

**MULTIMODAL ACADEMIC DISCOURSE SOCIALIZATION:
AN ETHNOGRAPHIC MULTIPLE CASE STUDY OF GEOSCIENCE STUDENTS'
POSTER PRESENTATIONS AT A CANADIAN UNIVERSITY**

by

Masaru Yamamoto

B.A., Kanda University of International Studies, 2016

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES
(Teaching English as a Second Language)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

August 2020

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The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, a thesis entitled:

Multimodal academic discourse socialization: An ethnographic multiple-case study of
geoscience students' poster presentations at a Canadian university

submitted by Masaru Yamamoto in partial fulfillment of the requirements for

the degree of Master of Arts

in Teaching English as a Second Language

Examining Committee:

Dr. Patricia A. Duff, Department of Language and Literacy Education
Supervisor

Dr. Ling Shi, Department of Language and Literacy Education
Supervisory Committee Member

Dr. Sandra Zappa-Hollman, Department of Language and Literacy Education
Supervisory Committee Member

Abstract

Academic discourse socialization (ADS) provides useful theoretical, methodological, and pedagogical insights into the processes, affordances, and challenges associated with students' learning and engagement in academic discourses and tasks (Duff & Anderson, 2015). While research has predominantly documented oral and written ADS, language socialization theorists have increasingly examined the significant affordances of multimodal and embodied meaning-making resources (Duff, Zappa-Hollman, & Surtees, 2019). However, the roles and dynamic interrelationships among these different modes require further ADS research. Another research gap concerns the type of academic task that is analyzed. Compared to lecture-type student presentations (Duff & Kobayashi, 2010), fewer studies have explored poster presentations, which foreground the orchestration of verbal, written, visual, and embodied resources to effectively communicate their meanings in dynamic ways (MacIntosh-Murray, 2007). Despite this complexity and the ubiquity of poster presentations in courses and at conferences, little is known about students' actual multimodal meaning-making practices in poster presentations. This thesis therefore explores the nexus of these two interrelated, underexplored areas.

Drawing on Vygotskian sociocultural theory, ADS, and ecological approaches (Duff, 2007; van Lier, 2004), this thesis reports findings from a multiple-case study of undergraduate students' multimodal ADS and poster presentation performance in a geoscience course at a Canadian university. Data generated through semester-long classroom observations, interviews with the instructor and students, and participant-produced documents (e.g., posters) were qualitatively analyzed following a multi-cycle procedure (Miles et al., 2019). Video-recorded data were analyzed using multimodal interaction analysis (Norris, 2019) to examine four participants' moment-to-moment deployment of multiple meaning-making resources in their poster presentations. Findings show that students were socialized into the recurrent in-class "observation versus interpretation" activity to learn to differentiate them in the visual geographical data in highly multimodal and embodied ways. The analyses of students' video-recorded poster presentations further demonstrate how these multimodal and embodied practices were manifested in students' performance using spoken and written language, visuals, iconic and deictic gestures, and viewers' questions as additional semiotic resources. This study emphasizes that multimodal enactments constitute a crucial dimension of disciplinary practices and values connected with learning to think, view, and represent knowledge "like geoscientists."

Lay Summary

This multiple-case study examines how undergraduate students learned to think, view, and represent disciplinary knowledge like experts in a geoscience course and in-class poster presentations at a Canadian university. Data include my semester-long classroom observations, video-recordings of four students' poster presentations, interviews with the instructor and the four students, and course documents. Findings show that students were learning to distinguish what they *saw* and what they *thought* they saw in geographic images. They also communicated them bodily in poster presentations. The study suggests that learning to view and orally, visually, and bodily communicate knowledge is an important aspect of thinking and communicating “as geoscientists”.

Preface

This study has undergone an ethical review process which was approved on October 1st, 2019 by the University of British Columbia Behavioural Research Ethics Board. The Human Ethics Certificate # H19-01501 for “Meaning making in the poster presentation: A multimodal analysis of university students’ task perceptions and performance” is valid until October, 2020. This thesis is original, independent work by the author, Masaru Yamamoto.

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List of Abbreviations

ADS	Academic discourse socialization
AP	Academic presentation
CMU	Coastal Mountain University
DES	Department of Earth Sciences
DFG	Douglas Fir Group
EPS	Earth and Planetary Science
ESL	English as a second language
L1	First language
L2	Second language
LS	Language socialization
PPT	PowerPoint
SCT	Sociocultural theory
TA	Teaching assistants

Acknowledgements

First and foremost, I would like to thank the teacher, TAs, and students who made this study possible by kindly welcoming me as a researcher into their geoscience course. To Robert, an enthusiastic, respected teacher, teacher educator, and geoscientist, I sincerely thank you for showing me what it means to be an educator and for opening my views on education through the research activities. To students and TAs in the geoscience course, I am particularly grateful to my focal participants, Emma, Leah, Jack, Rachell and Lilly and Michelle (all pseudonyms), who shared with me their perspectives and insights as geoscientists.

I would like to express my profound appreciation to my supervisory committee members. My sincerest gratitude goes to Dr. Patricia Duff, a respected scholar and my dearest *sensei*, for her mentorship and continuous support throughout this project. From the very first meeting in her PCOH office to the virtual MA defence via Zoom, Dr. Duff always patiently listened to me, read my drafts multiple times, and gave insightful comments and thorough feedback on my early drafts and even on my defence rehearsal. Dr. Duff has also always kept encouraging me throughout my master's study. I cannot find enough words to express my feeling, but I hope this thesis embodies my sincerest appreciation to her.

I would also like to thank sincerely my committee members, Dr. Ling Shi and Dr. Sandra Zappa-Hollman. Their thought-provoking questions and comments as well as their academic support as my committee members have helped me plant the seeds of ideas to grow in my future PhD journey in LLED. Both Dr. Shi and Dr. Zappa-Hollman were two of the very first LLED faculty members whom I met at SSLW 2018 and learned from throughout my master's study. I hope this thesis demonstrates how far I have come since I first introduced myself to you.

Additionally, I would like to recognize the academic and social support as well as continual encouragement I received from the faculty and alumni within the community of Department of Language and Literacy Education at the University of British Columbia. Among many others, I would like to express my sincere thanks to Drs. Monique Bournot-Trites, Anna Dong, Annette Henry, Bonny Norton for sparking my interests with their insights into their respective areas of expertise in LLED courses. I also wish to thank Kathryn Accurso, George Belliveau, Meghan Corella, Ron Darvin, Ryan Deschambault, Reginald D'Silva, Derek Gladwin, Lee Gunderson, Kendrick James, Nasrin Kowkabi, Ryuko Kubota, Guofang Li, Anthony Paré, Valia Spiliotopoulos, and Meike Wernicke for their support and encouragement. My

appreciation also extends itself to Dr. Victoria Surtees for her insights into pedagogy and peer language socialization research. It has been a real pleasure working with her on the GOAL module for Rits students and on a co-authored manuscript. I would like to extend my thanks to Dr. Alfredo Ferreira, without whose support this study would never have been impossible.

I would be remiss if I failed to recognize the tremendous administrative and social support I have received from the staff within LLED. Among many individuals, I specifically extend my sincere thanks to Lisa Altan, Brittany Bella, Ivana Petrovic, Ana Susnjara, Effiam Yung, and Alya Zhukova for their warmth and kindness, excellent professional service, and all the spontaneous conversations we would share in the kitchen and the corridor in PCOH.

Here, I wish to extend my warmest thanks to my peers within LLED who always stood by and supported me throughout my master's study. To the Case Study Group: Kyuyun Lim, Sara Van Dan Acker, Raymond Pai, and Aika Ishige, I am eternally grateful to you for your friendship and intellectual inspiration you brought to me. Without all your positive energy and support, I would never have been able to arrive to this stage. To the LLED Graduate Peer Advisor (GPA) Team 2019/20: Ashley Moore, Monica Shank Lauwo, and Aika Ishige, I thank you for always being a great source of inspiration and for your thoughtfulness and care. Working closely with you has been one of the most learning-rich experiences in my MA student life to learn and contemplate the true meaning of leadership. To the LLED GPA Team 2020/21: Farhad Jafari, Sadia Shad, and Jane Kuznetsova, I am very much grateful for their exceptionally thoughtful and innovative inputs and, above all, patience even when I was away for writing. To the AAAL 2021 Program Planning Team at UBC: Dmitri Detwyler, Ashley Moore, Greta Perris, and Yuya Takeda, I believe no master's student could enjoy the privileged opportunity to work closely with such amazing individuals for the prestigious applied linguistics conference. Even though we have been physically separated due to the current circumstances, I rarely felt alone because I felt strongly connected with the team.

I cannot name all my beloved LLED peers, but I also specifically think of Klara Abdi, Asma Afreen, Danielle Burrell-Kim, Liam Doherty, Jonathan Ferreira, Kaye Hare, Takeshi Kajigaya, Tolkyn Khazhimukhan, Zhen Lin, Simangele Mabena, Amir Michalovich, Esteban Morales, Wasan Qasim, Zhuo Sun, Denise Blanch Zelada, and Anastasia Zhuravleva for their continual peer support and for the elements of joy all of you brought to my master's study. I would also like to extend my *arigatou* to Japanese friends at UBC across departments: Mariko

Endo, Risa Hatanaka, Arika Kaneko, Haruho Kubota, Toki Inui, and Ai Yamamoto, for their friendship and all the food and beer we shared.

Across the Pacific Ocean or over the Rocky Mountains, support and encouragement came from many different parts of the world. To my former Kanda community, I would like to specifically express my sincere gratitude to my beloved *senseis*: Drs. Masaki Kobayashi and Yasushi Sekiya as well as Masaki-zemi folks, whose ongoing support has been “essential” in shaping the novice applied linguist I have become today. I wish to extend my thanks to Emi Kobayashi sensei, Dr. Atsushi Iida, and my friends in Emi-zemi, whose support was also key to my intellectual development. I would also like to express my appreciation to Dr. Jérémy Séror, whose sociolinguistics course at Kanda sparked my genuine interest in language. I wish to thank them all once again for their continued support even after my graduation from Kanda.

Intellectual stimuli also came from my peers in J-SLARF. I would like to specifically thank Shungo Suzuki, Masaki Eguchi, and Aki Tsunemoto for always involving me in their intellectually stimulating conversations and sharing their insights as *sempai* SLA researchers. Ryo Maie, I’m not leaving you out; I want to send a special word of thanks to you for stimulating my interest in SLA and applied linguistics ever since I got interested in the field when we were together studying at Kanda.

Going back to my hometown, I would like to extend my sincere and special words of *arigatou* to my dear friends in Chiba who are inseparable from my personal development as a human being—Suguru Muramatsu, Toshi Yabe, Kaito Ichinohe, Ryutaro Tokita, Hitomi Nakadai, and Nana Kawate for their support and friendship ever since we spent countless hours together at Chiba Kita and beyond.

Last but certainly not least, I owe my deepest gratitude and love to my family—my mother Noriko Yamamoto and my grandmother Aiko Yamamoto, and my dearest clumsy cats—for their unstinting support and unconditional love throughout my life.

いつもありがとう。

Dedication

To my family

Chapter 1: Introduction

1.1 Introduction

Learning to speak, write, think, and act according to local linguistic and cultural norms is a crucial aspect of education. The last two decades have witnessed increased attention to the nature of students' academic discourse socialization (ADS) into a diverse range of oral and written academic practices, such as whole-class or small-group discussions (Fujieda, 2019; Ho, 2011; Morita, 2004, 2009), presentations (e.g., Duff & Kobayashi, 2010; Zappa-Hollman, 2007), writing conferences (Gilliland, 2014), written feedback on assignments (Séror, 2009, 2014), and negotiations of written assignments (Fujioka, 2014). With the aim of obtaining a robust and explicit understanding of the characteristics, challenges, and pedagogical affordances of those academic practices, ADS researchers have investigated how students learn to think, communicate, and act meaningfully in socioculturally, institutionally, and disciplinarily valued ways. In the process, researchers examine how these learners (and their mentors and peers) become fuller, and better equipped participants in those oral and written discourses both inside and outside their local classrooms and in the broader disciplinary community (Duff, 2010; Duff & Anderson, 2015; Kobayashi, Zappa-Hollman, & Duff, 2017). The scope of ADS research also includes language use in computer-mediated environments (Yim, 2011) as well as the multiplicity of socializing agents in students' own social networks and their impact on one another's ADS (e.g., Seloni, 2012; Zappa-Hollman & Duff, 2015). With their rich descriptions and in-depth analyses of individuals' lived experiences, these studies have offered valuable insights into the dynamic and complex processes involved in students' ADS. Much of the existing research cited above focuses on learners of English as an additional language but many of the same learning processes are experienced by learners in their primary languages, as well, as they encounter academic discourse across different disciplines (e.g., Morita, 2000).

1.2 The Statement of the Problem

Situated in the field of applied linguistics, ADS researchers have traditionally focused on ADS with attention paid to spoken or written language as the primary mediational tool or modes for (as well as objects of) socialization both inside and out-of-class and in face-to-face and online environments. Despite the longstanding recognition that "[a]cademic discourse socialization is a

dynamic, socially situated process that in contemporary contexts is often *multimodal*” (Duff, 2010, p. 169, italics added), the multimodal dimension of ADS (e.g., embodiment and visuals, among many other possible modes) appears to have traditionally been conceptualized to play an ancillary role in the broader processes of ADS. In other words, the significance and the potential contribution of multimodal meaning-making resources to students’ ADS remains secondary to spoken and written language and thus relatively untapped for empirical scrutiny. The dynamic and complex interrelationships amongst different linguistic and non-linguistic modes in moment-to-moment interaction also remain underexplored in ADS (Kobayashi, 2003).

Another research gap exists in the types of academic tasks that have been examined with respect to ADS. Research has predominantly examined academic presentations (as a task type) to examine linguistic, rhetorical, and visual conventions in diverse disciplinary and local institutional contexts (Diani, 2015; Morton, 2009; Rowley-Jolivet & Carter-Thomas, 2005). Researchers have also studied the processes, learning affordances, and challenges associated with academic presentations in postsecondary institutions (Duff & Kobayashi, 2010; Kobayashi, 2003, 2016; Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). In contrast to a relative wealth of research on PowerPoint-type academic presentations, with very few exceptions (e.g., Kobayashi & Kobayashi, 2018), ADS researchers have yet to examine the nature of academic poster presentations. Such presentations are important at academic and professional conferences as well as in educational coursework and rely heavily on embodied representation—pointing, positioning one’s body in relation to viewers and the poster, and depicting and distilling complicated ideas into text and images that can fit on one sheet of poster paper. Therefore, they foreground the multimodal aspects of academic knowledge construction and representation (D’Angelo, 2016; Kobayashi & Kobayashi, 2018; MacIntosh-Murray, 2007). To be effective, presenters need to navigate the complex web of “writing, graphics, color, speech, and even gesture used to convey meaning” (MacIntosh-Murray, 2007, p. 352).

1.3 The Purpose of the Study and the Research Questions

This study aims to address these important research gaps by examining the embodied and multimodal dimensions of ADS at the university level. To do so, I conducted an ethnographic multiple-case study that examines second-year undergraduate students’ multimodal academic discourse socialization in a geoscience course at a Canadian university taught by an award-

winning instructor. The focus of this thesis is two-fold: (a) to examine how students learn to *think, view, and communicate as geoscientists* through recurrent multimodal small-group discussions and (b) to analyze in detail how students orchestrate a myriad of multimodal meaning-making resources to perform the geoscience poster presentation according to the values and norms of the geoscience classroom and those of the broader discipline.

Data were generated primarily through my semester-long classroom observations and fieldnote-taking, semi-structured interviews with the course instructor and the four focal student participants, video-recordings of the four focal participants' poster presentations, the collection of artefacts produced by the course instructor and the student participants (e.g., posters, lecture slides, task instructions), and my frequent visits to a university-affiliated geoscience museum (see Chapter 3). Those data were qualitatively analyzed following a multi-cycle iterative procedure (Frieese, 2019; Miles, Huberman, & Saldaña, 2019; Saldaña, 2016). Based on the findings of the qualitative analysis, I conducted an in-depth multimodal interaction analysis of the video-recorded data to examine moment-to-moment coordination of multiple different meaning-making resources deployed in students' poster presentation performances (Norris, 2004, 2019). The study addressed the following research questions:

1. What are some of the valued forms of scientific thinking promoted in the undergraduate geoscience course and observed in classroom interaction? How are students socialized into thinking, learning, viewing, and communicating like geoscientists?
2. What multimodal practices are promoted and enacted in this geoscience classroom to socialize students into geoscientists' ways of observing and interpreting? What are some of the disciplinary norms, values, and practices that underlie those multimodal practices?
3. What are the characteristics and expectations of the poster presentation task assigned to and performed by undergraduate students in the geoscience classroom? How were geoscience poster presentations linked to the multimodal practices and scientific thinking modelled by the instructor in the geoscience classroom?
4. What kinds of meaning-making resources do student presenters incorporate and act upon in their poster presentations according to the nature of their topic and their immediate interactional needs? More specifically, how do they orchestrate different kinds of

available multimodal meaning-making resources to communicate their observations and interpretations of identifiable “patterns” on their posters?

1.4 The Organization of the Thesis

The thesis is divided into six chapters. Chapter 1 serves as an introduction of the thesis, by outlining the background of the study, identifying the issues and knowledge gaps in the field, stating the research questions and the significance of the study, and discussing the organization of the thesis.

Chapter 2 introduces the three interrelated sociocultural theories that guide this study: language socialization theory, Vygotskian sociocultural theory, and van Lier’s ecological approach (Duff, 2007; Lantolf & Thorne, 2006; van Lier, 2004). I also discuss how those three sociocultural theories inform and offer different insights into the development of individual learners as well as the affordances in their own environment that scaffold or mediate their learning (e.g., Steffensen & Kramsch, 2017). The theoretical overview is followed by a review of the relevant literature, including past studies on ADS.

Chapter 3 provides a detailed description of the ethnographic multiple-case study (Duff, 2008) as well as methods for data generation and data analysis (Frieze, 2019; Miles et al., 2019; Norris, 2004, 2019; Saldaña, 2016). The background information of the research site and each of the student participants and the instructor is also provided in this chapter.

Chapter 4 presents the major findings related to the culture, values, and classroom practices fostered in the undergraduate geoscience classroom. Together, as I demonstrate, these socialize students into scientific ways of thinking, viewing, and communicating as geoscientists and are thus a locus of such multimodal academic discourse socialization. I then provide in-depth descriptions and interpretations of the recurrent classroom activity called *observations and interpretations* of geological features and patterns as a salient multimodal practice.

Chapter 5 analyzes students’ moment-to-moment multimodal practices in the geoscience poster presentation task. Based on the findings in Chapter 4, I specifically focus on how students communicate their observations and interpretations of the identifiable patterns in their poster’s data set.

Finally, in Chapter 6, I conclude this thesis by providing a discussion of the findings and their relevance to the existing literature and implications for pedagogy and future research. I also

provide a short reflection on my own socialization as a novice applied linguist in the geoscience classroom as a result of this research project.

Chapter 2: Sociocultural Theories and ADS Research on Academic Presentations: A Review of the Literature

2.1 Introduction

This study draws on several sociocultural theories to explore students' enactment and perception of the poster presentation and its interconnection with regular classroom practices and the wider disciplinary norms. More specifically, it foregrounds the multimodal dimensions of students' academic socialization. The present chapter contextualizes this study through a review of the relevant literature. In what follows, I first provide a detailed account of the three sociocultural theories guiding this study. After discussing how these theories intersect, I review relevant literature that has explored the nature of academic presentations (Morita & Kobayashi, 2008)

2.2 Sociocultural approaches to language use and learning

In this section, I first introduce three sociocultural theories of language learning and use that theoretically and methodologically guide this study: language socialization (Section 2.2.1; Duff & May, 2017; Duranti, Ochs, & Schieffelin, 2012), Vygotskian sociocultural theory (Section 2.2.2; Lantolf, Poehner, & Swain, 2018; Lantolf & Thorne, 2006), and an ecological approach to learning (Section 2.2.3; van Lier, 2004). After discussing each, I detail how these theories complement and intersect with each other (Section 2.2.4).

