove them to frequently look back and forth between text and other regions of interest (ROIs). In addition, this study revealed that eye movements between several ROIs could significantly predict learners' cognitive and emotional perceptions.

Keywords: Virtual Heritage Environment, Eye Movement, ENA.

1 Introduction

Recent studies have demonstrated that virtual reality (VR) technology has the potential to provide users with highly immersive experiences, which has led to its increasing use in creating virtual heritage environment (VHE) [1]. Compared to physical visits, VHEs offer people the opportunity to experience historical sites and artifacts without the constraints of distance and time. Furthermore, to enhance the viewing experience, various multimedia elements, such as text annotations, can be incorporated into VHEs.

To understand how viewers interact with VHEs and how multimedia elements might affect viewer behaviors, recent studies began to incorporate eye-tracking methods to examine viewers' visual processing of VR content [2]. Despite recent progress, there are still some limitations in this approach. Specifically, eye fixations have commonly been treated as independent instances, without considering how and what their associations could indicate.

As a method for analyzing and visualizing the structure and dynamics of knowledge networks [3], epistemic network analysis (ENA) has been adopted to analyze eye movement data, particularly to detect possible associations between different regions of interest (ROIs). For example, [4] recorded instructors' eye movements while viewing class recordings and utilized ENA to discover their strategies in assessing students' in-class cognitive and emotional characteristics. However, to the

best of our knowledge, ENA has never been adopted to model eye movement patterns in VR environments where viewers try to integrate meanings of various components and form a comprehensive and collective understanding of the immersive space. This study aims to expand the application of ENA to eye movement analysis in VR environments. In particular, we explore how text annotations in VHEs may affect viewers' cognitive and emotional process of understanding and appreciating culture heritage using ENA. The following research questions (RQs) guide this study: **RQ1** To what degree do viewers' eye movements across ROIs differ in VHE with and without text annotations? **RQ2** To what degree are viewers' eye movements across ROIs related to their cognitive and emotional perceptions?

2 Method

A user experiment was conducted with 40 university students (19 females) from diverse majors. Participants were recruited through posters and online advertisements, and all of them participated voluntarily. The average age of participants was 23.7 with a standard deviation of 3.55 years. In this experiment, participants were asked to view four VR scenes of heritage environments in Hong Kong, two of which contained additional text narrations. The VHEs were developed with Unity and presented through the HTC Vive Pro Eye, which also recorded participants' eye movements using a built-in Tobii eye-tracker. A detailed experimental design was provided in [1].

After each VR scene, a short oral survey was conducted to assess participants' perceptions of the presented heritage in 6-point Likert scale, including perceived understanding, confusion, immersiveness, and interestingness of the virtual heritage environment. Eye movements were calculated based on head orientation and coordinates of the eye gazes in the 360 spheric virtual environment [5]. Eye movement measures used in this study included fixation location and duration. Based on the categories of items shown in the VR scenes (Fig. 1), six ROIs were defined, including culture heritage sites (CUHE), text (TEXT), nature (NATU), tamed nature (TANA), urban constructions (URBN) and others (OTHE).

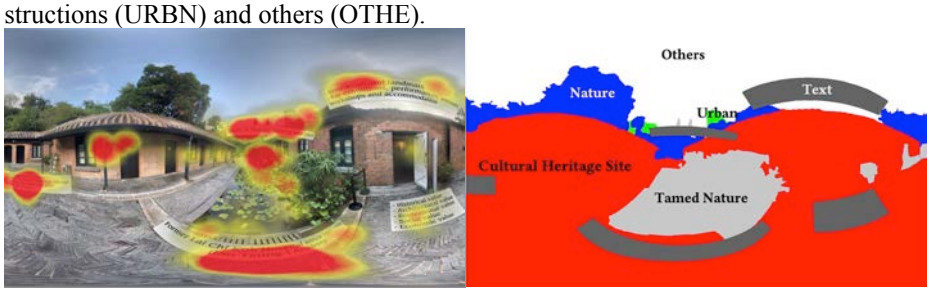

Fig. 1. Sample VR scene and ROIs (replicate from [5])