2.2.1 Language Socialization into and through Academic Settings

Theoretically and methodologically, this study has been largely guided by the scholarship on academic discourse socialization, which concerns students' socialization in and through postsecondary discursive contexts as a branch of the broader theory of language socialization (LS; Duff, 2010; Duff & Anderson, 2015; Duff & May, 2017; Duff & Talmy, 2011; Duranti, Ochs, & Schieffelin, 2012; Kobayashi, Zappa-Hollman, & Duff, 2017).

Rooted in anthropological and sociological foundations, LS seeks to account for the process by which novices or newcomers in a community or culture gain communicative competence, membership, and legitimacy as well as other (often tacit) sociocultural knowledge

of the group through participation in the target community (Duff, 2007; Duff & Talmy, 2011). Typically, novices (e.g., students) are assumed to become more knowledgeable and competent in the use and understanding of their communicative resources (linguistic, non-linguistic) and valued ways of communication as they participate in language-mediated social activities of the group. In other words, novices are socialized *through* language and socialized *to use* language as primary means and ends of learning (Ochs, 1986, p. 2). For this reason, social interaction is a major locus of socialization, in which novices' learning of linguistic and non-linguistic practices is *facilitated* by socially and culturally informed members and artefacts in their given environment (Ochs & Schieffelin, 2012). However, LS is neither deterministic, static, nor unidirectional; rather, it is always dynamic, socially and temporally situated, reciprocal and multidirectional in its processes and possible outcomes (Duff & Anderson, 2015). Specifically, while expert assistance may not always be effective or available in a timely manner, novices, as active agents, can reach out to or negotiate with their mentors, or alternatively, seek out additional support from their peers or institutionally available resources (Morita, 2004; Séror, 2009, 2011). As a result, mentors can also learn from their mentees' and from their own mentoring experience itself, gaining a better understanding of newcomers' needs and effective mentoring skills and practices (Duff & Talmy, 2011). On the other hand, students may exercise their agency to conform to or challenge and reject the linguistic and sociocultural practices prevalent in their community (Duff & Doherty, 2014; Ochs & Schieffelin, 2012). Thus, while the desired outcome of newcomers' LS is the internalization or reproduction of the existing knowledge and practices of their mentors, LS can also result in unanticipated outcomes, such as the development of hybrid/syncretic communicative and sociocultural practices (Duff & Talmy, 2011).

Academic discourse socialization (ADS) is specifically concerned with university students' lived experiences in gaining "the necessary dispositions and learn to perform meaningful actions in institutionally and socioculturally valued ways as they participate in their disciplinary communities" (Kobayashi et al., 2017, p. 240; see also Duff, 2010; Duff & Anderson, 2015). Scholars have examined university students' socialization processes in and through a variety of academic domains that include, but are not limited to, PowerPoint-type presentations (Duff & Kobayashi, 2010; Kobayashi, 2003, 2016; Morita, 2000; Morton, 2009; Yang, 2010; Zappa-Hollman, 2007), poster presentations (Kobayashi & Kobayashi, 2018),

participation in class/pair/group discussions in face-to-face and online environments (Ho, 2011; Morita, 2004; Yim, 2011), academic writing (Gilliland, 2014; Fujioka, 2014; Séror, 2009, 2011, 2014), and development and roles of individual networks of practice (Seloni, 2012; Zappa-Hollman & Duff, 2015).

While the multifaceted nature of ADS can be challenging for both L1 and L2 students (e.g., Morita, 2000), the latter population is more susceptible to these challenges and thus of great interest to (L2) ADS researchers. According to Duff and Anderson (2015):

the children or adults learning a *second* (or additional) language, often in multilingual societal contexts, already possess cultural and linguistic/discursive repertoires and experience with norms governing interaction and participation from their first or previous languages and cultures. How people's (multiple) languages, literacy traditions, and cultures interact with each other is of great interest to L2 socialization scholars because it allows for a broader understanding of the potential discordances, similarities, tensions, interactions, and synergies across different contexts and how these can impact language learning/use as well as identities and membership in various target communities of practice (pp. 338–339).

Importantly, the learning of language, content, and sociocultural knowledge is seen as situated and thus deeply rooted in the broader societal, local sociocultural, and micro-interactive contexts within which it occurs (DFG, 2016). For this reason, LS/ADS embraces micro-meso-macro multiscalarity as a theoretical lens through which to view individuals' learning as *sociocognition* or “the complex and dynamic interrelationship and interaction between psychological and sociocultural processes that shape—both enable and constrain—[L1] and L2 learners' engagement in a variety of activities and associated learning processes and outcomes” (Duff & Kobayashi, 2010, p. 76). As Duff (2007) observes, LS/ADS is concerned more with the “social” dimension of sociocognition, that is, the understanding of a group's sociocultural interaction process, participatory structures, and sociopolitical and ideological processes circulating in the community from their *insider's* perspective. On the other hand, she notes, attention to the cognitive aspect seems to be backgrounded in LS/ADS compared to other

complementary sociocultural approaches. I will discuss theoretical tenets of Vygotskian SCT in the following section.

2.2.2 Vygotskian Sociocultural Theory

This research also draws on Vygotskian sociocultural theory (SCT; Duff, 2007; Lantolf & Thorne, 2006; Lantolf, Thorne, Poehner, 2015). SCT is a theory which specifically concerns how humans' biologically endowed, lower mental functions (i.e., involuntary attention, memory) are developed into higher mental functions (i.e., voluntary memory and attention, planning; Lantolf & Thorne, 2006; Vygotsky, 1978). According to Vygotsky (1978), the fundamental premise of SCT is that human higher order cognitive capacity originates from and develops in contextualized interactions with an expert member of the community. In SCT, these social interactions and cognitive processes are always mediated by a range of material artefacts (e.g., computers) and symbolic or psychological tools (e.g., language, numeracy, gestures). SCT theorists argue that human mental processes are mediated and organized by culturally available mediational means. Among these tools, language is seen as the most important and powerful psychological means to “mediate their connections to the world, to each other, and to themselves” rather than a product of cognitive development (Lantolf et al., 2015, p. 210). It is for this reason that SCT assumes the social origin of human cognition, in this case the learning and development of language abilities and knowledge (Vygotsky, 1978). In other words, development and learning “appears twice: first, on the social level, and later, on the individual level; first, *between* people (*interpsychological*), and then *inside* the [individual] (*intrapsychological*)” (Vygotsky, 1978, p. 57, italics original). In short, language is seen as both the object and means of learning (Swain, 2006).

In SCT, the development of human capacity is described as increasing, sequenced regulations: object-, other-, and self-regulation (Lantolf & Thorne, 2006; Vygotsky, 1978). Storch (2017) explains the notion of mediation using the case of a novice L2 learner:

the novice transforms from being object-regulated (reliant on concrete physical representation of objects such as the reliance on realia in beginner L2 classes), to being other-regulated (reliant on the assistance of an expert such as the teacher or textbooks to produce and comprehend the L2) to ultimately becoming self-regulated (independent user

of the L2 who is able to rely on abstract rules of the L2 when producing and comprehending language) (p. 70)

Thus, with external assistance, a novice can be other-regulated and thus jointly produce an interpsychological activity within the zone of proximal development (ZPD), or the distance between what a person can do alone and what is made possible with external mediation (van Compernelle, 2015; Vygotsky, 1978). What is learned in social interactions is then (re-) organized and internalized within the individual and subsequently made available as a cognitive resource for the individual (i.e., self-regulated, intrapersonal functioning; Lantolf & Thorne, 2006; van Compernelle, 2015). More recently, however, SCT researchers have begun to conceive of other regulation as *co-regulation* to foreground the dialogic nature of mediation and ZPD as collaborative, more dynamic and contingent engagement rather than ascribing agency only to the expert and passiveness to the novice (Lantolf & Poehner, 2014; van Compernelle, 2015). Indeed, van Lier (1996) proposed an expanded notion of *multiple zones of proximal development*, in which learners as active agents can extend their self-regulated zones not only through experts' assistance but also by a wider range of resources that include equal and less capable peers as well as their own inner resources (pp. 193–194). Much of the existing SCT-related research in language learning examines *language* forms that learners encounter and develop or internalize. However, some SCT researchers have extended their research to the mediational and interactional roles of gestures/embodied actions in the context of L2 learning (McCafferty & Stam, 2008; McNeill, 2005; Smotrova & Lantolf, 2013; Stam, 2018) because “linguistic forms and gestures participate in a real-time dialectic during discourse, and thus propel and shape speech and thought as they occur moment to moment” (McNeill, 2005, p. 3). These expanded notions of learning and mediation (linguistic and embodied) require a broadened, holistic understanding of the relationship of the individual with the environment within which mediated action and learning take place. In response to the call, I will discuss van Lier's (2004) ecological approach in the following section.

2.2.3 van Lier's Ecological Approach

Thirdly, this study draws on van Lier's (2000, 2002, 2004) ecological perspective, which views social interaction and learning as semiotic, meaning-making activities situated in the

complex relations of the individual and the environment surrounding them (see also Steffensen & Kramsch, 2017).

The fundamental tenet of the ecological approach is that “the totality of meaning-making . . . is not merely linguistic; it is semiotic” (van Lier, 2000, p. 252). To be more specific, language is conceptualized as only a part of the whole meaning-making practice; it is only in conjunction with gestures, gaze, and other sociocultural artefacts that individuals negotiate, interpret, and achieve shared understanding of the meaning of the spoken/written words or expressions (van Lier, 2002, see also Wertsch, 1995). Thus, “language emerges as an embodied and situated activity” *in and with* an environment full of meaning-making potential (van Lier, 2000, 2002, p. 146). By extension, learning is viewed as an emergent phenomenon in which individuals as active agents perceive, pick up, and act upon physical or symbolic artefacts as they interact in and with their environment (Steffensen & Kramsch, 2017; van Lier, 2004). Here, “environment” means not just the immediate interactional context as well as the sociocultural, institutional, and interpersonal contexts; it also includes the wider disciplinary context (van Lier, 2004).

The relations between an actively engaged individual and their environments (micro-meso-macro) is captured by the ecological notion of *affordance* (van Lier, 2000, 2002, 2004). According to van Lier (2000), an affordance refers to

a particular property of the environment that is relevant—for good or for ill—to an active, perceiving organism in that environment. An affordance affords further action (but does not cause or trigger it) (p. 252).

In short, an affordance is something available to the person in the environment, which offers *action potential* as an individual interacts with the physical and social environment and later perceives it as useful or relevant to them (van Lier, 2004). Importantly, van Lier (2002) argued that social interaction is *triadic* in nature, for active participants’ interaction and joint attention is highly structured and mediated by the objects of the environment “as a third interlocutor” (p. 148). For this reason, the ecological perspective also places strong emphasis on linguistic as well as other meaning-making resources that include, but are not limited to, gestures, pictures, and other object and symbolic artifacts available in their environment (van Lier, 2000).

Therefore, the ecological perspective offers a theoretical lens through which to explore the complex and dynamic relationship between the students' language use and learning and the environment in its totality (van Lier, 2000).

2.2.4 Intersections between Vygotskian SCT, LS, and the Ecological Approach

In the preceding sections, I discussed how the three sociocultural theories are interrelated and offer complementary theoretical insights to the present study. Overall, these theories hold sociocultural orientations to learning or *participation* (Sfard, 1998, p. 6), which view learning as doing, becoming, belonging, and experiencing rather than merely acquiring or accumulating knowledge (see also Wenger, 1998). With regard to the common ground of the theories, Steffensen and Kramsch (2017) summarized four tenets shared by the ecological approach as well as LS/ADS and SCT:

1. the emergent nature of language learning and use;
2. the crucial role of affordances in the environment;
3. the mediating function of language in the educational enterprise; and
4. the historicity and subjectivity of the language learning experience, as well as its inherent conflictuality. (p. 17)

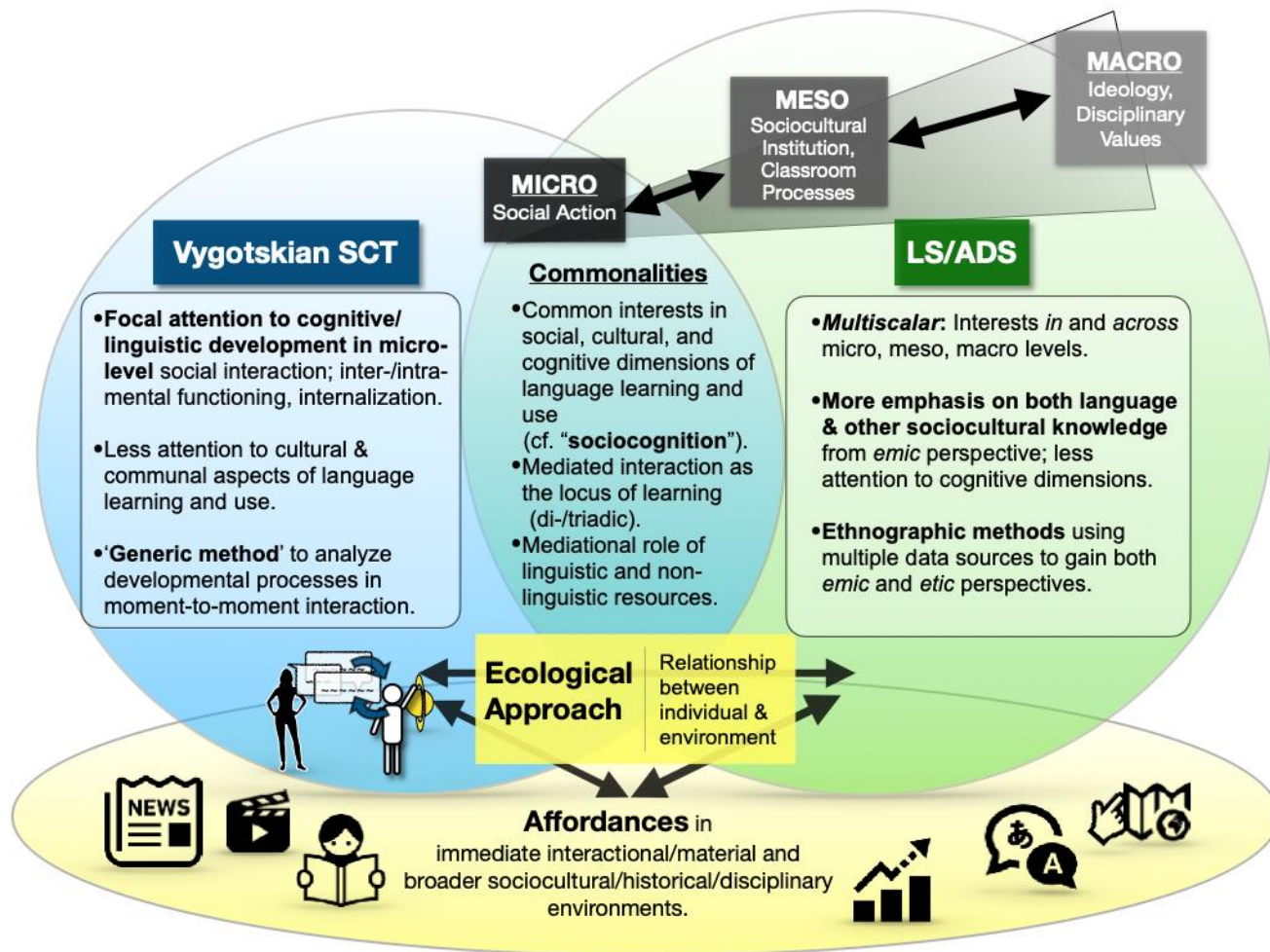


Figure 2.1 Interconnections between SCT, LS/ADS, and the ecological perspective

Figure 2.1 represents the interconnections between Vygotskian SCT, LS/ADS, and an ecological perspective with reference to a few key theoretical tenets of each framework, although it must be acknowledged that this visual representation is neither comprehensive nor representative of multiple timescales and spaces (physical/virtual) from which meaning potential can also emerge.

As Steffensen and Kramsch (2017) observed, these three sociocultural approaches respectively recognize the crucial role of affordances as key to individuals' participation in social interaction *in* and *with* the environment. Here, the affordances and social interaction are always seen as reciprocal and thus co-constitutive of each other: according to van Lier (2004), "affordances arise out of participation and use, and learning opportunities arise as a consequence of participation and use" (p. 92). Individuals, as active agents, learn as they participate in social

interaction, in which they perceive, pick up, act upon, and further create meaning-making/action potential (i.e., affordances) through their ongoing interaction *in* and *with* their environment and their interlocutor(s). For this reason, the learning and use of language is seen as emergent, contingent upon, and symbolically, materially, and bodily mediated by the immediate interactional context—and by extension the broader sociocultural and disciplinary environment—within which the interaction is embedded (Steffensen & Kramsch, 2017; van Lier, 1996, 2004).

While sharing some theoretical tenets and common research interests in social, cultural, and cognitive processes of language learning and use (i.e., *sociocognition*), Vygotskian SCT and LS/ADS, respectively, seek to understand different facets of multifaceted nature of sociocognition (Duff, 2007). Grounded in social psychology, Vygotskian SCT pays more attention to individuals' cognitive and linguistic development *in* and *through* micro-level social interaction mediated by material and symbolic tools (e.g., language). Learning, in the realm of SCT, first emerges from the *interpsychological* functioning between individuals and then gets appropriated and internalized as *intrapsychological* functioning within an individual (Lantolf & Thorne, 2006; van Compernelle, 2015). For this reason, SCT espouses microgenetic analysis, or the analysis of scaffolded/co-regulated moment-to-moment interaction to capture the activity of "individual-operating-with-mediational-means" and their development in-flight (Lantolf & Thorne, 2006; van Compernelle, 2015; Wertsch, 1995, p. 64).

Rooted primarily in linguistic anthropology, on the other hand, LS/ADS is more concerned with novices' negotiation and (ultimately) mastery of language and other forms of knowledge (e.g., ideologies, identities, affects, stance) and cultural practice from an *emic* and *etic* perspective (Duff, 2007; Duff & Talmy, 2011). Here, because of its broader research foci, LS/ADS research extends beyond analyses of micro-level social interactions, which are of primary interest to SCT researchers (Duff, 2007). LS/ADS also takes into account (to a greater extent) meso-level phenomena (e.g., identities, agency, power relations in particular sociocultural, educational, and institutional settings) and macro-level phenomena (e.g., society-wide ideological structures or particular disciplinary norms and values), all of which are mutually influencing and thus co-constitutive of each other (Douglas Fir Group, 2016). In other words, LS/ADS allow for within- or multiscale analyses of individuals' sociocultural experiences and norms and practices of the researched community from a variety of disciplinary

and theoretical vantage points (Duff, 2019). Methodologically, LS/ADS research typically takes an ethnographic design and uses multiple data sources in order to gain a holistic, in-depth, and participant-informed understanding of the researched community and their worldviews (Duff & Talmy, 2011), often illustrating the practices through multiple case studies.