In answering the first RQ, this study utilized ENA to model and visualize eye movements across ROIs [6]. Participants under each condition were treated as units of analysis (UoA). A moving stanza with a size of four consecutive fixations was used to construct adjacency matrices to represent ROI co-occurrences (i.e., two ROI appear in

the same stanza). While there is no universally accepted stanza size for eye movement data, we experimented with different options (e.g., 1 to 16) and did not find a significant influence on the resulting patterns. Thus, the default size (i.e., four) was adopted. The adjacency matrix for each UoA was then unfolded into a high-dimensional vector and projected onto a two-dimensional plane through singular value decomposition. Based on the locations of UoAs, the coordinates of ROIs were determined via an optimization routine. For each UoA, its eye movement pattern during VHE viewing was represented as a network where the nodes of the network were the six ROIs and the edges indicated frequencies at which two ROIs co-occurred. A thick edge denoted that participants' fixations moved across two ROIs within the same stanzas very frequently. To address the second RQ, this study employed linear mixed modeling (LMM) to further investigate how cooccurrence frequencies of any two ROIs identified through ENA could predict participants' perceived viewing experiences (e.g., understanding). In building LMMs, cooccurrence frequencies of any two ROIs were group mean centered (i.e., raw data values were adjusted by subtracting the mean of each VHE condition) and used as predictors, while each perception measure was included as the outcome variable.

3 Preliminary findings

By comparing viewers' eye movements across ROIs with and without text annotations, this study found that text annotations could significantly attract viewers' visual attention in VHEs (Fig. 2). Specifically, adding text annotations to VHEs created strong connections between TEXT and other ROIs including CUHE and OTHE. This indicated that participants frequently viewed back and forth between text annotations and other components of the VR scenes. Regarding the thick TEXT-CUHE connection in particular, it could suggest that text annotations were useful for participants to understand the CUHE. Meanwhile, when text annotations were not offered, participants exhibited relatively more connections among CUHE, TANA, and URBA, which might indicate that, in the absence of text annotations, viewers relied on the surrounding components to make sense of the CUHE. Overall, it could be learnt based on the edge thicknesses that having text annotations could reduce viewers' attention to other elements in VHEs and focus them on the interplay between TEXT and CUHE.

Furthermore, this study identified several significant associations between eye movements across ROIs and perception measures. For instance, connections CUHE-TEXT ($b = 0.012$, $p < 0.01$), TANA-URBN ($b = -0.022$, $p < 0.05$), NATU-OTHE ($b = -0.105$, $p < 0.01$), and TEXT-OTHE ($b = 0.004$, $p < 0.01$) could significantly predict learner's perceived level of understanding, with these four predictors explaining nearly 30% of the variance. Combining with the ENA outcomes (Fig. 2), it was suggested that text annotations could enhance viewer's understanding in VHE. Additionally, URBA-OTHE ($b = 0.047$, $p < 0.05$) and TEXT-OTHE ($b = 0.004$, $p < 0.01$) could significantly predict valence, while CUHE-TANA ($b = -0.020$, $p < 0.05$) predicted arousal. These results indicated that various components in VHEs could influence viewers' emotional experiences collectively.

In summary, this study demonstrates the feasibility of using ENA to model and detect differences in eye movement patterns in VR environments. The study also highlights the potential of the connections between ROIs as useful predictors of perceived cognitive and emotional outcomes. The results of this study have important implications for the design and implementation of VHEs.