To sum up, LS/ADS, Vygotskian SCT, and van Lier's ecological perspective respectively locate mediated, contextualized interaction at the heart of sociocultural theorizing as the locus of language use, hence the emergence of development and learning (Duff, 2007; Wertsch, 1995; van Lier, 2000). Whilst an LS/ADS approach places more emphasis on individuals' experiences in and communal aspects of learning language and sociocultural knowledge from an ethnographic standpoint, a Vygotskian SCT takes into account individuals' *inter-* and *intrapyschological* development of language and cognitive functioning by focusing on microgenetic, moment-to-moment interaction (Duff, 2007; Lantolf & Thorne, 2006; van Compernelle, 2015; Vygotsky, 1978). van Lier's (2004) ecological approach offers useful theoretical insights into the dynamic relationship of the agent with their interlocutor and the affordances offered by the environment. The *environment* here can involve not only the immediate, interactional/material environment, but also the broader sociocultural/institutional/classroom environment as well as the wider ideological and disciplinary environment (DFG, 2016; van Lier, 2004). Thus, these theoretical perspectives go hand in hand with each other in offering a holistic and in-depth understanding of the focal phenomenon under investigation through contextually well-grounded within- and cross-scalar analyses.

2.3 Academic Discourse Socialization into the Academic Presentation: Characteristics, Challenges, and Pedagogic Affordances

In what follows, I review extant socioculturally informed ADS research that investigated the socially and temporally situated, dynamic processes of negotiation and learning in and through APs (Duff & Kobayashi, 2010; Kobayashi, 2003, 2016; Kobayashi et al., 2017; Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). Characterized by Morita (2004) as process-oriented research, those studies have provided in-depth, contextually well-grounded documentation of students' experience from their own *emic* perspectives by adopting qualitative and/or

ethnographic research methods (Morita & Kobayashi, 2008; Morita, 2000). This means that process-oriented ADS researchers generally immerse themselves in their research sites for a substantial amount of time to collect/generate and triangulate different kinds of observational and/or participant-informed data to provide a credible account of their interpretations (Duff, 2006). This section provides an overview of the recent scholarship on this line of process-oriented academic presentation (AP) research, by reviewing some of the research findings that highlighted the characteristics of in-class APs, challenges faced by students, and affordances of APs.

2.3.1 Characteristics of the Academic Presentations as a Locally Situated Practice

Firstly, I review previous research findings by paying special attention to characteristics of APs in relation to disciplinary values and practices promoted in different higher education contexts (Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). This is important because process-oriented studies seek to explore the interrelationship between the text (i.e., APs) and contexts in which the text is socially and culturally produced (Morton, 2009).

Employing ethnographic methods, which commonly include sustained classroom observations, interviews with students and instructors, and the collection of relevant documents, Morita (2000), Yang (2010), and Zappa-Hollman (2007) respectively provided the AP characteristics of the classroom(s) in which they conducted research, involving seven different university courses in six different disciplines at Canadian universities. Two of the three studies were conducted in graduate-level courses (Morita, 2000; Zappa-Hollman, 2007) whereas the remaining study (Yang, 2010) took place in an undergraduate course. Collectively, these research findings show clearly that APs were structured rather uniquely in each of the classroom contexts. At a descriptive level, for example, the number of presenters and time allotment show great divergence among the seven researched courses: while the number of presenters per AP ranged from 2 to 5, the lengths of presentations also varied from 7 to 100 minutes (Yang, 2010; Zappa-Hollman, 2007). Shedding further light on more tacit norms and practices, Zappa-Hollman's cross-disciplinary comparison revealed that whereas valued APs features in social science (i.e., history and anthropology) could be characterised by making personal interpretations of the presented research articles and expressing openness to audience feedback (see also Morita, 2000 for a similar finding), biochemistry and neuroscience students were expected to be highly

meticulous and precise as well as critical about the research findings and methodologies in their AP performance. In a similar vein, Morita's (2000) within-disciplinary comparison of AP features in two graduate-level TESL courses revealed that different task preconditions (i.e., whether the presented articles had been shared with the audience) served different pedagogic purposes and influenced the way in which their APs were organized in the two respective courses.

In sum, these findings suggest that doing an effective AP involves not only the mastery of appropriate linguistic skills and the production of the expected structure of the genre, but students also need to become aware of, identify, and eventually negotiate each instructor's expectations in their respective AP contexts. In other words, students need to have a clear understanding of task requirements and preconditions specific to each AP task and of the values and norms promoted in each local context and in the broader institutional and disciplinary communities (Morita, 2000; Morton, 2009; Zappa-Hollman, 2007). Undoubtedly, this underlying and often unexplained complexity can pose a great challenge to students regardless of their linguistic and sociocultural background. The next section sheds light on AP challenges faced by students.

2.3.2 Challenges of Academic Presentations Experienced by Students

As previously discussed, the demand of navigating the complex web of linguistic, sociocultural, and broader disciplinary expectations can be very challenging (and perplexing) for students, especially those from different linguistic and cultural academic contexts (Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). In her study, Morita (2000) identified three major interrelated factors that could influence students' engagement in APs: linguistic, sociocultural, and psychological factors.

For students who present using an additional language, their (perceived) language abilities and limitations were often the biggest challenge (Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). For instance, Morita (2000) and Zappa-Hollman (2007) reported that their graduate-level participants expressed their concerns about limitations in their linguistic abilities (e.g., pronunciation, grammar, and vocabulary) to fully communicate and elaborate on their complex ideas in nuanced ways. While some studies have shown that students were able to compensate for such limited language abilities through the use of particular delivery strategies

(Morita, 2000; Zappa-Hollman, 2007), Yang (2010) reported a rather contrastive case, wherein students' strategy use negatively impacted their in-class AP experiences and their instructor's evaluation. Yang's study investigated a group of five L1-Chinese students' AP engagement in an undergraduate commerce course at a Canadian university. She found that while audience involvement was highly valued by the course instructor, in their attempt to avoid extemporaneous talk in English, the L1-Chinese students strategically restricted the type and degree of presenter-audience interactions. Those strategies included choosing to merely display their knowledge and ask only closed-ended (i.e., yes-no) questions. Even though the students' strategy helped compensate for their limited linguistic ability, this was at odds with the task requirements of the course AP to generate and facilitate discussions. As a result, the students failed to fully meet the course instructor's expectations. Importantly, their strategic decision was not solely motivated by their linguistic limitations; their prior experiences and knowledge of valued APs affected their decisions and subsequent discrepancies with the instructor's expectations.

In combination with linguistic challenges, sociocultural differences add another layer of complexity and difficulty to presenters—especially L2 presenters. Collective research findings suggest that these sociocultural differences exist not only at macro societal level but also at institutional or classroom levels (Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). At the macro level, Zappa-Hollman's (2007) Chinese graduate students reported a clear sociocultural discrepancy between values associated with scripted and unscripted speech. More specifically, whereas these students believed scripted presentations to be more formal and authoritative, their belief was at odds with the AP practices promoted in the Canadian graduate classroom, which embraced more unscripted and conversational interactions. This gap, which is essentially linked to the necessity of high linguistic command to achieve extemporaneous talk, resulted in Chinese students' strong sense of unpreparedness, placing them in a disadvantaged position in their respective classroom AP contexts (see also Morita, 2000). At the institutional/classroom level, Yang's (2010) Chinese undergraduate students experienced consequential gaps of valued AP features between two different English-speaking contexts. While knowledge transmission was a legitimate form of AP in their former ESL classroom, mere knowledge display did not meet the instructor's expectation in their current disciplinary course. They were expected to more actively stimulate audience participation to generate class discussions throughout the presentation. As a

result, the Chinese students unknowingly diverged from the task requirements and later became aware of the gap between the AP features favoured in the past and current contexts.

Third, Morita (2000), Yang (2010) and Zappa-Hollman (2007) reported that the great majority of their students faced psychological challenges during their APs regardless of their linguistic, cultural, and academic background. Their overall findings indicated that their psychological challenges stemmed from: a lack of confidence in content knowledge and speaking in public, the perceived need to portray themselves as “smart” and expert/legitimate speakers about their topic, and fear of being critically judged by their peers and instructors (Morita, 2000; Zappa-Hollman, 2007, p. 471). Importantly, as Morita (2000) insightfully observed, the psychological difficulty was influenced and magnified by other linguistic and sociocultural challenges, especially for students for whom English was an additional language.

Taken together, research has shown that APs can inevitably pose linguistic, sociocultural and psychological challenges for students, especially for those from different educational backgrounds. Importantly, ADS research has indicated that these linguistic, sociocultural, and psychological factors were mutually influencing and interwoven, and thus often amplified challenges for students.

2.3.3 The Academic Presentation as a Locus of Learning: Pedagogical Affordances

As discussed above, while APs can pose a great challenge to students, research has shown that students gradually came to better understand AP practices valued in their community as they prepared for, observed, and performed APs over time (Duff & Kobayashi, 2010; Kobayashi, 2003, 2016; Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). Indeed, Yang (2010) noted that many AP groups who performed *after* the focal group attempted to more actively stimulate audience participation to generate class discussions. Likewise, graduate students in Morita’s (2000) study reported the benefit of observing peer performance and instructors’ regular oral practices to inform the planning of subsequent APs. While some ADS studies described the processes and learning affordances involved in the achievement of classroom AP tasks (i.e., negotiating instructors’ expectations, observing others often facing challenges, and employing coping strategies), very few studies have provided in-depth accounts of students’ actual discursive co-construction of such learning opportunities and processes as well as of individual students’ long-term learning trajectories across time and space.

These research gaps were addressed by Duff and Kobayashi (2010), based on Kobayashi's (2003, 2016) ethnographic studies of out-of-class and in-class engagement with APs by groups of Japanese undergraduate students studying at a Canadian university. Collectively, these studies documented students' behind-the-scenes negotiation and co-constructions of their mutual understanding of task requirements, the content and language of their PPT slides, and delivery strategies enhanced by peer-coaching. Kobayashi (2003) reported that a group of Japanese students jointly developed their ideas of the valued and expected form of the course AP through their discussion of the task instructions. They actively linked the written task requirements with a variety of resources that included their observations of others' AP performance (i.e., their peers, instructors, TA) and one student's previous experience performing comic stage dialogues. Kobayashi (2003) (see also Duff & Kobayashi, 2010) also witnessed students' active language learning and peer socialization through their engagement with the written language of their PowerPoint slides and peer coaching in their out-of-class rehearsal (i.e., audience-friendly, and often humorous grammatical, lexical, and pragmatic choices). Their AP rehearsal, in turn, afforded a group of students the opportunity to notice linguistic and cultural knowledge gaps. In short, Duff and Kobayashi (2010) and Kobayashi (2003) offered useful insights into learning affordances made available by students' out-of-class and in-class collaborative engagement *within* a single group AP project.

In his more recent study, Kobayashi (2016) traced one female Japanese student's year-long learning trajectory *across* three different AP projects in Canadian content-based L2 classes (one poster and two PPT-type presentations). His ethnographic research showed that she underwent a significant transformation in her understanding and performance of valued forms of APs over time. More specifically, her AP strategies changed from script delivery (task 1; reading from her written script at hand), to a combination of memorized recitation and script delivery (task 2; reciting a memorized written text in combination with occasional script delivery), and eventually to a more spontaneous, audience-oriented presentation (task 3; a combination of spontaneous talk and reading her PPT slides without any written script). Importantly, the student's differing task orientations and strategy use were mediated by her cumulative and *on-site* observation of her peers' and instructors' AP performances as well as her own (un)satisfactory experiences in AP performances. For example, she intentionally chose to use direct quotation from the reading material (as opposed to paraphrasing) based on her observation

of the course instructor's regular oral academic reference practice. This choice reveals the dynamic relationship between individual students' oral practices at a micro-interactional level, the meso-level processes in the course more generally, and potentially the broader disciplinary practices at a macro-level (Duff, 2019).

2.3.4 Summary of the Literature Review

Based on university classroom practices, past process-oriented studies have uncovered the complexity underlying students' successful engagement and socialization in APs, which involved dynamic and ongoing negotiations of valued ways of presenting according to the local, institutional, and broader disciplinary norms and practices specifically fostered in each AP context (Duff & Anderson, 2015). Linguistic, sociocultural, psychological factors are tightly interwoven and thus can pose a great challenge for students. While out-of-class AP preparations can provide meaningful affordances for their learning of both linguistic and non-linguistic content through peer collaboration (Duff & Kobayashi, 2010; Kobayashi, 2003), these opportunities may or may not be taken up by students, or in turn, may result in a consequential divergence from the AP forms that are expected (Yang, 2010; Zappa-Hollman, 2007). Those studies also demonstrated that, as active agents, students constantly navigated the complex web of intertextual ties that linked their own previous experiences, their instructors' regular academic practices, and their own prior knowledge to inform their immediate AP performance and hence long-term ADS.

2.4 Summary of the Chapter

This chapter introduced language socialization and academic discourse socialization, Vygotskian sociocultural theory, and an ecological perspective to situate the present study in the relevant theoretical literature. The relationship among the three theories was also discussed to delineate the complementarity perspectives. The chapter also reviewed the relevant literature exploring the nature of academic presentations. ADS research to date has, in sum, underscored the complex and dynamic nature of novices' engagement and socialization in APs, which involved ongoing negotiations of locally and disciplinarily valued ways of presenting knowledge.

Chapter 3: Research Methodology

3.1 Introduction

As shown in Chapter 2, research has demonstrated that expectations and requirements associated with presentations (traditional academic presentations as well as poster presentations) are highly context-specific and locally determined in relation to the broader disciplinary norms, values, and practices (Morita, 2000; Yang, 2010; Zappa-Hollman, 2007). Given the importance of taking account of the local classroom and broader disciplinary contexts, in this study I employed an ethnographic multiple-case study design in order to gain a contextually well-grounded understanding of multimodal practices that were promoted and given disciplinary value in a geoscience classroom, in general, and in the poster presentation within that classroom context, in particular. In this chapter, I first provide a detailed methodological description of the ethnographic multiple-case study. I then offer brief descriptions of the research site and focal participants. I proceed to discuss how I generated and analyzed the data. At the end of the chapter, I discuss trustworthiness and ethical considerations of this research.

3.2 An Ethnographic Multiple-Case Study Approach

According to Duff (2020), the primary objectives of case study research in applied linguistics is to “[make] visible some of the complex dimensions of people’s language-related and social engagement in events” (p. 144). Merriam and Tisdell (2016) explain that case study research is particularly useful in exploring a phenomenon which is inseparable from its social context and that this can be achieved through an in-depth description and analysis of a small number of “bounded” phenomenon in question—or a *case*. While any kind of macro and micro phenomenon being studied can be regarded as a case (Duff, 2008; Merriam & Tisdell, 2016), the phenomenon of interest of this particular study is multimodal ADS and multimodal practices that were instantiated in a university geoscience classroom. The course was therefore the case, and multimodality the phenomenon of interest. Then, several students were selected from this larger case as focal participants (i.e., cases), who performed group poster presentations. Thus, the present study presents what Duff (2014) calls a “nesting of cases” (p. 236), wherein the phenomenon in question is studied in human cases (i.e., undergraduate students’ enactment and perceptions of poster presentations), who are embedded in a larger classroom context, which is

further nested—and also constitutive of—a larger disciplinary context (geoscience). As is typical in ADS research (see Chapter 2), I employed a multiple-case study design because it “offer[s] the researcher an even deeper understanding of the processes and outcomes” and enables researchers to identify similarities and variations amongst cases (Miles, Huberman, & Saldaña, 2019, p. 29; see also Duff, 2014).

This study also makes use of an ethnographic approach in order to offer descriptions and analyses of broader disciplinary and local classroom contexts and well-grounded micro analysis of students’ poster presentation performance. According to Li (2020), ethnographic research refers to the study of:

someone’s observation of and experience with a community and their cultural practices in specific contexts. It usually is aimed at offering “a ‘thick’ description and interpretation of what is happening in the community at a particular time and space (p. 154)

Although the distinction between case study and ethnographic (case study) research is often unclear, Duff (2014) notes that ethnographic research offers a particular focus on and insights into “sociocultural meanings and practices” of a particular community, and especially as they unfold over time (p. 250; see also McKay, 2006). In other words, ethnographic research requires obtaining an *emic* (or cultural insider’s) perspective to provide participant-informed, rich, contextualized thick descriptions of the phenomenon being studied, as well as the researcher’s (etic) perspectives and analysis (Merriam & Tisdell, 2016; Li, 2020). This can be achieved through the researcher’s immersion in the community under investigation, in which the researcher talks to and sometimes interviews people, participates in, observes, and takes notes of social practices, and collects cultural artefact, among many other means (Copland & Creese, 2015). Although ethnographic research is often sustained over half a year to a year or two, in this case the research took place over one semester (four months), from the beginning to the end the course.

3.3 Research Site and Context

This study was undertaken in the Fall semester of academic year 2019 in an undergraduate Earth and Planetary Science course (henceforth EPS 251, a pseudonym) within

the Department of Earth Science (DES) at a western Canadian university which I have called Coastal Mountain University (CMU). As one of Canada's largest research-intensive universities, CMU comprises a total of nearly 40 faculties, schools, and colleges that offer over 180 undergraduate and 250 research-based graduate programs. CMU is home to a total of approximately 50,000 undergraduate and graduate students, both local and international.

DES offers a broad spectrum of advanced educational and research experiences in areas pertaining to earth and marine sciences. The department's undergraduate programs involve several specializations: science programs related to atmosphere, geology, ocean, geological engineering, and geophysics, among many others. In addition, DES works with a broad range of academics within CMU and off-campus partners in industry to realize its mission: to address complex real-world earth science issues (e.g., climate change). In fact, the department website indicates that DES holds a joint program with almost all CMU's science departments and collaborates with other units.

For the duration of the study, I observed one DES second-year course, EPS 251. Unlike other first- and second-year DES courses whose primary foci are memorization of the disciplinary knowledge and/or advanced mathematics (according to focal participants and the instructor), EPS 251 was designed to nurture students' academic skills (academic writing, reading, presenting) and critical thinking skills that are necessary to address complex issues related to earth and planetary sciences. EPS 251 was selected as the focal research site based on the following pre-established criteria: (a) the course is offered at CMU; (b) the course involves a poster presentation activity as one of its course assignments; and (c) the course instructor and the majority of the students consent to my regular classroom observations and video and audio-recording of their poster presentations. Further details about the course are provided in Chapter 4.

3.4 Participants

For this classroom-based ethnographic multiple case study, I recruited several participants, including the instructor, students, and teaching assistants in EPS 251.

3.4.1 Course Selection and Participant Recruitment

I became acquainted with Robert, the instructor, after attending a public poster session the previous academic term, in which he and many other instructors and students showcased their work. When I described my interest in the ways in which language and content are integrated in particular disciplinary fields, combined with my interest in academic discourse socialization (and specifically poster presentations), multimodality, and the experiences of international students who speak languages other than English in mainstream coursework, Robert expressed his willingness to allow me to conduct research in his course the following semester. Initially, I had planned to focus primarily on international (multilingual) students' experiences in the course but in the end, in order not to categorize students in this manner which might be perceived to be stigmatizing, I opened recruitment up to any and all interested students. Nevertheless, I was motivated by a desire to understand how undergraduate students in this field, including international students, come to know how to think, observe, interpret, speak, and represent knowledge like experts in that field (i.e., geoscientists). In addition, I wanted to see how poster presentations were used in this context as part of students' ADS.

Prior to formal recruitment, I contacted Robert, who confirmed he would use posters as one of his course assignments and would welcome me to conduct research in his course. I explained my intention to conduct research on students' multimodal practices in poster presentations as well as the ADS practices that took place in his class (see Appendix A). Robert suggested that I make informal visits to his class first to familiarize myself with the course content and classroom activities. In the meantime, I obtained official ethics approval from the university to conduct the research. At that point, I formally introduced myself to the class and gave a short presentation about the purposes and procedures of the study and distributed Informed Consent Forms to each EPS 251 student, the instructor, and the teaching assistants (see Appendices B, C, D). These were signed and then returned to me the following class. Because this research project involved multiple data generation methods that included video- and audio-recordings and interviews (with poster presenters and viewers), I classified the students into three participation statuses according to their individual responses to the consent form (see Table 3.1). Those who gave full permission for all aspects of the research became the focal participants, and those who did not consent to any of the research activity (especially the video-recording as viewers) were classified as non-participants. Others were classified as non-focal participants.