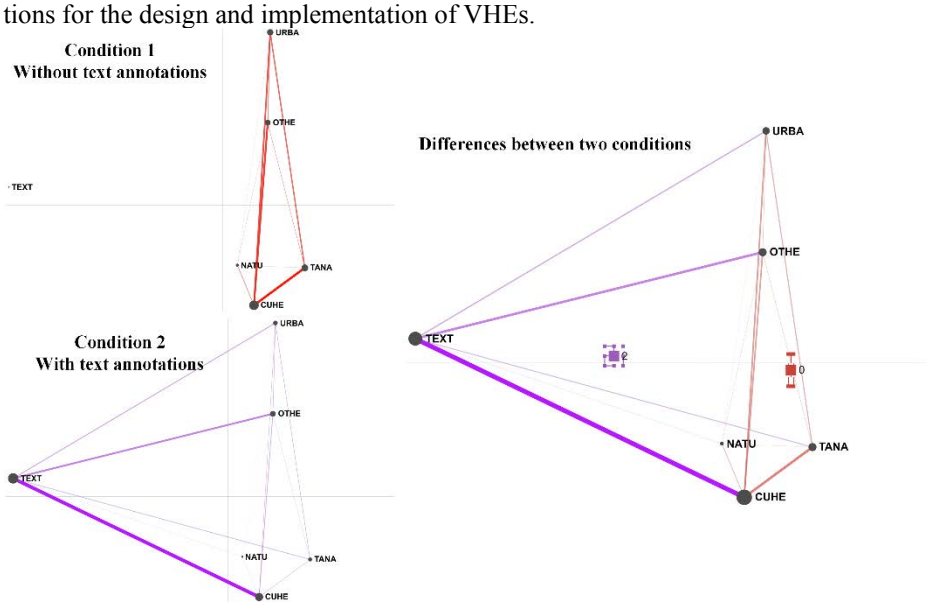

Fig. 2. ENA for conditions without and with text annotations and their differences

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Exploring STEM Pathway Programs: Perspectives of Alumni and Faculty on Identity Exploration

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Abstract. Using interviews with alumni participants and faculty leaders of STEM pathway programs at a public and private university, this work explores and compares how each interviewee conceptualizes such programs as shaping STEM identity formation for underrepresented students. For four randomly sampled interview cases, epistemic network analysis helped to highlight differences between participant and leader perspectives and suggests possible differences by school. We hope this work inspires future work that leverages quantitative ethnographic approaches toward assessment of programmatic outcomes from the perspectives of multiple stakeholders.

Keywords: STEM Pathway Programs, Identity Exploration, Epistemic Network Analysis.

1 Introduction

With an ongoing need for higher education programming that supports STEM major and career acquisition for underrepresented students, there is evidence to suggest that STEM pathway programs that support identity exploration have utility [1]. Current research on STEM pathway programs suggest that perceptions of student experience may differ by stakeholder [2], which holds implications for program design if, for example, there is a mismatch between program leaders' expected impacts and students' self-reported experiences. This work addresses this topic by comparing interview data from program participants (alumni) and faculty leaders to explore these nuances.

2 Identity Exploration in STEM

The successful acquisition of a STEM major or career is a targeted goal that students may work toward (often with designed support) by engaging in identity exploration [1]. STEM identity exploration is a situated and intentional processes of self-reflection and

action over time, during which a learner evaluates various interconnected aspects of the self in the present (e.g., cognitive, emotional, and behavioral elements, self-definitions), then takes intentional steps to develop these features toward future STEM roles. A review of literature highlights the following relevant identity constructs as summarized by the Projective Reflection theoretical framework [3] (See Table 1): (1) cognitive features such as STEM skills or knowledge (2) affective features such as interest and valuing of the STEM topic, (3) behavioral features such as goal-setting, self-monitoring, and self-regulation, and (4) self-definitions and self-perceptions, or assessments of self-confidence, characteristics, and roles they embody or hope to one day enact [4].