Table 3.1 Classification of student participation status

	N (36)	Video + audio recording as presenters	Video + audio recording as viewers	Interviews	Collection of documents (e.g., poster)
Focal	11	Yes	Yes	Yes	Yes
Non-focal	16	Yes	Yes	No	Yes
		No	Yes	Yes/No	Yes
Non- participants	9	No	No	No	No

In the end, a total of 11 students consented to all aspects of the research process, while the other 25 students were classified into non-focal participant (16 students) or non-participant (9 students) categories. In careful consideration of the 11 students' responsiveness to my follow-up emails and the participation status of their poster presentation partner(s), I narrowed down the number to six. Accordingly, I videotaped six pair/groups' poster presentations and interviewed six individual participants. In the end, for this thesis I selected four students, who constituted two poster presentation pairs, as the focal cases of this study (Emma and Leah; Jack and Rachel). I selected the four students (two pairs) because they were the only ones who consented to all aspects of the research procedure as pairs. They also exhibited tremendous resourcefulness and openness to the study. The biographical information of each focal participant is provided in Section 3.4.3.

3.4.2 The Instructor: Robert

Robert was a Canadian instructor who had extensive teaching experience in postsecondary institutions as a geoscience education expert. He started his teaching career in the early 2000s and had approximately 15 years of teaching experience at the time of this study. Prior to coming to CMU, Robert had taught geology at a western Canadian college, in which he attended and eventually led a number of education training programs, such as instructional skills workshops. He then joined CMU as a geoscience education specialist to become part of a long-term project aimed at improving undergraduate science education in collaboration with other

faculty members within DES. Thus, his job as a geoscience education expert centred primarily around supporting other faculty members in their planning and teaching of undergraduate courses as well as teaching his own geoscience classes. Outside DES, he was also committed to a first-year pathway program for international students for whom English is an additional language. I first met him in the end-of-year conference in the pathway program. Robert also regularly worked closely with international students to support their science learning (and their learning of English as a medium of instruction) for their successful transition into the second year of a science degree program. However, that important aspect of his work with international students was not the central focus of this study. His enthusiasm and openness to participate in this research to assist me with my thesis research and help others understand ADS in his field was clear evidence of his commitment to both international and domestic students at the university and to knowledge mobilization across disciplines.

As a geoscience education specialist, Robert told me in an interview that he focused more on the process of scientific thinking and learning than mere memorization of content. In fact, he always encouraged his students to try things out and become comfortable making “mistakes” for the sake of their learning (see Chapter 4, Section 4.2.2.3, for further discussion). To create an environment for students to make healthy mistakes, Robert explained that establishing mutual trust with students and being seen by them as non-threatening was a crucial aspect of his teaching. Indeed, his students described Robert’s personality and expertise using such adjectives as “humorous,” “kind,” “knowledgeable,” “helpful,” “approachable,” and “compassionate.” The 2019–20 academic year was the first time he had taught EPS 251, which he took over from an instructor who was on study leave and whose course materials he adapted.

3.4.3 Focal Students

As I mentioned earlier, there were four focal participants in this study, who paired up and formed two focal poster presentation pairs. The four students were selected after multiple phases of communication regarding case selection (e.g., filling out the consent form to become focal participants, responding to my emails in a timely manner, allowing me to video-record their presentations, coming to interviews). As I discuss later, all four focal participants were described by Robert using such adjectives as “keen” and “high-achieving.” Indeed, I found out in formal and informal conversations with them that some of them were highly interested in pursuing a

graduate study after their undergraduate degree. Thus, it would be reasonable to say that the four focal participants were exceptionally invested not only in the coursework but also my research project, representing exemplary and information-rich cases of learners in EPS 251. In addition, they were already very comfortable working together in pairs with each other based on past collaborations, which was not the case with all participants. Table 3.2 summarizes the focal students' profiles. Two of the students (Emma and Leah) were Canadian Anglophones majoring in geophysics. The other two (Jack and Rachel) were international students from China who were bilingual in Mandarin and English. The latter were both earth science majors who had taken Robert's course in the pathway program for international students the previous year. In what follows, I also offer brief biographies for each of them.

Table 3.2 Summary of focal students' biographies

Pseudonym	Gender	Nationality	Language	Major (other background)	Additional information ¹
Emma	Female	Canada	English	Geophysics (Taking an Astronomy course)	- Actively participated in class activities - Took a first-year integrated science program with Leah
Leah	Female	Canada	English	Geophysics (Previously worked in a genetics lab)	- Actively participated in class activities - Took a first-year integrated science program with Emma
Jack	Male	China	Mandarin English	Earth science (Former Chemistry major)	- Actively participated in class activities - Robert's former student in a first-year pathway program
Rachel	Female	China	Mandarin English	Earth science (Former Chemistry major)	- Actively participated in class activities - Robert's former student in a first-year pathway program

¹ Focal participants' biographic information was gathered in combination of my classroom observations and interviews with each of the focal participants.

3.4.3.1 Emma

Emma was a second-year female student from a large eastern Canadian city. After completing a first-year integrated science program that synthesized biology, chemistry, physics, and math, she selected geophysics as her major subject of her undergraduate program. Alongside EPS 251 and her other geophysics-major courses, she was taking an astronomy course. Indeed, in an interview with me, she expressed her interest in minoring in astronomy in the future. Thus, she had some disciplinary knowledge in both geophysics and planetary sciences.

Emma had met and befriended Leah in the first-year integrated science program. The closeness of their friendship was evident in my observation that they would always sit next to each other in class, pair up for various group activities and demonstrate seamless collaborative explanations in their poster presentations. My regular classroom observations also suggested that they might have been perceived as relative experts amongst their EPS 251 peers. For example, in a group project using a specialized software called MATLAB (11/01/2019), Emma was often spoken to by her peers in different groups and asked for assistance.

She was also a keen contributor to class discussions and activities. In fact, Robert disclosed to me in his interview that Emma had contributed one photographic image as material for a recurrent icebreaker classroom activity called “*observations and interpretations*” (see Section 4.2.3). Having seen her behind-the-scenes and in-class contributions, Robert described Emma as “keen,” “high-achieving,” and “very, very accomplished.”

Prior to EPS 251, she had experienced several poster presentations in high school and at CMU in different subject areas (e.g., English, history, physics). This was her first poster presentation in the context of geoscience.

3.4.3.2 Leah

Also described by Robert as keen, high-achieving, and accomplished, Leah was a second-year female student from a city in central Canada. As I explained earlier, Leah had been a good friend of Emma’s since her first year in the integrated science program. After her first year, like Emma, Leah decided to major in geophysics. In an interview with me, Leah expressed the breadth of her academic interests and told me that the integrated science program motivated her

to study at CMU because of her belief that it would offer a broad range of learning opportunities in different science areas. Previously, Leah had worked in a genetics lab and gained some disciplinary knowledge and skills related to biology and medicine. Therefore, Leah had some prior disciplinary knowledge in geophysics, biology, and medicine.

My classroom observations, coupled with data from my interview with Robert, suggested that Leah was one of the most vocal, convivial, and active students in EPS 251. Indeed, Leah was often the very first to respond to Robert's discussion questions addressed to the whole class, even if they were cognitively challenging. In her interview with me, Leah also expressed her preference for active participation in spoken activities over receptive listening and note-taking in class. Like Emma, her EPS 251 peers often asked Leah for help with their in-class tasks, which suggests that she was also viewed as a relative expert by her peers. Leah also had some previous experiences giving poster presentations in different subject areas, but it was also the first geoscience poster presentation for her.

3.4.3.3 Jack

Jack was a third-year student from a large city in central China who was classified as an international student. After completing his English-medium high school program in his Chinese hometown, Jack moved to Canada to pursue his postsecondary education. His first year was in the pathway program at CMU, after which he entered the second year of his science degree program. After the pathway program, he had initially majored in chemistry in his second year, but eventually switched to a major in geology in the middle of that year. In his interview with me, he described his decision to change majors very positively and indeed expressed his interest in pursuing graduate studies in geoscience after graduation. In short, his disciplinary background encompassed chemistry and geoscience.

Jack had met both Robert and Rachel in the pathway first-year program. As his first-year disciplinary instructor, Robert explained to me that he had witnessed Jack's significant personal transformation from a student who had refused to work with others to one of the "keenest" students to contribute to class activities and work in groups (Robert, Interview, 01/24/2020). Indeed, Jack often told me about the value of collaborating with and learning from others for his intellectual development. Jack had a very close relationship with Rachel, and according to Robert, they had always sat next to each other and actively participated in their shared first-year

classes. As a researcher, I also observed them sitting side by side and actively engaged in class activities in EPS 251. Although he had previously experienced giving PowerPoint presentations, it was Jack's first poster presentation.

3.4.3.4 Rachel

Following a very similar postsecondary educational trajectory to Jack's, Rachel was a third-year student from China who was also classified by the institution as an international student. Unlike Jack, Rachel had moved to Canada in her second year of high school and completed her secondary education at a local Canadian school. She then studied for a year in the pathway program at CMU and successfully transitioned into a degree program in her second year. Similar to Jack, Rachel had initially majored in chemistry, but she changed her specialization to geology in her second year. In her interview with me, Rachel described Robert's first-year course as very impressive and enjoyable, expressing her appreciation for skills and knowledge she learned in the pathway program (especially academic writing and critical thinking skills). In this sense, Robert had greatly influenced both Jack's and Rachel's academic trajectories.

My classroom observations suggested that Rachel was normally a quiet and calm student who would nevertheless often make important oral contributions to class activities in EPS 251. Sitting side by side with Jack, Rachel most often worked with Jack but was also willing to work others as well. In her interview with me, she described teamwork as one of the most valuable lessons learned through the course. For her, talking to someone she hadn't worked with before and learning their ideas was an important aspect of learning. Like Jack, Rachel was also described by Robert as "high-achieving" and "excellent." While she had previously presented a research-based poster in the end-of-year conference in the pathway program, her first geoscience poster presentation was in this course.

3.4.4 Teaching Assistants

Although not involved in this study as focal participants, there were two teaching assistants (TAs) in EPS 251 who consented to participate in the study, Michelle and Lily. Both were second-year master's students in the department. Their primary job within the class time

was to assist students in their group activities by responding to questions related to disciplinary knowledge. For the poster presentation project, they also actively helped students to navigate a wide range of data sources (e.g., from NASA) and figure out possible research questions their students could explore in their posters. Outside of class, they provided grades and written feedback on submitted written assignments.

In addition to their general TA duties, Michelle and Lily helped me a great deal to gain background disciplinary knowledge about earth and planetary sciences. Indeed, it was because of their help that I was able to develop a clearer idea of the disciplinary importance of *scales* in geoscience (see Chapter 4, Section 4.2.3.2). Although they were important informants to me, I did not include them as focal participants for this study because: (a) they did not attend the end-of-term poster presentation session and (b) they were not available for formal interviews. Even so, their expert perspectives helped me sharpen the observational and analytic foci of my research activities in the unfamiliar context of earth and planetary sciences. I kept detailed notes of my informal conversations with Michelle and Lily and their classroom behaviours as TAs. In short, as near-peer geoscience experts, they played an important role in socializing *me* as an applied linguistics researcher into the geoscience classroom and discipline, a theme I return to in my concluding chapter.

3.5 Data Generation

In line with most ethnographic case study research, I made use of a number of different data sources. Those included three months of regular classroom observations and fieldnotes, in-depth semi-structured interviews and informal conversations with focal students and the course instructor, video- and audio-recordings of students' poster presentations, and course documents and student-generated artefacts, and my frequent visits to the department-affiliated geoscience museum. The study generated a total of 128 pages of typed-up fieldnotes, seven hours of audio-recorded interviews and 12 hours of audio- and video-recorded data from students' presentations, and many instructor- and student-produced artefacts. In what follows, I will provide detailed explanations of each of the data generation approaches.

3.5.1 Classroom Observations and Fieldnotes

As discussed at the beginning of this chapter, one of the most important objectives of an ethnographic case study is to better understand a given phenomenon and sociocultural meanings of particular naturally occurring actions and events from an *emic* or cultural insider's perspective (Duff, 2008; McKay, 2006). Participant observation is one of the major methodological approaches to obtaining an in-depth understanding of “the physical, social/cultural, and linguistic contexts in which language is used” (Duff, 2008, p. 138). McKay (2006) also suggests that sustained participant observation not only helps to attain an emic perspective, but also a *holistic* view of the people and a particular context under investigation. Copland and Creese (2015) describe the nature of observation in an ethnographic approach as more open-ended (in contrast to more fixed, protocol-driven studies) and systematic in that *what* and *how* to observe is—overtly or covertly—guided by one's theoretical orientations and research questions. For this reason, Duff (2008) states:

it is important to understand the sorts of information or evidence that are relevant and important to one's analysis before undertaking it. . . . [O]ne begins with larger fields of observation and then narrows things down over time, focusing to a greater extent on the cases in question (p. 139).

A key aspect of ethnographic participant observations is the use of fieldnotes (Copland & Creese, 2015). Curdt-Christiansen (2020) describes fieldnotes as a way to “connect the dots of scattered events and incidents to make a holistic view of the researched site, community or individuals” (p. 343). With regard to what to write in fieldnotes, Merriam and Tisdell (2016) provide a comprehensive list of observational content and guiding questions to, which include: *the physical setting, the participants, activities and interactions, conversations, subtle factors, and [the researcher's] own behaviour* (p. 141, italics original). Copland (2018) cautions observers about their linguistic choices in writing fieldnotes. Specifically, she advises avoiding the use of opinionated words in fieldnotes in an attempt to describe observed phenomena *neutrally*. In addition to descriptive observations and fieldnotes, Copland and Creese (2015) and Curdt-Christiansen (2020) emphasize the importance of including their interpretations and reflections in their fieldnotes, such as researchers' feelings, values, beliefs, and concerns.

I observed all EPS 251 classes for 13 weeks (30 class meetings) with the permission of Robert and his students. The purpose of the classroom observations was: (1) to gain a contextual understanding of the classroom and broader discipline of earth and planetary sciences in which multimodal academic discourse socialization and the poster presentation task took place and (2) to observe and examine some of the important multimodal disciplinary practices fostered in the geoscience classroom. During my classroom observations, I generally quietly watched, listened to, and took notes of the physical settings, participants, their activities and interactions before, during, and after the class. In other words, my role was *observer as participant*, whose presence and observer activities were known to the group in ESP 251 (Merriam & Tisdell, 2016). This role enabled me to observe and take notes of a wide range of in-class events as well as my immediate reactions, questions, and interpretations in the classroom. In my fieldnotes, I carefully separated my own observations, on the one hand, and my own interpretive and reflective thoughts and questions, on the other hand (which, it turns out, was a fundamental distinction made in Robert's geoscience teaching). Initial fieldnotes were mostly handwritten, and I typed them up in a Word document immediately after each observation. I also took photos of myself to reproduce and keep notes of embodied actions produced by students and the instructor in class. Although ethnographic case study research captures emic perspectives, geoscience was an unfamiliar field to me, as an applied linguist. Therefore, my perspectives and analyses provide an etic view but one that was also being transformed as I was gradually being socialized into this course and discipline through my observations and discussions with participants and various texts.

3.5.2 Interviews and Informal Conversations with the Instructor and Students

In order to obtain a participant-informed understanding of the disciplinary and classroom norms and practices, I also conducted semi-structured interviews with the instructor and focal participants who consented to be interviewed. According to Duff (2008), interviews are useful in ethnographic case study research when the phenomenon in question is unobservable from the researcher's viewpoint. While interviews can take a wide variety of forms in its structure and format, Richards (2009) explains that a semi-structured interview is particularly instrumental when the researcher has a clear understanding of what topics and questions need to be covered but is also prepared "to allow for the interview to develop in unexpected directions where these

open up important new areas” (p. 186) Thus, semi-structured interviews were conducted as an approach to gaining insights into disciplinary and local classroom norms and practices from participants’ own perspectives.

I conducted one semi-structured interview with each of the focal participants between late-November and mid-December 2019 and two interviews with the instructor in mid-October 2019 and mid-January 2020. All interview schedules and locations were arranged according to participants’ availability and preferences. All interviews were one-on-one and face-to-face, conducted in English in a quiet public space on campus. The interviews were recorded using a high-quality voice-recorder with an external microphone. As a gesture of appreciation, I provided light refreshments to the participants at the beginning of the interview (e.g., a cup of tea or coffee, a muffin) and offered a \$20 CMU Bookstore gift card at the end of the interview. The average duration of the interviews was 52 minutes, with the longest interview lasting 66 minutes and the shortest 36 minutes. While the content and order of interview questions was basically guided by the interview protocol (see Appendixes E and F), I also remained flexible about unexpected conversational directions so I could delve into some important aspects from participants’ own perspectives. In the interview, I usually followed Richard’s (2009) recommendation by beginning with a set of open questions about everyday topics and then move toward more specific questions related to the course and the poster presentation. I also consulted Duff (2008, pp. 136–137) for her interview guidelines to be aware of my own language use and behaviour during the interview.

3.5.3 Video and Audio-Recording of Students’ Poster Presentations

While regular classroom observations helped me better understand what kinds of multimodal practices were recurrently enacted in EPS 251, video-recordings were indispensable for this study to capture and later analyze not only verbal but also other multimodal aspects of students’ poster presentation performance (Duff, 2008). While I was aware that the use of multiple video-recording devices can be obtrusive and logistically challenging (Duff, 2008), I asked for and received permission from focal participants to place two video-recording devices (i.e., iPad Generation 7 attached to a tripod) beside each of the two presenters. At times, I had four iPads recording two concurrent presentations. In addition to these recording devices, I asked focal presenters to attach clip-on microphones to their clothing near their mouths to ensure high

audio quality that was sufficient for transcription, given that there were multiple concurrent poster presentations in an acoustically challenging public space surrounded by large glass windows, floor tiles, high ceilings, and many passers-by. Figure 3.1 represents the overall configuration of people and objects in a typical poster presentation setting in this study.

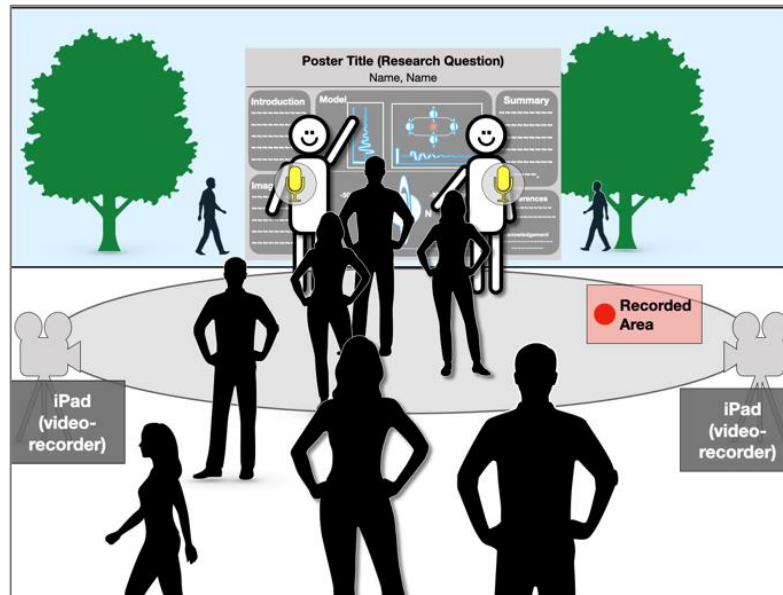


Figure 3.1 The position of recording devices and focal participants

Having two video-recorders on the two sides had the following advantages in this particular project: (a) the two devices complemented each other when one of the cameras was blocked by a presenter or their viewers; (b) a central space was opened up for the presenters and their viewers to interact with each other and with the poster; and (c) these two iPads occasionally picked up poster viewers' spoken utterances (questions, clarification requests) which were often inaudible in the data obtained from the presenters' voice-recorders.

During the recording of poster presentations, I primarily took the role of *observer as participant* to observe focal groups' poster presentations and watch over the recording devices so that nobody would knock over the iPads and tripods. Nevertheless, I often played a more active role in the poster presentation and in other off-task informal conversations when spoken to by students or the instructor, for instance, to ask questions (since these presentations were open to the public as well as members of the class). In other words, I took a dual observational stance as

observer as participant and *participant as observer* in the poster presentation sessions (Merriam & Tisdell, 2016, pp. 144–145).

3.5.4 Collection of Relevant Documents

In addition to the aforementioned data sources, materials and documents linked to the course and students' poster presentations were collected. These materials fell into two categories. The first set of documents were instructor-produced documents, which were accessible to the researcher through the CMU learning management platform. These materials included digital copies of the course description, course readings, lecture slides, the poster template, poster presentation task descriptions and rubrics, and other relevant course assignments (e.g., weekly writing tasks). The second category comprised student-produced artefacts relevant to the poster presentation. While there were differences in the number and types of artefacts obtained from each focal student/group, all of them offered me the digital copy of the final version of their poster which they used in the presentation. Other student-generated artefacts included: a poster presentation script, annotated journal articles cited in the poster, the first and final versions of a student poster, and an online discussion log on Google Document.

3.5.5 Fieldwork

My frequent visits to the department building and its affiliated facility also provided me with ample opportunities to interact with multimodal representations of geoscientific data. In the end, this became an important place for me to observe and try to interpret displayed geoscientific artefacts and generate questions about the meaning of different modes used in different kinds of exhibitions. I kept notes of my thoughts, feelings, interpretations, and hunches that emerged through my fieldwork after each visit to the facility.

3.6 Data Analysis

In this study, two analytic approaches were used: qualitative data analysis (Miles et al., 2019) and, more specifically, multimodal interaction analysis (Norris, 2004, 2019). First, qualitative data analysis was used to investigate the culture, values, and multimodal practices fostered in EPS 251. These results are presented in Chapter 4. This approach was employed to

seek answers for Research Questions 1, 2, and 3. Second, multimodal interaction analysis was employed to specifically analyze students' multimodal performance in the poster presentation task in the geoscience course. This second analytic approach was employed to respond to Research Question 4, and the findings are reported in Chapter 5. I made use of the findings from my initial qualitative data analysis as a reference point to narrow down the analytic foci of multimodal interaction analysis in ways that make visible how the culture, values, and multimodal practices fostered in EPS 251 were manifested in the geoscience poster presentations.

3.6.1 Qualitative Data Analysis

As is typical of qualitative inquiry, data analysis for this study was an iterative, inductive, and ongoing process to manage, sort, code, and cross-reference an abundance of data while looking for emergent patterns and themes (Duff, 2008; Miles et al., 2019). Echoing Flick's (2014, as cited in Merriam & Tisdell, 2016) statement, the purpose of data analysis was "the classification and interpretation of linguistic (or visual) material to make statements about implicit and explicit dimensions and structures of meaning-making in the material and what is represented in it" (p. 5). In the analytical process, I made use of a computer-assisted qualitative data analysis software called *Atlas.ti* together with its software manual *Qualitative data analysis with Atlas.ti* (Frieze, 2019) to assist me with my data organization, management, and analysis.

Following Merriam and Tisdell's (2016) recommendation, I started analyzing the data generated both inside and outside the research site. For instance, as I took fieldnotes, I wrote short pieces of analytic notes—or what Miles et al. (2019) call *jotting*—using Microsoft Word's Comment feature to write down my own reflective and interpretive thoughts as the researcher. I also jotted down my thoughts during my transcriptions of the audio-recorded data. As I proceeded, those initial analytic notes served as important analytic tools to think through the data and point to potential themes that deserve further analytic attention (Miles et al., 2019).

After the initial plain transcriptions of audio-recorded data, I started the first cycle of data analysis through multiple readings of all data while descriptively labeling data chunks with essence-capturing words or phrases used by participants. In other words, I first applied *In Vivo* codes to my data in this first-cycle coding. Also known as "emic coding," I believe that the use of *In Vivo* coding supported me to develop preliminary ideas for possible themes and keywords

that might have captured important elements from disciplinary insiders' own viewpoint (Saldaña, 2016, p. 91). Some examples of *In Vivo* codes include: "I have to find the pattern," "scientists love patterns," "just directly telling what you see," and "no guesses" bracketed by quotation marks. This *In Vivo* coding was parallel to my analytic memo writing, wherein I wrote down my analytics hunches textually and often visually to further come up with higher-level analytic meaning (Miles et al., 2019). Then I proceeded to second-cycle coding by applying pattern codes (Miles et al., 2019; Saldaña, 2016). Here, I first created several Code Groups whose names loosely described common themes and keywords that emerged in my first-cycle coding (e.g., "GEOSCIENTISTS' OBSERVATIONS" and "GEOSCIENTISTS' INTERPRETATIONS"). I then sorted all the *In Vivo* codes into those Code Groups according to their loose similarities. Within each code group, I selected all the codes that described one common theme and merged them to create fewer and more abstract codes, such as "observations for finding patterns in the data set" and "observations as archival objective data." Those codes were further developed to more specifically identify deeper themes related to the culture, value, and multimodal practices of EPS 251. In the end, I identified and decided to report on two of the most illuminating, interrelated major themes and their interrelated subthemes that would further provide useful insights into the analysis of the poster presentations. Those will be reported in Chapter 4.

3.6.2 Multimodal Interaction Analysis

In order to present in-depth analyses of students' multimodal practices in the poster presentation in Chapter 5, I adapted Norris's (2004, 2019) analytic framework of multimodal interaction analysis (MIA). According to Norris and Pirini (2017), MIA is "a holistic analytical framework that understands the multiple modes in (inter)action as all together building one system of communication" (p. 24) that takes into consideration the link between social actors and the environment in which their (inter)action is embedded. With its methodological focus on the materially and symbolically mediated (inter)action as a unit of analysis (Vygotsky, 1978; Wertsch, 1998), researchers employing this analytical approach analyze both *lower-level mediated actions* and *higher-level mediated actions* (Norris, 2019).

Norris (2019) defines lower-level mediated actions as "smallest pragmatic meaning unit of mode" and higher-level mediated actions as "the coming together of many chains of lower-level mediated actions" (pp. 41, 44). Situating these analytic notions in the present study, social

actors' spoken and written language use, gestural and bodily movements, gaze shifts, object handling (among many other modes) all constitute the presenter's lower-level mediated actions. In contrast, delivering the poster content, listening and responding to the viewer's questions, or even the whole poster session could be considered as higher-level mediated actions because those broader activities are made up of the coordination of lower-level mediated actions. Thus, lower-level and higher-level mediated actions are co-constitutive of each other.

Because of MIA's broad analytical framework which allows an analyst to "study anything that has to do with people's actions and interactions" (Norris, 2019, p. 64), I first attempted to delimit the analytical focus of the study. More specifically, I utilized the findings of my qualitative data analysis (see Section 3.6.1 and Chapter 4) as my reference points to guide my search of a phenomenon of interest for in-depth analyses. In the end, I decided to specifically analyze how students communicated their *observations and interpretations* (see 4.1.3) of the visual data set through the orchestration of a multitude of different meaning-making resources in the poster presentation.

In the analytical process, I used an audio and video annotation software called ELAN (<https://archive.mpi.nl/tla/elan>) to first descriptively annotate the holistic meaning and type of the selected excerpt (i.e., observations versus interpretations) and then annotated plainly transcribed speech, gestures, gaze shifts, parts of the poster in use, and their interlocutor's actors and other (inter)actions when needed (see Figure 3.2). In other words, I annotated both higher-level mediated action (observation versus interpretation) and lower-level mediated action (multimodal resources used in the poster presentation) within the interface of ELAN. The layered view in Figure 3.2 helped me visually see the complexity and cooccurrence of focal students' multimodal practices in the poster presentation. For the final reporting, I detailed the transcribed audio-recorded spoken data by adapting Duff's (2008) transcription conventions (see Appendix G). Video-recorded data were also transcribed adapting Norris's (2019) multimodal transcription technique and later blurred the images to ensure participants' anonymity.

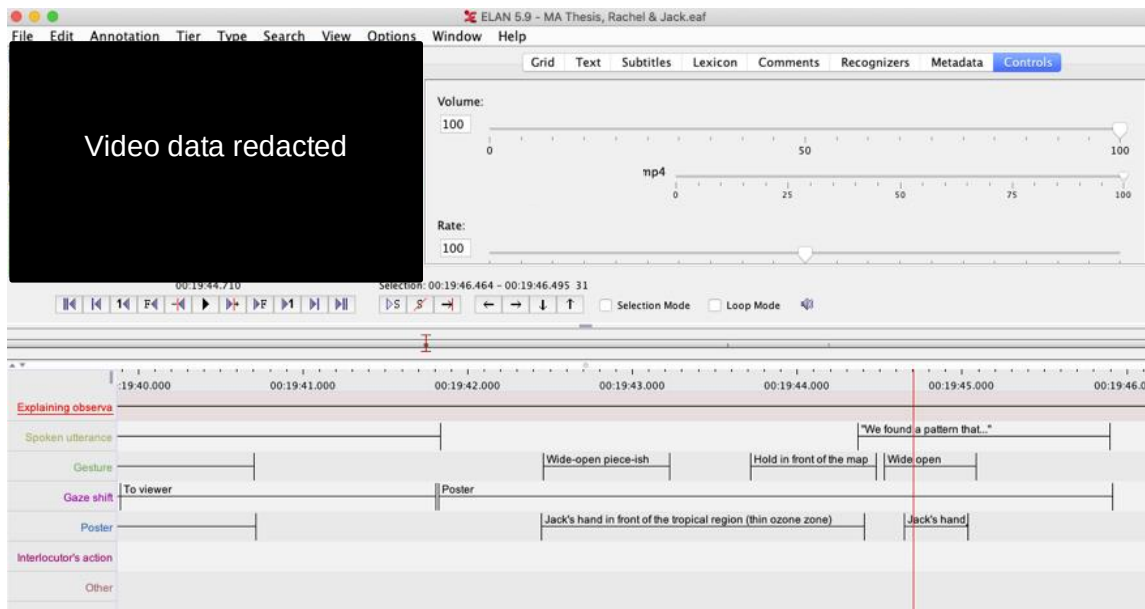


Figure 3.2 Screenshot of ELAN interface

3.7 Trustworthiness of the Study

In an attempt to enhance the trustworthiness of the study, I have employed multiple strategies throughout the research.

Firstly, I conducted semester-long data generation through my regular classroom observations and interviews with multiple focal participants (Miles et al., 2019). This process involved regular contact with the disciplinary content in lectures and my frequent visits to the department-affiliated facilities as well as regular informal conversations with the geoscience course instructor, his teaching assistants and students who served as geoscience experts for me. I believe that my sustained engagement with the content and individuals in the discipline helped me develop and test my emergent informal hypotheses about observed phenomena in an ongoing manner.

Secondly, I attempted to produce and provide detailed and thick descriptions of each of the cases (Duff, 2008). In so doing, my detailed fieldnotes of the teacher's and students' multimodal practices, their classroom behaviours, and my own interpretive thoughts and questions were highly useful in offering rich, contextualized details about the cases under discussion. In addition, I attempted to detail the procedures and explanations of case selection, data generation and analysis involved in this study.

Thirdly, as noted earlier, this ethnographic multiple-case study involved multiple data generation methods, multiple data sources, and multiple participants' viewpoints. This multiplicity allowed me to employ data triangulation, methodological triangulation, and perspective triangulation to help strengthen the credibility of the study.

3.8 Ethical Considerations

Because the data collection took place in an undergraduate course that involved formal assessment by the instructor (or by peers), great care was taken not to make potential participants feel obliged to participate in the study for fear of negative repercussions or extra perceived pressure. In order to minimize the risk of unintended academically negative consequences, the results of the study were not publicly presented or published until long after any formal course assessment of students or course evaluations were completed. Furthermore, because this study involved in-depth analyses of a small number of focal participants, their privacy and confidentiality were carefully taken into consideration. Specifically, the names of participants, the course, and institutions were substituted with pseudonyms, and non-key details were omitted or partly changed to strictly ensure confidentiality (Duff, 2008). In terms of the treatment and presentation of visual data (i.e., still shots of posters and presentations), key details such as participants' names, the title of their poster, and their faces were blurred. The study received ethical approval from the university accordingly.

3.9 Summary of the Chapter

To summarize, in this chapter I have outlined the research design, details about the research site and focal participants, multiple data generation methods (classroom observations, interviews, video-recordings, artefacts, fieldwork), and two analytical approaches and procedures in detail. In the following two chapters, I first examine the broader culture, values, and multimodal practices promoted in EPS 251 in Chapter 4. Then in Chapter 5, I specifically analyze students' multimodal practices in the geoscience poster presentation at a more micro-level.

Chapter 4: Community Context and Multimodal Practices in the Geoscience Classroom

4.1 Introduction

In this chapter, I present the major findings that concern the community and disciplinary features of the classroom in which the poster presentation task took place. More specifically, I first offer descriptions of the course objectives and my analyses and interpretations of the culture and values fostered in the Earth and Planetary Science Classroom (EPS 251). I then explore the recurrent classroom activity called *Observations and Interpretations* of geological features and patterns as a salient multimodal practice. The concluding summary recapitulates the major findings to bridge the present and ensuing chapters.

4.2 The Classroom Culture of the Earth and Planetary Science Course

In what follows, I provide an overall description of the geoscience classroom by focusing on the course objectives, the community values, and multimodal practices.

4.2.1 Course Objectives

Offered during the first semester of the academic year 2019–2020, EPS 251 was an undergraduate course designed primarily for second-year students at Coast Mountain University (CMU). There were three in-person class meetings per week, and each class lasted approximately 60 minutes Monday, Wednesday, and Friday afternoons (i.e., approximately 180 minutes per week). While there was no course textbook, a short weekly reading was assigned to students on a range of topics in earth and planetary science. These weekly readings were generally 4–6 pages in length and came from a wide variety of journals, such as *Scientific American* and *Nature Climate Change*. Those weekly readings were used as a source for in-class activities and assignments, including quizzes and the weekly writing task. The majority of class time was devoted to regular activities such as the instructor’s lecture and pair/group work.

One striking feature of EPS 251, in contrast to other generic (geo)science courses at CMU, was its major pedagogic focus on the process of “*thinking as scientists*” rather than the

learning of the course content (EPS 251 Course Outline, italics added). Specifically, the course outline stated the overall course objectives as follows:

What is this course about?

This course aims to help you build crucial skills related to thinking about science in general and Earth and planetary science in particular. You will be exposed to exciting and usually unresolved cutting edge problems in Earth and Planetary Science—the kinds of problems that inspire us as scientists to question and to wonder. In this context you will explore the process of how scientists construct knowledge and build understanding and how scientists often must deconstruct their own conditioning so that they can learn.... We run this course somewhat like a graduate seminar. You will be reading articles from primary and secondary sources. Class time will involve discussion, debate and team work so coming prepared is a necessity. In addition, two group projects will be completed, giving you opportunities to explore in greater detail topics of your choice....

(EPS 251 Course Outline, bolds original)

The next paragraph explicitly stated that the course was not about memorizing content:

What is this course not about?

Regurgitating... Getting “the right” answer...

(EPS 251 Course Outline, bolds original)

This process-orientation was reiterated across many different classes for the duration of the semester, including in the lecture and in Robert’s casual conversations with his students as well as with class visitors. When a group of external class observers visited EPS 251, Robert introduced the course objective to them privately by saying:

The course is focusing more on writing, presenting, discussing and thinking like a geologist. Content is not important in this course [because the original course title gives great flexibility in the content]

(Robert, Fieldnotes, 10/09/2019)

Furthermore, values in the process of learning, or the socialization of scientific thinking, also appeared to be recognized and appreciated by the students. For instance, in the end-of-semester class meeting, the whole class created a list of scientific skills that had been practiced and emphasized to enable them to *think as scientists*. Some of these scientific skills and dispositions

included: “observing things, interpreting things” (Leah), “Don't be afraid to be wrong” (Rachel), “Teamwork/Working with people” (Jack) (Fieldnotes, 11/22/2019).

Importantly, these course features were often discussed in comparison with other geoscience courses the students had already taken or were concurrently taking. For example, in the wrap-up discussion, Emma described her other science courses as more receptive: “Other courses are taking notes and doing the math.” (Emma, Fieldnotes, 11/22/2019) Leah also echoed the sense of more receptive pedagogic style in her other geoscience courses: “In other classes, we just sit and write notes and everything.” (Leah, Interview, 12/02/2019).

Thus, more than mere memorization of knowledge as truth or “the right answer,” EPS 251 was a student-centred, process-oriented earth and planetary science course designed to support second-year undergraduate students to become able to *think, communicate and learn about and question scientific ideas as (geo)scientists* (Ochs, Gonzales, & Jacoby, 1996).

4.2.2 Thinking and Learning as (Geo)Scientists

As mentioned above, one major course objective was helping students to learn to *think as (geo)scientists*. The course outline provided five specific goals related to thinking like (geo)scientists: (1) reading and using scientific articles, (2) communicating, (3) [having] enthusiasm for and knowledge of earth and planetary science, (4) [gaining] awareness of science learning, and (5) [having] healthy scientific skepticism. As a result of my detailed analysis of multiple sources of data (i.e., fieldnotes, interviews, and course documents), I identified three major overarching conceptions that appeared to underlie the expected course learning outcomes. The following sections, respectively, provide an in-depth discussion of the three conceptions related to *thinking as geoscientists*: communication for scientific thinking and learning (Section 4.2.2.1), identifying knowledge gaps in geoscience and in their knowledge (Section 4.2.2.2), and “learning means being wrong” (Section 4.2.2.3).

4.2.2.1 Communication for Scientific Thinking and Learning

As explicitly stated in the course outline, communicating scientific ideas and learned knowledge was one of the valued practices promoted in EPS 251 not only as a way of transmitting knowledge, but also as a locus of practicing science thinking and science learning.

In the course outline, Robert elaborated on the kind of expected communication for science thinking and learning as follows:

Communicating: Present, debate, and ask insightful (and precise) questions about scientific ideas in assigned and self-selected readings.

(EPS 251 Course Outline)

The importance of communication in scientific thinking and learning was reiterated throughout the Course Outline and stressed in his lectures and interviews as well.

In fact, it was evident in my regular classroom observations that students' science communication was regularly practiced in a wide variety of pair/group activities throughout the semester. Those activities included regular small-group and whole-class discussions (e.g., *observations and interpretations*; see Section 4.2.3), peer feedback sessions (primarily for written assignments), a one-week data analysis project using software called MATLAB (October 25–November 4, 2019), and two poster projects including in-class preparations and presentation sessions (October 7–16, 2019 for Poster 1; November 15–29, 2019 for Poster 2).

The explicit statements in course documents as well as my regular observations of these course activities together suggest that the kind of scientific communication valued in EPS 251 was not mere one-way transmission of scientific knowledge from the expert/knower to the novice/unknower. Rather, it was bidirectional scientific communication that was highly valued in EPS 251, whereby students as active participants would mutually engage in joint thinking and construction of scientific ideas, knowledge, and questions through interaction.