Table 1. Identity Constructs in the Projective Reflection Theoretical Framework

Code	Definition	Example
Knowledge	Understanding of STEM subject; awareness of how to use information in context.	Alumnus: *If you got a mechanical engineering degree* [like me]*, you understand most physics and how stuff works.*
Interests and Valuing	Attraction or motivation to engage with topic, often due to recognition of its significance or importance.	Leader: *This is our way of introducing the program to students interested in learning more…That's where students will commit to being a part of the program.*
Self-organization and Self-control	Ongoing regulation of thoughts, emotions or behaviors to achieve desired goals/outcomes.	Alumnus: *I was in the process of starting up a company with my friend that does a lot of systems automation for companies…*
Self-perceptions and Self-definitions	Self-evaluations, beliefs, descriptions, judgments or labels.	Leader: *We allow the community itself these interactions…to bolster their sense of self efficacy, the fact that they can do this work, that they can be successful.*

Our prior work has used quantitative ethnographic (QE) approaches to understand identity exploration in context from the perspective of learners [1, 3] and organizational leaders who design experiences that support identity exploration [5]. This work extends this inquiry with the following comparative research question: "What similarities and differences emerge between alumni participants' and faculty leaders' conceptualizations of student identity exploration processes through STEM pathway programs?"

3 Methods

This study is a part of a research project funded by the National Science Foundation (NSF) to examine STEM identity exploration processes in learners who participated in STEM pathway programs for underrepresented groups. Faculty program leader from a Private and State University (both predominantly white institutions) answered semi-structured interview questions via zoom related to the programming offered at their institutions and their perceptions of how their students engage in STEM identity exploration. Fifty-four student and alumni participants completed analogous semi-structured

interviews on their own prior experiences. For this preliminary comparison, one engineering alumni participant from each school was randomly sampled for comparison.

Data was transcribed by a transcription service and segmented into lines by topic of discussion using thematic review of data, with socially moderated agreement reached by two researchers. Deductive codes were defined by the Projective Reflection framework and applied by hand, with Cohen's kappa established at or above 0.7 for all codes. A qualitative review of the interviews determined an appropriate window size for the data to be approximately 3 lines, as participants tended to organize their thoughts relatively discreetly around the questions provided. We constructed an epistemic network where: units of analysis were role (participant or leader) and school (private or state university), and conversations were defined by interview. The ENA model represented the connections between codes in each line of the data to other lines in its stanza window and summed the connections for all lines within each unit. The model normalized the resulting connection counts, and we used a means rotation to project the normalized connection counts for units into an ENA space. We compared units in the first group and second group by examining their mean network graphs and a difference model. Given the small sample set, we do not expect difference to a degree of statistical significance, which aligns with the small-scale, exploratory nature of this work.

4 Results

The alumni participant from the private university primarily discussed the internship they completed during engagement with the STEM pathways program. They described the pace of classes and work experiences as supportive of future professional flexibility:

Being a chemical engineer [Self-perception]*, especially doing the rotational program and honestly, it was like [SCHOOL]'s super-fast. They require you to be able to learn and then be able to apply new knowledge* [Knowledge] *and then start all over again in 10 weeks. So, I think that prepared me.*

The leader from the private university also highlighted how their programming was intended to support the "life cycle" of students at every stage, with a focus on fostering students' self-perceptions related to a sense of belonging:

The work that we do…to support students authentically [Self-organization]*, meeting them in the communities that they're drawn to* [Interest] *is…how students feel connected, supported, well-resourced, able to face challenges, celebrated in these communities, and appreciated in very authentic ways* [Self-perceptions].

The alumni participant from the state university participated in a STEM pathways program designed for engineers. They emphasized how the program developed specific knowledge and skills that they used to complete academic and professional goals:

You just pick them [interdisciplinary skills] up along the way, like we had a physics course that dealt with electrical engineering and then your capstone project at [SCHOOL] [Knowledge]. *There's primarily interdisciplinary work now [at my job]… myself and three biomedical engineers* [Self-organization].