This view was also echoed by student participants in their interviews. For instance, Jack, who had previously taken another science course with Robert in his first year, appreciatively expressed the value of interaction fostered in both of Robert's first and second-year courses in Excerpt 4.1. EPS 151 is used as a pseudonym for the first-year course:

Excerpt 4.1: "That's a good way to study."

- | | | |
|----|--------|--|
| 01 | Masaru | And do you what kind of activity do you did you like the most in |
| 02 | | EPS 151? in his course. |
| 03 | Jack | In EPS 151? |
| 04 | Masaru | Yeah. What kind of |
| 05 | Jack | Group work. |

06 Masaru Group work? Okay.
 07 Jack Mhm yeah.
 08 Masaru Is that similar to things
 09 Jack Yeah cuz,
 10 Masaru We've done in 251?
 11 Jack Yeah, in 251. Cuz, as we discuss, I can find my
 12 mistake and corrected by, like, by my friends
 13 Masaru Mhm
 14 Jack Or, like, I can get new ideas from my friends.
 15 Masaru Mhm
 16 Jack That's a good way to study or to correct my mistake.
 17 Masaru Right.
 18 Jack And that would be very impressive for me. Yeah.

(Jack, Interview, 12/13/2019)

Simply put, classroom interaction in EPS 251 seemed to be promoted and viewed not only as a form of knowledge transmission, but also as a locus of practicing *thinking and learning as (geo)scientists* with others in the community (e.g., through classroom groupwork and discussion). This social interaction, furthermore, enabled students to identify gaps in their own or others' knowledge. Therefore, they were agents of socialization into scientific thinking for one another (as well as themselves).

4.2.2.2 Identifying Knowledge Gaps in Geoscience and in their Knowledge

Overlapping with the notion of communication for scientific thinking and learning was identifying knowledge gaps in the broader discipline and in individual knowledge. This latter aspect was viewed as another important dimension of *thinking and learning as (geo)scientists*. The importance of identifying and addressing knowledge gaps in EPS 251 was repeatedly emphasized by Robert throughout the semester (e.g., in the course outline, lectures). In the Course Outline, for instance, Robert stressed the importance of articulating knowledge gaps as follows:

Awareness of science learning: Articulate both what you have learned and specifically what you perceive as missing in your own understanding. Be able to say: "I don't know" and enjoy the opportunities that emerge with this phrase.

(EPS 251 Course Outline, underline added)

In addition to this written statement, Robert regularly reiterated the importance of identifying and addressing knowledge gaps in his lecture through his explicit spoken instruction or by posing questions to make his students practice thinking about scientific knowledge gaps (Fieldnotes, 11/22/2019).

As expressed by Jack in Excerpt 4.1, students were also cognizant of the importance of identifying and addressing knowledge gaps as a source of science learning. Importantly, this value appeared to be taken into consideration when students made their own choices in classroom activities. For instance, Emma, who presented a poster with Leah on the relationship between the orbital position and the weather of Uranus (which is the seventh planet from the Sun), explained to me the reason for choosing the topic for the poster project (see Excerpt 4.2):

Excerpt 4.2 “We were just trying to pick something that was less studied”

- | | | |
|----|--------|--|
| 01 | Masaru | How did you like, end up in that topic? Did someone help you or |
| 02 | Emma | Uhh: |
| 03 | Masaru | What kind of resources did you find useful in that process? |
| 04 | Emma | Well we kind of, like, had a few other ideas like we wanted to |
| 05 | | like Pluto or Europa because like, we wanted to look for sources of life |
| 06 | | on the different planets and see how that would play out. |
| 07 | Masaru | Mhm |
| 08 | Emma | But then we just looked at, because a lot of people do Europa |
| 09 | | and a lot of people do Mars and a lot of people do Venus. |
| 10 | | And so we were just trying to pick something that was less studied. |
| 11 | Masaru | Ah okay. |
| 12 | Emma | And we're like, okay, how about like the icy giants because no one |
| 13 | | really talks about them. And so we talked to |
| 14 | | Michelle and Robert ((TA and the instructor)) about it. |
| 15 | Masaru | Mhm |
| 16 | Emma | And they were like, yeah, this could work. Like you could try to figure |
| | | out |
| 17 | | how like the rotation, like because it's very wonky. |
| 18 | | Like, it's flipped 90 degrees. |
| 19 | Masaru | Mhm. |
| 20 | Emma | So we thought that was really cool. And we're like, okay, |
| 21 | | let's just try and see what we can find. |
| 22 | Masaru | Mhm |
| 23 | Emma | We also look for like knowledge gap in like the research because |
| 24 | | if not a lot of people have looked into it. You want to be like, |
| 25 | | okay, well, why didn't they look into it? |

(Emma, Interview, 12/02/2019)

In lines 4–6, Emma indicated that her group had had a few other candidate ideas for their poster presentation, including Pluto and Europa (the moon of Jupiter). In lines 8–10, Emma, however, explained that they ended up avoiding these popular topics based on their observations of their peers and chose instead to “pick something that was less studied.” Here, she stressed the word ‘less’ as indicated by underline, which appears to suggest that for Emma choosing an under-researched topic could have been an important aspect of making a good poster presentation for EPS 251 and by extension *thinking as a geoscientist*. Furthermore, she uses the phrase *knowledge gap* in line 23 as part of her explanation.

Similarly, Jack and Rachel, a pair who presented on the distribution pattern of ozone layer, appeared to echo Emma’s view that addressing knowledge gaps was a crucial aspect of the poster presentation task. In the following excerpt, Jack reflected on how his group had developed their ideas for the poster content in consideration of knowledge gaps.

Excerpt 4.3 "You know ozone layers. I know ozone layers. But most people don't understand why the distribution is like that."

- | | | |
|----|--------|---|
| 01 | Masaru | So how did you choose the topic? I mean the question like |
| 02 | | the ozone layer, how |
| 03 | Jack | Oh, so we chose volcanos first. |
| 04 | Masaru | Mhm |
| 05 | Jack | But we found it's really easy to explain. |
| 06 | Masaru | Mhm |
| 07 | Jack | Cuz, just about the continent. They squish and |
| 08 | | the volcano, they're, and they're really active. |
| 09 | Masaru | Mhm |
| 10 | Jack | That's all. But, so we came up, uh, we like |
| 11 | | We decided another topic. It's really complicated |
| 12 | | and really hard to explain. And like, <u>less</u> . |
| 13 | | Cuz, for this one, the ozone layer, it always be there. |
| 14 | Masaru | Mhm |
| 15 | Jack | It's just always surrounded. |
| 16 | Masaru | Yeah yeah yeah |
| 17 | Jack | Yeah. And but <u>no one</u> knows the patterns |
| 18 | Masaru | Mhm |

19 Jack Like why it's thicker at poles and why it's thinner there.
 20 Masaru Yeah right. mhm
 21 Jack No, like, and, nobody understand why that happens.
 22 Masaru Mhm
 23 Jack So it's really, like, everyone knows that. but,
 24 no one understand that,
 25 Masaru Yeah yeah
 26 Jack You know ozone layers. I know ozone layers. But like,
 27 most people don't understand why it the distribution is like that.
 28 Masaru Yeah, I didn't even know that there is a distribution pattern here.
 29 Jack Yeah, so it's an easy topic,
 30 Masaru Mhm
 31 Jack But it's hard.
 32 Masaru Mhm
 33 Jack Like - no one knows.
 34 Masaru Mhm
 35 Jack So that's why we chose that. And it's really like strong
 36 connections between the human beings and, or, and the distribution?
 37 Masaru Yeah, and especially during this time of environmental change.
 38 Jack Yeah

(Jack, Interview, 12/13/2019)

In lines 3–10, Jack explained that they decided not to present “volcanos” (to be more specific, the dense distribution of volcanos in Alaska, according to Rachel) because of their realization that this topic could have been addressed by a straightforward explanation, namely the activity of plates (Rachel, Interview, 12/13/2019). According to Rachel, Robert’s feedback played a crucial role in their realization of the lack of knowledge gaps in their previous topic of Alaskan volcanos. From line 10, Jack expanded on how and why the pair had settled on the new poster topic of the distribution of the ozone layer, repeatedly emphasizing the way in which their new topic could address important knowledge gaps. Through his repeated and emphatic juxtapositions of what is known (ozone layer) versus unknown (the distribution pattern of ozone layer), Jack’s utterances in lines 23–27 appeared to be particularly exemplary and indicative of his group’s commitment to addressing a general lack of scientific knowledge that was puzzling.

Importantly, Rachel, who paired up with Jack, detailed in her interview that having faced challenges to identify knowledge gaps worth addressing, they sought assistance from their peers in their own social network outside EPS 251. In the following interview excerpt, Rachel

described her group's difficulty in choosing a suitable topic and then their coping strategies to tackle that challenge.

Excerpt 4.4 "Actually, nobody knows. So that's why we decided we need to do this one."

- 01 Rachel So, and then, we, after we come up with this idea, like this topic,
02 we asked our friends. I'm, cuz, we are afraid that the answer
03 to this question is also simple.
04 Masaru Mhm
05 Rachel Like it- it can't be explained in one or two sentences. xx hard to like,
06 like switch to another topic. So we asked our friends like,
07 Very smart friends. ((laughter))
08 Masaru ((laughter)) Ahah interesting.
09 Rachel We asked them if they know the answer to this question.
10 Masaru Mhm
11 Rachel Like, I said if you don't know, can you guess what the possible answer.
12 Because we already got answers in xx. We asked them if you don't know
13 the answer, can you guess what the possible answers?
14 Masaru Mhm
15 Rachel And then, nobody knows the answer.
16 Masaru Really? Wow. That's so interesting.
17 Rachel Yeah nobody knows the answer. And then their guesses are wrong.
18 One of my friends even came up about some physics explanation.
19 So actually, nobody knows. So that's why we decided we need to do this.
20 Masaru Okay
21 Rachel Because it's worth it. Like nobody knows what the answer is.
22 And we got a lot to explain it. Yeah. It's also very important
23 because ozone affects our uh everyday life.

(Rachel, Interview, 12/13/2019)

Thus, there was a communal aspect of sourcing the subject for their presentation, not just within the class but through wider social networks. In lines 1–5, Rachel explained that the group had initially been concerned about the potential straightforwardness of their new topic for the poster presentation. Having acknowledged this concern, both Rachel and Jack reached out to peers in their social networks to make speculations on the knowledge gap in their peers' own knowledge (lines 6 and onwards). Having observed their peers' inaccurate accounts for their provisional research question, they made the decision to further explore the distribution of the ozone layer in their poster presentation. Importantly, their selected research question "Why is the ozone layer

thinner at the tropic than the Poles?” appeared to be well-received by Robert. In his interview with me following their poster presentation, he said:

Excerpt 4.5 "I think the question is a good choice."

- | | | |
|----|--------|--|
| 01 | Robert | I think the question is a good choice. And I think it's a question that got |
| 02 | | people's <u>attention</u> . Because, uh, yeah, <u>why</u> ? Why is it there? You |
| 03 | | know? Like, what are the reasons that happens? |
| 04 | Masaru | Mhm. |
| 05 | Robert | And so yeah. I was quite impressed with this one. |
- (Robert, Interview, 01/24/2020)

In sum, identifying and addressing knowledge gaps was articulated by both the instructor and his students as an important facet of *thinking and learning as (geo)scientists* in EPS 251. Its values and importance were reiterated on a number of in-class occasions across different modalities. The classroom value of addressing gaps also appeared to be recognized by Robert's students and taken into consideration when they selected the research question for their poster presentation. Although generating a question that can address and stimulate knowledge gaps could be perceived as a great challenge, a group of students overcame the challenge by drawing on their immediate social networks to speculate about potential knowledge gaps in their peers' knowledge.

4.2.2.3 “Learning Means Being Wrong”

In order to practice *thinking and communicating as (geo)scientists*, students were encouraged and expected to try things out and become comfortable to be “wrong.” This means that throughout the semester, Robert regularly encouraged his students to view their own mistakes and lack of knowledge in a positive light as a vital source and process of further science learning.

For instance, when the majority of his students remained silent and hesitant to speak up during a whole-class discussion, Robert encouraged their active participation and contributions by articulating the importance of trying ideas out and making mistakes as (geo)scientists. The following excerpt is an approximate transcription of his utterances from my fieldnote:

When no students raised their hand to speak up, Robert said something like “It’s okay to make mistakes. I’m always modeling making mistakes as a scientist. Remember you can be wrong. I’m wrong all the time.”

(Robert, Fieldnotes, 10/05/2019)

In his statements, not only did he encourage his students to participate, but he also highlighted the importance of making mistakes as an essential part of a healthy science learning process that he himself modeled. An instance of such ‘modeling making mistakes’ comes from two consecutive class meetings in which some of his students had noticed and eventually pointed out a piece of inaccurate information mistakenly presented by Robert at the end of a prior class meeting. In response to the correction made by his students, Robert acknowledged his inaccuracy at the very beginning of the following class meeting and provided accurate information. It should be noted that his self-correction also accompanied compliments to his students: “It’s amazing you corrected me. . . . Please do correct me when I am wrong” (Robert, Fieldnotes, 10/07/2019). Notably, on the first PowerPoint slide of the second class meeting, he wrote “The sun (aka Robert’s an idiot),” which appeared to highlight his own mistake and by extension modeling the admission of being wrong as a (geo)scientist as being virtuous.

In light of Robert’s approach, the majority of his students seemed to view their mistakes and lack of knowledge in a positive light and as a vital part of learning. For instance, as previously presented in Excerpt 4.1, Jack emphasized the importance of teamwork and peer interaction as an opportunity to “find and correct [his] mistakes” and “get new ideas from [his] friends” (Jack, Interview, 12/13/2019). Similarly, in the end-of-term course wrap-up discussion, Rachel brought up “Don’t be afraid to be wrong” as a key learning outcome that she had developed throughout the course (Rachel, Fieldnotes, 11/22/2019).

4.2.3 Multimodal Practices Fostered (and Valued) in the Classroom Community

To foster students’ *thinking and learning as (geo)scientists*, a wide variety of classroom activities were regularly implemented in EPS 251. One recurrent activity particularly pertinent to multimodal practices in geoscience was a two-phased activity called “observations and interpretations.” Figure 4.1 provides a brief description of how this activity typically proceeded in class.

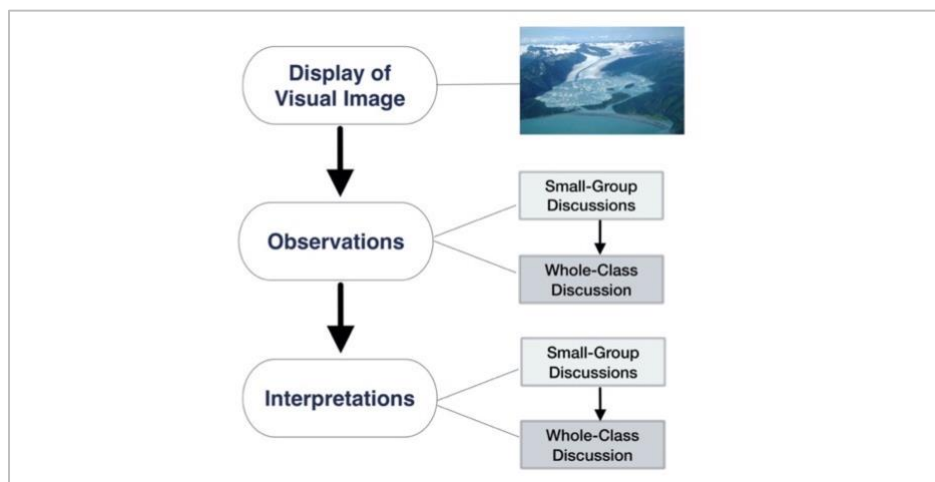


Figure 4.1: The sequence of observation and interpretation activity

At the beginning of each class meeting, Robert would display a visual image to the class. The images were typically earth or planetary photographs as shown at the top right of Figure 4.1 (drawn from Lecture Slide #2, Lecture 13, 10/02/2019). Immediately after the display of an image, Robert would prompt his students to make *observations* of the displayed image in small groups. Following a one-to-two minute small-group discussion, Robert would then invite students to share their observations with the class. After the whole-class discussion, Robert would then prompt students to make *interpretations* of the displayed image based on their observations, first in small groups and then in the whole-class discussions. The activity typically took approximately 10 minutes and ended with Robert's explanations or interpretations of the displayed image.

In what follows, I provide detailed descriptions and analyses of *observation* and *interpretation* activities. In addition, I discuss *scales* as an important observational device in geoscience.

4.2.3.1 Making Observations of Geological Features and Patterns

4.2.3.1.1 Making observations as a descriptive practice

Making observations was the first of the sequenced activities at the beginning of most class meetings in EPS 251. As briefly described above, Robert would normally begin a class by presenting a visual image to the whole class. While visuals were typically photographic images

related to topics and issues in earth and planetary science, graphical, and telescopic images were also presented occasionally in the activity. Figure 4.2 provides some examples of the visual images used for the activity that Robert would ask students to describe and discuss (as “observations”). The whole-class discussion would generally last one to two minutes, and four to six students typically spoke up to provide their observations. The class would then move on to the *interpretation* phase, which will be discussed in Section 4.2.3.3. Note that Robert’s remarks oftentimes included negative feedback, “That’s an interpretation,” when student contributions appeared to diverge from his expectations of observations only.



Figure 4.2 Sample visual images used in observations and interpretations activity

4.2.3.1.2 What constituted a valued form of observations in the geoscience classroom?

My classroom observations as well as interview data together suggest that there was an expected kind of observation as a geoscientist. To be more specific, student observations were expected to be descriptive, without interpretations or speculation about the phenomenon depicted. The expectation for descriptive reporting appeared to be realized in Robert’s lexical choice in his prompt questions: “What do you *see/observe*?” This point was made clear by

Robert in his interview with me in Excerpt 4.6. Lines 1–10 are presented to provide the context for lines 11–19. Underlining is used to signify stressed utterances.

Excerpt 4.6 "The observation is supposed to be completely descriptive. And not interpretive."

((In line 01, "it" in Robert's utterance means the separation of observations and interpretation.))

- 01 Robert It's a very hard thing to do. But I'm just having them practice it a little bit.
02 And they have trouble with it. I have trouble with it sometimes.
03 When you look at something and you say, what is this? ((deep breath))
04 What do you see? I mean, you see colors.
05 Masaru Mhm
06 Robert You don't see rock. It was like someone said RUST. I'm like, what?
07 So you see orange, right? And you're interpreting oxidation but it's orange.
08 And you see lines, you know, and then like, we can go really
09 ridiculous with that.
10 Masaru Mhm
11 Robert But, you know, when you're saying, oh that looks like ice,
12 that's an interpretation.
13 Masaru Mhm. Yeah. That looks like ice?
14 Robert Yeah.
15 Masaru Yeah so you first probably begin with description?
16 Robert That's basically what the observation is supposed to be.
17 Completely descriptive,
18 Masaru Mhm
19 Robert And not interpretive.

(Robert, Interview, 10/09/2019)

As I continued my classroom observations and conducted interviews with participants, it became clear to me that students were expected to find and report geological features and *geological patterns* in particular in the displayed visual image. Here, recall that the great majority of the images presented for the activity were mostly spatial, as illustrated in Figure 4.2.² For example, in my interview with Jack, he stressed the importance of finding geological patterns in the activity, providing some specific examples of geological features and patterns that should or could be listed in the observations:

² In addition to spatial photographic images, other kinds of visual data (e.g., temporal, numerical, graphical data) were used in EPS 251. However, such non-spatial visual data were presented more often in other classroom activities than in the observation and interpretation activity.

Excerpt 4.7 "I have to find the pattern and some specific things."

- 01 Masaru So what do you have to do to observe? And then what do you
02 have to do to interpret?
03 Jack Oh, so, for observation, we have to look for like, for example,
04 a picture of like some rock, I have to find the pattern. And like
05 some specific things, for example, like the edge the, like holes
06 or like the x size, like that. So that's for observation.
07 Masaru Interesting.

(Jack, Interview, 12/13/2019)

In a similar vein, Rachel made specific reference to finding geological patterns as an important observational practice in this activity, by drawing a comparison with making interpretations:

Excerpt 4.8 "You don't have to explain what the pattern is but find these patterns."

- 01 Masaru And so could you make clear to me how they're different?
02 I mean, what do you have to do? To make observations.
03 Rachel So observations is like tell what directly, what will you see. Don't make
04 any guesses. And like, yeah, you don't make any guesses. And just
05 directly telling to choose what you see. And the interpretation
06 is guesses what it could be or what it could be formed.
07 Masaru Yeah, I think that's a really interesting point.
08 Then, so, to make observation, what do you do?
09 Rachel So carefully and like, find the patterns. You don't have to explain
10 what patterns is but find these patterns. Yeah.
11 Masaru Okay. Patterns. Interesting.

(Rachel, Interview, 12/13/2019)

To summarize participants' accounts, observations required that students find geological, spatial, temporal or graphical patterns and to become able to "list them as observations and then you move to interpretations" (Robert, Interview, 10/09/19). Therefore, this practice comprised socialization of scientific viewing and then conveying those perceptions linguistically.

4.2.3.1.3 Multimodal practices during the observation activity in the geoscience classroom

In my regular classroom observations, it became clear that both Robert and his students actively communicated their intended meanings by orchestrating a wide variety of multimodal

meaning-making resources. This was especially apparent when they discussed and reported their observations in paired or small-group activities.

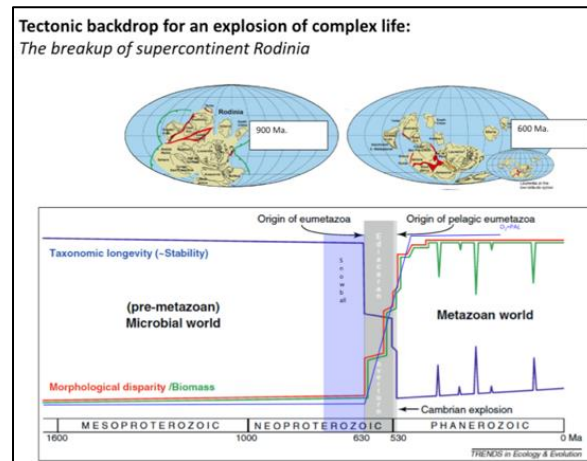


Figure 4.3 Course slide 4 (Snowball Earth, 09/30/2019)

One common multimodal practice was the use of pointing gestures in an attempt to indicate specific observable features, trends, or patterns in the displayed image (spatial, temporal, or numerical). McNeill (1992) defines this type of pointing hand motion as *deictic gestures*, by which the individual can “[indicate] objects and events in the concrete world” (p. 18). For instance, when students were prompted to make observations of a trend or pattern in the graphical data in Figure 4.3, many students produced a pointing gesture in their pair/small-group discussions. Figure 4.4 represents my approximate reproduction of a typical pointing gesture observed in my classroom observation.

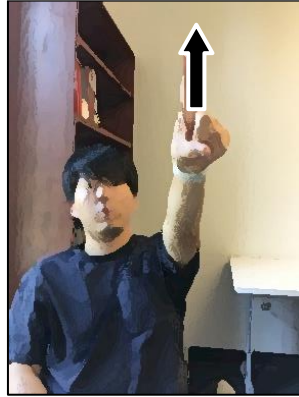


Figure 4.4 Students' pointing gesture to the screen
(reproduced by the researcher, 09/30/2019)

As exemplified in Figure 4.4, students typically performed pointing gestures by using their index finger, raising their arm to the level of their head or shoulder (depending on the relative positions of the student versus the front screen). My observation in this particular observational activity with the graphical image was that after producing the pointing gesture, some students gradually moved their pointing hand rightward and then tilted their index finger to the right as they continued their discussions of the graphical image (Figure 4.5).

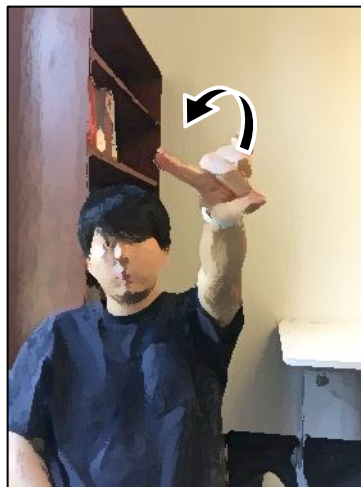


Figure 4.5 Students' tilted pointing gesture
(reproduced by the researcher, 09/30/2019)

Here, it is important to note that the specific direction that Robert had given to his students was: *“What’s happening here? What do you see on this graph? Tell me one thing you see.”* (Robert’s

direction, Fieldnotes, 09/30/2019). Whilst giving his directions accompanying a spoken deictic “here”, Robert circled the areas coloured in purple and grey utilizing his laser pointer as shown in Figure 4.6. The red dotted oval indicates the movement of his laser pointer on the screen.

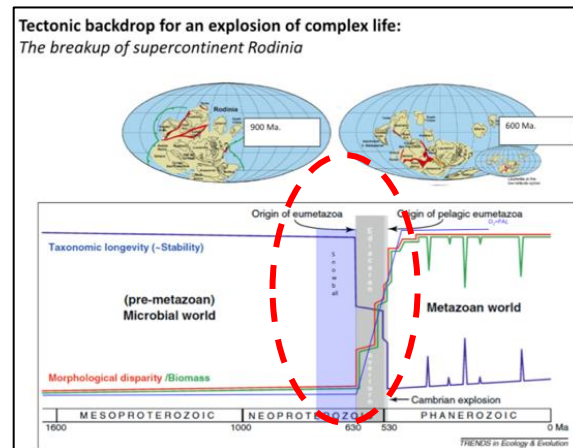


Figure 4.6 Course slide 4 with Robert’s laser pointer movement circling the coloured zones (Snowball Earth, 09/30/2019)

This action constitutes the socialization of observation by focusing attention on key elements of an image that viewers might not otherwise notice. As can be seen in Figure 4.6, there are four lines labelled with four different terms: colour-coded in blue (taxonomic longevity), red (morphological disparity), green (biomass), and purple (O_2 =PAL). Placed at the top of the graph, the blue line was parallel to the rest of the lines at the bottom. At the right end of the purple area in the dotted circle, these parallel lines demonstrated a sudden sharp decrease and increase respectively, intersected in the middle of the grey area, and eventually got completely reversed afterwards.

Here, my observations of student pair/group embodied practices during the activity and the graphical patterns on the image together appear to suggest the possibility that students’ deictic gestures/embodiment may have been performed in some alignment with the nature of the observable patterns on the displayed image under discussion.

In a similar fashion, Robert also performed deictic gestures to point to and locate specific objects and geological patterns in the observation activity. Here, unlike his students whose deictic gestures were not able to pinpoint the referents on the visual, Robert utilized his laser pointer to more precisely point to specific objects and patterns in the displayed image in a more

visually well-grounded manner. Importantly, in his lecture, as exemplified in Figure 4.6 above, he would often demonstrate the simultaneous coordination of spoken and gestural deictics to orally and gesturally point to the specific referents observable in the displayed image.



Figure 4.7 Course Slide #9 (Europa, 09/27/2019)

Figure 4.7 is a spatial image of the surface of *Europa*³ (one of Jupiter's satellites) taken from the course slide used on September 27, 2019, and Figure 4.8 represents a series of deictic laser pointer movements performed by Robert on Figure 4.7 on the screen. In the middle of the class, Robert prompted his students to make observations of the displayed image in small groups. When a pair of his students coordinated their deictic gesture and spoken utterance “The top left is very . . . (followed by inaudible utterances),” Robert jumped in on their discussion and pinpointed the top left area using his laser pointer accompanying his spoken deictic utterance “There?” (see Figure 4.8-a). Similarly, in the subsequent whole-class discussion, he made use of his laser pointer to refer to and locate specific observable patterns in the displayed image, accompanying such spoken deictics as *there*, *this*, and *these* (see Figure 4.8 extracted from my Fieldnotes, September 27, 2019).

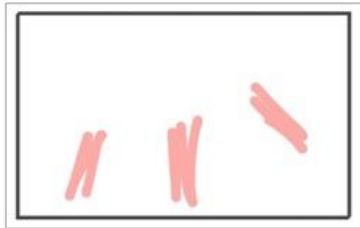
³ Prockter, L. M., & Pappalardo, R. T. (2007). Europa. In L-A. McFadden, P. R. Weissman, & T. V. Johnson (Eds.), *Encyclopedia of solar system* (2nd ed., pp. 431–448). San Diego, CA: Academic Press.



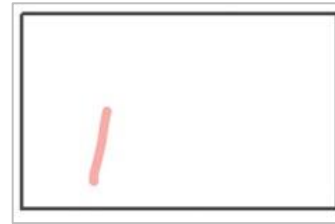
a. Robert: "There?"



b. Robert: "This way, this way."



c. Robert: "Do you mean these ones,
ones,
these ones, or these ones?"



d. Robert: "This vertical one is. . . ."

Figure 4.8 Robert's simultaneous coordination of deictic laser pointer use and spoken utterances (Fieldnotes, Europa, 09/27/2019)

It is noteworthy that in the absence of his laser pointer due to battery issues, Robert made use of his laptop cursor (an arrow, ↖) as an alternative means to point to specific objects and patterns on the screen (Fieldnotes, 11/06/2019). These findings together suggest the prominence of deictic gestures in coordination with spoken deictics in making geological observations in the activity. Deictics are critical in this disciplinary context because of the need to pinpoint observable elements in images in relation to other elements and to identify patterns and relationships.

To summarize, making observations appeared to constitute an important part of *thinking and communicating like geoscientists* in EPS 251. As an initial phase of geoscientific knowledge construction, students were expected to remain descriptive and discuss and communicate what they saw and observed exclusively, without making any interpretations or assumptions about *what* they saw. Notably, it was observable geological, spatial, temporal or graphical *patterns* in the displayed images that were targeted to be identified in the observation activity. In so doing, both the instructor and his students actively orchestrated gestural and spoken modes to deictically refer to, locate, and further generate discussion about the observable patterns and features in the visual image.

4.2.3.2 The Role of Scale as a Vital Tool for Observations

Before proceeding to the discussion of interpretation, the crucial roles of ‘scales’ in this activity and in geoscience at large must be discussed as an essential device to provide context for the observable geological features and patterns in question. In an attempt to provide a general definition of what a scale means, I first draw on a piece of literature in geoscience. In a journal specializing in remote sensing technologies related to terrestrial, oceanic, and atmospheric environments (which fall under the broader territory of geoscience), Dabiri and Blaschke (2019) provided a basic explanation of a scale and its roles in geoscience as follows:

In geoscience disciplines (also known as Earth sciences), scale concepts are well recognized as a critical factor when studying patterns in nature and the processes that cause them.

(Dabiri and Blaschke, 2019, p. 419)

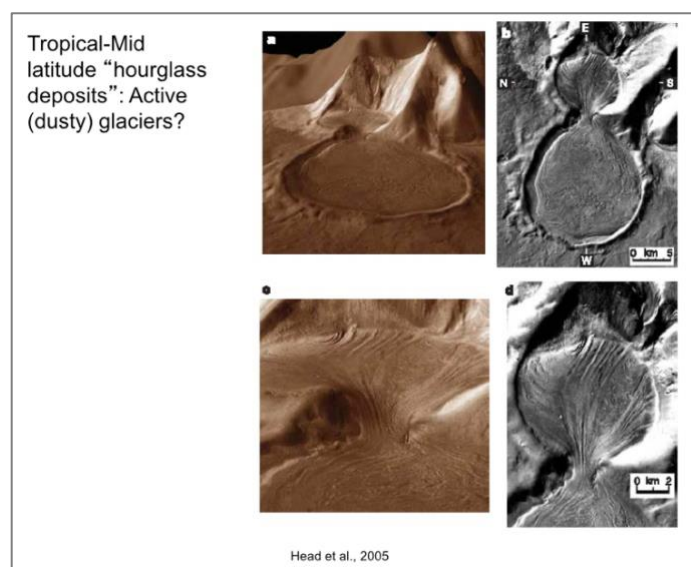


Figure 4.9 Sample scale bars in course slide #19 (Mars surface process, 09/20/2019)

Echoing Dabiri and Blaschle’s view on scales as ‘crucial’ factors studying the pattern, Robert also described scales as “a vital piece of observational experience,” without which accurate observations and reasonable interpretations would become arduous (if not impossible; Robert, Interview, 01/24/2020). While what constitutes scales seems to be highly ambiguous and conceived differently across and even within disciplines (Dabiri & Blaschle, 2019), some

common types of scale seen in EPS 251 included typical scale bars (see Figure 4.9, bottom right side of images on right) or material objects at geologists' disposal in their fieldwork (e.g., hammers, pencils, coins), and humans as a reference point for comparing geological features within the image). Figure 4.10, for example, shows a number of humans (dressed in red), giving a sense of the scale of the crystals and cave shown.



Figure 4.10 Course slide #2 (Cave of Crystal, 10/23/2019)

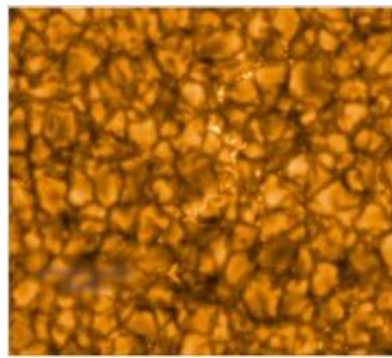
Despite the importance of scales in making reasonable observations and interpretations of the geological features and patterns, a great majority of the photographic images presented in EPS 251 lacked any kinds of scales (see Figure 4.2 as examples, especially those on the right side). In fact, Robert clarified in his interview that he had purposely selected photographic geological and planetary images that did not explicitly display a scale. Or when a material or human scale or reference point appeared to be present in the image, these scales seemed to be backgrounded in relation to the massive size of the geological and planetary features and objects (see Figure 4.10). With regard to his purposeful omission of scales from the images, Robert disclosed his pedagogical intention as follows:

Excerpt 4.9 "I wouldn't expect them to get that picture because the scale is not there."

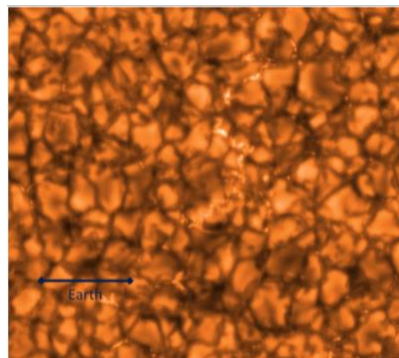
- | | | |
|----|--------|---|
| 01 | Masaru | Yeah. And while I was in class, observing your teaching, |
| 02 | | I felt it's very important to have this kind of scale, right? |
| 03 | Robert | Eventually. Yeah, yeah. But I was trying to do it on purpose. |

04 This is trying to show them that the universe has similar structures
 05 at multiple levels. I mean, the fact that you can have something
 06 that looks like cells, cheese, or the sun and it all looks the same.
 07 That speaks to some greater thing about how these sorts of structures.
 08 Masaru And what do you think is the role of like, how would you describe
 09 the role of like uh like a scale?
 10 Robert The scale is a vital piece of observational experience. I mean,
 11 you really can't tell. And I mean, I wouldn't expect them to get
 12 this picture. And their job isn't to get it right. Their job is to think about it.
 13 I wouldn't expect them to get that picture because the scale is not there.
 (Robert #2, Interview, 01/24/2020)

In short, Robert's pedagogical intention was to help his students to become able to make visually well-grounded observations and interpretations of geological and planetary features and objects *in their own context*. To achieve this way of *thinking and viewing like geoscientists*, students were inclined to take scales into consideration and think of the relative size of the observed objects when they make observations and interpretations.



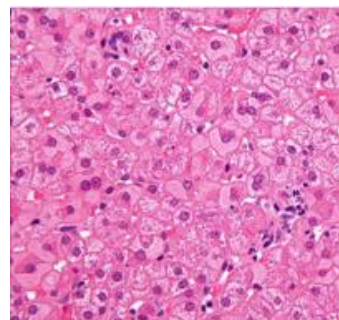
Surface of the Sun
without a scale
(Slide 2)



Surface of the Sun with a
scale
(Slide 3)



Cross section of cheese
(Slide 4)



Cells
(Slide 5)

Figure 4.11 Course Slides #2-4 (Wrap up, 11/22/2019)

In his interview (Excerpt 4.9), the vital role of scales was highlighted in lines 5–6 with a specific example drawn from a set of particular images used in the final class meeting (Figure 4.11). In Figure 4.11, the first two magnified images represent the surface of the sun *without* (Slide 2) and *with* a scale (planet Earth, Slide 3). As Robert articulated in lines 5–6, the image *without* a scale in Slide 2 could inevitably be interpreted in a number of random ways without an understanding of the object’s actual size, including cheese and cells (Slides 4–5). In fact, in the whole-class discussion, some students provided their own guesses of the image in Slide 2, including a cookie or a granola bar, a beehive (Leah), Venus (whose radius is similar to that of the Earth’s⁴), and so forth. It was only after the overt presentation of the scale in the subsequent Slide 3 that more focused observations and interpretations were made possible for students to draw comparison between the scale and the visual image in question. In other words, scales served to provide “context” (according to a TA’s metaphor, Fieldnotes, 11/08/2019) or a basis for a visually well-grounded observation and interpretation of the geological/planetary objects or features *in the object’s own context*, rather than on the basis of individual observers’ own assumptions or preconceptions.

To sum up, taking into consideration scales was one crucial aspect of *thinking—or viewing/observing—as geoscientists* that was promoted in EPS 251. Viewed by Robert as “a vital piece of observational experience” (Interview 2, 01/24/2020), scales served to provide context for the geological/planetary objects and features in the image to be observed and interpreted *in their own context*, independent of the observer’s own assumptions. In the observation and interpretation activity, students were expected to make their observations and interpretations in careful consideration of scales, which were realized by a wide variety of available reference points within the image (e.g., Figure 4.9).

4.2.3.3 Making Interpretations of Observable Geological Features and Patterns

After the discussion of student observations, the class would proceed to making interpretations of the displayed image, first in small-groups and then in the whole-class

⁴ Smrekar, S. E., & Stofan, E. R. (2007). Venus: Surface and interior. In L.-A. McFadden, P. R. Weissman, & T. V. Johnson (Eds.), *Encyclopedia of solar system* (2nd ed., pp. 149–168). San Diego, CA: Academic Press.

discussions (Figure 4.1; see also Section 4.2.3). To initiate these discussions, Robert would orally utter prompting questions that typically included: “What interpretations do you make based on your observations?” (09/27/2019) and “What interpretations can you think of?” (10/26/2019). Following these oral prompts, students would start discussing their interpretations in groups for about one to three minutes. In the following whole-class discussion, three to four students would typically offer their own interpretations of the displayed visual image. The whole-class discussion generally lasted longer than the other phases of the observation and interpretation activity, since it normally included student responses and Robert’s feedback and follow-up explanations about the displayed image.