Finally, the leader from the state university emphasized how they design programming to support students' Self-organization between peers and program graduates:

It [workshops] is a way for the students to get to know each other…even outside of program structured activities [Self-organization]*... We bring guest speakers in from industry, and most likely they're going to be program alums who are talking about topics* [Knowledge] *that the students have decided are of interest to them* [Interest].

4.1 Epistemic Network Analysis

The mean network graph for alumni participant and faculty leader interviews (See Fig. 1a and 1c) showed that both groups made the strongest connection between *Self-Organization* and *Knowledge* and *Self-Organization* and *Self-Perception*, but that alumni participants had a stronger *Knowledge* connection and faculty leaders had a stronger connection to *Self-perception.* Using the difference network that compares the mean network graph between the two groups (See Fig. 1b), we identified the x-axis of the ENA space as characterizing the difference between alumni participants' focus on *Knowledge* and faculty leaders' heavier focus on *Self-organization*. It should also be noted that the unit means for interviewees from the Private University are situated in the upper quadrants of the model, suggesting stronger connections to *Self-perception*.

Fig. 1. Network model for alumni participants (1a), faculty leaders (1c), and their corresponding difference model (1b). Unit means for private university interviewees are in the upper quadrants, while unit means for public university interviewees are in the lower quadrants.

5 Results

Given the small scale of inquiry, establishing direct relationships between what leaders intended with program design and what students experienced in terms of STEM identity exploration is unfeasible. However, the qualitative case analysis and comparative epistemic networks reveal insights that warrant deeper future exploration. Alumni and leaders were more likely to describe how STEM pathway programs supported their *Self-organization* as the prepared for STEM professional roles (*Self-perceptions*), while alumni also more frequently referenced development and use of *Knowledge*. Interviewees from the private university both connected to *Self-perceptions* more frequently, while those from the state university deepened connections between relevant STEM *Knowledge* and *Self-organization*. We hope this work inspires future research on assessment of programmatic outcomes from the perspectives of multiple stakeholders.

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Quantitative Futures Ethnography

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Abstract. In this talk I will argue for a new premise for a Quantitative Futures Ethnography; that is an approach to quantitative ethnography which has a futures-focused, pre-emptive and interventional agenda.

Mixed methods approaches have, for years, sought to bring together the benefits of qualitative knowledge and quantitative data. However this has often been on the premise that quantitative data can verify qualitative findings on a larger scale, or that qualitative ethnography can unravel the details and complications of life that are hidden by large data sets. The dynamic and predictive capability of big data analytics offers a new possibility for mixed methods research; it invites us to consider how the continually changing and contingent processual worlds from which qualitative ethnography emerges complicate the assumptions drawn from continually collected and analysed big data.

In this talk I discuss and go beyond these developments, to propose how bringing together such approaches might better enable us to address questions concerning possible futures: I will outline a futures ethnography approach informed by design anthropological foresighting, and discuss how this can both complicate and engage with quantitative foresight.

Indeed, I will argue that it is crucial that the social and computational sciences consider such steps in order to engage effectively with the uncertainties that characterise contemporary times.

The Politics of Decipherability: A Critical Race Feminista's Epistolary Offering to Quantiative Ethnography

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Abstract. The field of education has often relied on statistical evidence to describe the educational experiences of marginalized populations with limited problematizing of how race and racism permeate such facts and conclusions (Garcia & Mayorga, 2018). Underlying this debate is epistemic violence, power, and how discourse has reproduced inequities for communities who live at the margins of U.S. society and more broadly (Garcia, Lopez, & Velez, 2018). Amidst unprecedented social upheaval, the need to interrogate how researchers use positionality as a methodological concept is greater than ever before. In this talk, Garcia will discuss her positionality as a QuantCrit (Gillborn et al., 2018; Garcia et al., 2018) and Chicana/Latina feminista entering and deciphering the emerging field of Quantitative Ethnography. Through an epistolary offering she will groundtruth the use of story, fairness, and community through a Critical Race and Chicana/Latina Feminist lens.