4.2.3.3.1 What constituted a valued form of interpretations in the geoscience classroom?

In contrast to *observations* wherein student comments were expected to remain completely descriptive of what they *saw/observed* (Robert, Interview, 01/24/2020), the subsequent interpretation activity appeared to seek a scientific understanding and account of observable geological features and patterns. To be more specific, students were expected to ‘think about’ and ‘communicate’ their own hypotheses about the observable geological pattern and features, and in particular, about possible *geological processes* that might have caused them. In his interview with me, Robert explained the nature of interpretive processes as follows:

Excerpt 4.10 "It’s almost like a creativity thing."

01	Robert	Interpretation is hard, because that requires a depth of knowledge
02		of what things look like. What processes might have occurred on them.
03		And so there’s certain. It’s almost like a creativity thing. Like, what
04		could this possibly be? What did these shapes make me think of?
05		And how could it have formed in this layer. You would need to
06		look for hints and clues about relative timing of events. You want to
07		look for clues about what the properties of the events are.

(Robert #2, Interview, 01/24/2020)

Jack echoed this sense of how to make interpretations as geologists based on their earlier observations, providing some concrete examples in his following explanation:

Excerpt 4.11 "We have to know what caused these patterns."

01 Jack For interpretation. So firstly, we have to know what caused these
02 patterns. And like for example, if there's a smooth surface,
03 that might be water or fluid. If there's like something, for example,
04 just for the strata, the ground is layered and covered by layer,
05 if something bent and that means something like pushed them.
06 So we can like basically use this patterns. We can explain things.
07 Masaru Yeah okay.

(Jack, Interview, 12/13/2019)

It should be noted that while recognizing this interpretive process as challenging, Robert often provided a wide variety of assistance to his students in the interpretive discussions. This generally included reiteration of earlier student observations (Fieldnotes, 10/02/2019) and encouragement for students to think about the 'scale' (e.g., "What do you think the scale is?"; Fieldnotes, 10/25/2019). Robert also often attempted to elicit scientific reasoning when a student explanation was deemed insufficient or unreasonable by "What's your evidence for that?" (Fieldnotes, 09/18/2019) or repeatedly asking "Why?" and "How?" (e.g., Fieldnotes, 10/02/2019).

In addition to providing scientific accounts, my classroom observations further suggest that expressing tentativeness of their hypothesis in their discussion appeared to be an important aspect of constructing and communicating their own interpretation as geoscientists. To be more specific, hedged grammatical constructions were often used by both Robert and his students when they orally provided their interpretations and when Robert attempted to elicit his students' interpretations. Some examples of such hedged spoken utterances can be found in the above excerpts (with italics added here): "What *could* this *possibly* be?" and "How *could* it have formed in this layer" (as in Excerpt 4.11; Robert, Interview, 01/24/2020) and "[i]f there's a smooth surface that *might* be water or fluid" (as in Excerpt 4.11; Jack, 12/13/2019).

In sum, in making their interpretations as geoscientists, students went beyond the descriptive observation and reporting of the geological patterns and features in the image. Rather, they were prompted to think, hypothesize, and communicate possible explanations for the geology in question and geological *processes* in particular that might have formed/shaped the observable geological features and patterns, synthetically considering their early observations, scales, and other kinds of scientific knowledge. The elusive interpretive process was often

scaffolded by the instructor through his repetitions of early student observations, his prompt questions to make them think about the scale, and the elicitation of reasonable scientific accounts when scant reasoning was provided. Their interpretations often accompanied hedged spoken utterances that served to demonstrate tentativeness of their hypothetical accounts of the geological processes and patterns in question.

4.2.3.3.2 Multimodal practices during the interpretation activity in the geoscience classroom

Whereas the coordinated use of spoken and gestural deictics was prominent in the early observation phase (i.e., pointing to observed geological feature and pattern) as noted in Section 4.2.3.1.3, my classroom observations suggest that Robert and his students appeared to predominantly demonstrate *iconic* gestures when they were engaged in their interpretive discussions (McNeill, 2005). According to McNeill (2005), an iconic gesture is one type of gesture that is representational and characterized by its resemblance to the object and/or event it represents. He defines iconic gestures as follows:

[Iconic gestures] present images of concrete entities and/or actions. They are gestures in which the form of the gesture and/or its manner of execution embodies picturable aspects of semantic content (aspects of which are also present in speech). (p. 39)

In short, both Robert and his students appeared to *iconically* embody hypothetical geological processes that could have caused the observable features and patterns in making and communicating their own interpretations.

One notable example comes from a small-group activity, in which students were prompted to provide concise explanations of plate tectonics⁵ to their partner. When a student in a dyad attempted to explain the geological process that could result in an earthquake, the student uttered their explanation “One is going over the other” accompanying two contiguous gestural hand motions as my approximate reproductions show in Figure 4.12 (Fieldnotes, 09/30/2019).

⁵ According to Cox and Hart (1991), plate tectonics is a scientific theory of “the forces within the earth that give rise to continents, ocean basins, mountain ranges, earthquake belts, and other large-scale features of the earth’s surface” (p. xvii).

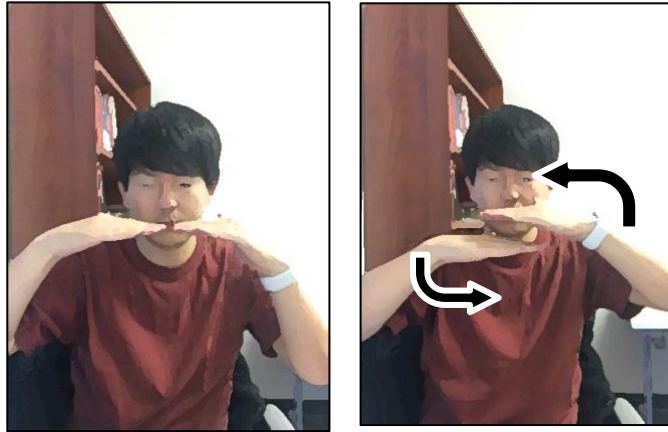


Figure 4.12 Student's "One-is-going-over-the-other" gesture
(reproduced by the researcher, 09/30/2019)

The first image on the left presents the student's initial hand movement, wherein their hands were positioned in front of them horizontally in the air, with the palms completely facing down. Here, their right and left middle fingers were closely attached to each other and appeared to shape an embodied flat line. Then the student detached their middle fingers and moved their hands over or underneath one another as depicted in the second image on the right. This hand movement coincided with a spoken utterance "one is going over the other." The co-occurrence of the contiguous flattened and layered hand motions and the spoken utterance in relation to the topic of discussion together appear to suggest that their hand positions were representational of two converging tectonic plates in the first image while the subsequent inward hand movements and layered positioning appear to represent the geological movement of the embodied tectonic plates in the second image. Namely, the latter appears to embody the geological process of subduction, wherein one of the converging tectonic plates moves and is forced to sink under another. The coordination of students' flattened, palm-down hands, their spatial positions vis-à-vis one another (i.e., the upper vs. lower positions), the convergent hand movement, and their spoken accounts appeared to fulfill the preconditions for representing and communicating the embodiment as a representation of the geological process of subduction.

Another instance of student iconic embodiment comes from my observation of a different class meeting, in which students first watched a YouTube video about the planets and then had

several discussions about issues related to the planets (Fieldnotes, 09/25/2019). The YouTube video was a 40-second short videoclip titled “Planets of the Solar System: Tilts and Spins” (<https://youtu.be/my1euFQHH-o>), which animated the rotation of all eight planets and juxtaposed their obliquity and rotation periods as in Figure 4.13. After watching the video, Robert posed a question about the climate and seasons of Venus.

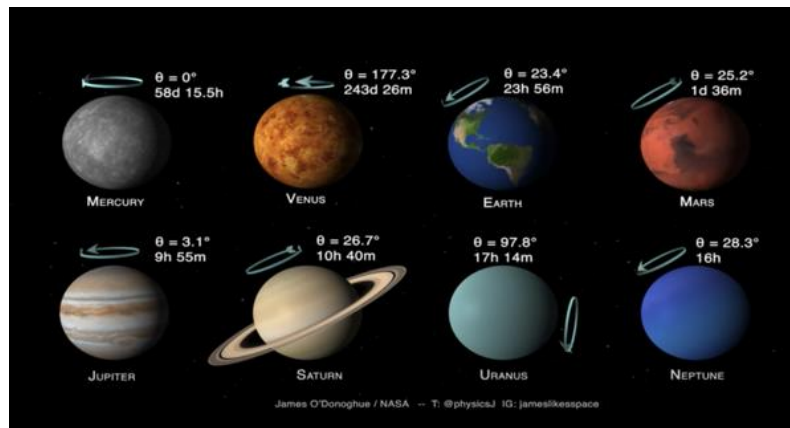


Figure 4.13 A screenshot of a YouTube video used in a class activity (Fieldnotes, 09/25/2019)

In the small-group discussion, several students produced a holding gesture similar to the one shown in Figure 4.14, with their palm facing up and fingers slightly bent inwardly. Concurrently, these students rotated the holding hand inwardly and horizontally in the direction that the arrow indicates in Figure 4.14 at notably slow speed. Recall here that the students had watched the rotation of the planets in the video, in which Venus was rotating at the slowest speed of all other planets (i.e., it takes approximately 243 Earth days for Venus to rotate once). Taken together, the possible interpretation of the students' rotational iconic gesture would be that students might have embodied the spherical shape of Venus as well as its notably slow rotational speed in ways that they had seen in the video.



Figure 4.14 Student's rotational gesture
(reproduced by the researcher, 09/25/2019)

In other words, students were being apprenticed into forms of observation and interpretation in geoscience in a very embodied way, in which language, visual images, and (iconic) bodily movements coalesced to construct and convey meaning. Presumably in other disciplinary fields, such as medicine, engineering, or forestry, such embodied deictics are also heavily used to physically, and sometimes dramatically, capture processes and relationships among physical objects or systems.

In a similar fashion, Robert produced a series of iconic gestures in his explanations about the climate and seasons of Venus soon after the small-group discussion (Fieldnotes, 09/25/2019). In his explanation during the whole-class discussion, Robert uttered “The sun is here . . . and it’s the opposite.” accompanying a series of the upper-body movements as reproduced in Figure 4.15. The first image on the left represents the moment in which Robert first raised his right arm straight vertically, orally uttering “the sun is here.” Here, he appeared to provide a contextual meaning to his right arm as the ‘embodied’ sun through his spoken utterance. He then extended his left arm horizontally further left. As he provided his spoken explanations (which could not be transcribed due to Robert’s fast speech rate), he gradually moved his tightly extended left arm from the left to his front and to the right, producing a circular and horizontal arm movement as represented by an arrow in the second image. When his left arm reached the opposite end, he stopped his body movement and uttered “... and it’s the opposite.”

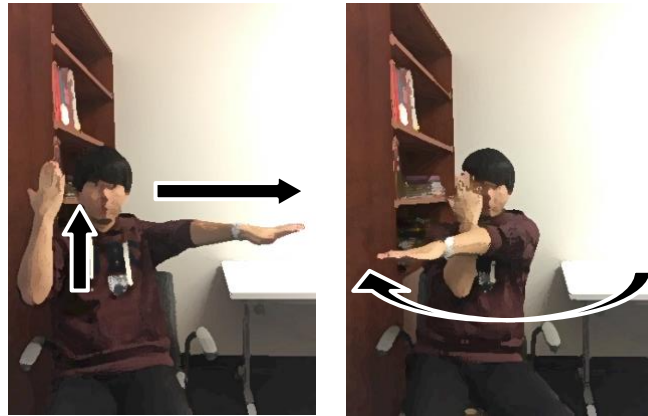


Figure 4.15 Robert's orbital gesture
(reproduced by the researcher, 09/25/2019)

The simultaneous coordination of spoken utterances and embodied actions as well as the topic being explained (i.e., the climate and seasons of Venus) together indicate that Robert attempted to embody Venus's orbital position and movement vis-à-vis the sun, which takes the central, fixed position in the Solar System. First, his right arm was orally given a contextual meaning as the sun and demonstrated no arm/hand movement in the series of embodied explanation. Second, the embodied sun (i.e., right arm) appeared to be used as a pivot around which the left arm rotated toward the other end. The horizontal and circular left-arm movement would be particularly indicative of its resemblance to the actual orbital motion of the planet under discussion (i.e., Venus), which orbit horizontally and circularly around the sun (McNeill, 2005). Furthermore, the end point of this particular circular movement seems to be also important for him to further explain the influence of changing orbital position on seasonal climate changes on Venus.

In summary, making interpretations appeared to constitute another important facet of *thinking and communicating like geoscientists* in EPS 251. Here, *communicating* involved not just oral, written and graphic texts or images, but also embodiment and relational (iconic) gesture and movement. As the second phase of geoscientific knowledge construction, students were expected and prompted to synthetically think about and communicate possible hypotheses for the observable geology and the geological processes in particular that may have formed/shaped it based on their early observations, scales, and other kinds of science knowledge. In this process, hedged spoken language was commonly used by both Robert and his students that served to

express tentativeness of their interpretive accounts. They also employed a number of iconic gestures to embody (relative) positions, shape, directionality, and movement of the object(s) to represent geological and planetary processes.

4.3 Summary of the Chapter

Guided by Research Questions 1 and 2, this chapter presented the major findings related to the culture, values, and classroom practices fostered in the undergraduate geoscience classroom. I demonstrated that these norms and practices socialized students into scientific ways of thinking, viewing, and communicating *as geoscientists* and are thus a locus of such academic discourse socialization. I then provided in-depth descriptions and interpretations of the recurrent classroom activity called *observations and interpretations* of geological features and patterns as a salient multimodal practice. From an ecological perspective (van Lier, 2002), those interactions were *triadic*, mediated not only by individuals' linguistic actions, but also by a myriad of embodied and multimodal meaning-making resources (i.e., gestures, visuals on the screen, scales, and so forth). Each of those modes served as *affordances* (van Lier, 2000, 2004) for students to act upon and unfold their social action and interaction in ways that were valued in the geoscience discipline. Seen in this light, therefore, “talking, demonstrating, gesturing . . . cannot be seen as irrelevant to or separate from developing academic discourse in the required discipline” (van Lier, 2004, p. 161). In Chapter 5, I discuss how these classroom multimodal and embodied practices were manifested in students' micro-level presentation performance (spoken and written language, visuals, iconic and deictic gestures).

Chapter 5: Students' Multimodal Practices in Geoscience

Poster Presentations

5.1 Introduction

Poster presentations were a significant curricular component of geoscience education in the course I observed, where representation, observation, and interpretation of scientific phenomena were emphasized. In this chapter, I report on the task characteristics and context of the poster presentation in EPS 251, linking this task to key principles that were part of the approach to geoscience teaching described in the previous chapter. I also examine the multimodal practices performed by student presenters and their viewers in their geoscience in-class poster presentations. In particular, I present two posters prepared and presented by pairs of students based on templates and instructions provided by the instructor, and then discuss the salient forms of ADS that took place through this activity. More specifically, this chapter first offers the descriptions of the task requirement of the geoscience poster presentation task in EPS 251. I then provide in-depth analyses of students' poster presentation performances that specifically focus on their multimodal observational and interpretive activities. The final summary recapitulates the major findings of this chapter to bridge the present chapter and the concluding chapter that follows this.

5.2 Descriptive Features and Task Context of the Poster Presentation

Posters were assigned to take place both in the middle and at the end of the course, though the latter were the most elaborate and had the highest stakes associated with them (30% of course grade). These latter posters are therefore the focus of this chapter. Because the final poster was the culminating activity for the course, Robert (the instructor) methodically socialized or mentored students into poster presentations throughout the course. As part of their mid-term poster activity, for example, students had been encouraged to provide one another feedback on each other's group posters, which were relatively hastily prepared and represented the summaries of articles. Later, in the class meeting on November 6, 2019, Robert discussed the task requirements for the end-of-term poster presentation to take place 2-3 weeks later. This information was delivered through his spoken explanation in combination with PowerPoint written descriptions as well as a written document, which covered key details about the logistics,

content, and organization of the poster presentation. I provide concise descriptions of each of the items below.

5.2.1 Logistics of the Poster Presentation

Poster presentation sessions were held in the three class meetings of the final week of the Fall semester (November 25th, 27th, and 29th, 2019). The poster presentation task was done in groups of two or three students, so that a total of 17 groups were eventually formed (15 pairs and two groups of three). Students were able to choose their partner(s) when they formed poster groups. There were six concurrent poster presentations each of the three days, and the poster sessions were held in a public space within the geoscience department building. The duration of the poster sessions each day was approximately 50 minutes, during which non-presenting students could freely visit their presenting peers, watch their presentations, ask questions, and take notes on pieces of paper or using their mobile phones to evaluate each other's poster presentation, as required. Members of the public were also welcome to attend the sessions although most of the people in attendance on all three days were members of the class. Six student pairs/groups agreed to be video-recorded, but I focus in this chapter on two pairs (four focal participants) to illustrate multimodal ADS in geoscience (see Chapter 3, Methodology). Robert and students not presenting their posters moved around the poster space alone or in small groups and interacted with presenters as they went along. At the far end of the corridor were snacks and drinks students could enjoy as part of this end-of-term activity.

5.2.2 Content on the Poster

In the November 6 class, Robert explained that the topic of the poster presentations could be anything broadly related to topics and issues in Earth and planetary science. To guide this topic selection process, Robert provided several instructions to students.

First, students were instructed to find a *data set* that showed intriguing *patterns* in it. They were also expected to be able to explicitly identify the key elements of their chosen pattern and provide justification for their interest in exploring the pattern. Furthermore, Robert explicitly requested that students include their data set in a large 'Figure 1' in their poster, so that the data set could be easily seen by the audience. To scaffold this data search process in preparation of

their posters, Robert provided a number of links to databases (e.g., Nasa, Seismic Tomography database, Global SO₂ monitoring, Volcanic Eruption databases, etc.).

Second, students were instructed to formulate *a research question* and use it as the title of their poster. Importantly, Robert stressed that the question must be formulated based on the pattern of interest in their data set. In his written instructions, he stated:

Your question must be motivated by a temporal or spatial pattern of behaviour you observe in a specific data set. Your question must fall explicitly out of some feature in this pattern that catches your attention. This data set can be published (e.g. recent climate change, mars surface roughness, etc.) or it can be a data set that is yours.

(Task Description, 11/06/2019)

Third, students were requested to provide a *model* (see Section 5.2.3) in their poster that was used to construct their scientific account of the observable pattern in the selected data set. In both the lecture slide and written task description, Robert stated the following:

You must present a model that is used to build understanding of the pattern in the data. This model can be one that is published or one of your own design.

(Task Description and Course Slide #7, 11/06/2019)

Thus, while Figure 1 specifically required a data set that motivated the research questions in the poster, the Model section contained visual and written scientific explanations regarding the observable patterns presented in the data in response to the research question(s). In terms of academic discourse socialization, therefore, three elements were emphasized: finding appropriate data (i.e., interesting pattern), posing suitable research questions (as the title of the poster); and then creating explanatory models. In this way, Robert scaffolded the poster presentation carefully and clearly about critical components, layout, and content.

5.2.3 Basic Organization of the Poster

In addition to the oral and written task requirements, Robert provided students with a poster template (.pptx format) that students could adapt or adopt to design their own poster. (The instructor later printed the posters, free of charge, for the students from the electronic file using a large printer in his department. These printed versions were displayed during their presentations.)

Figure 5.1 below shows the poster template given to the students. The template explicitly required several written and visual components that must be included in the poster, which served to socialize students into preferred ways of displaying knowledge in this format. At the top of the poster, the poster template required the title of their presentation and authors' names and affiliations. The title was set to 145 point font size, which was the biggest of all the written components in the poster.

The poster template features a blue header bar at the top. On the left side of the header is a black square representing a school logo. To its right, the text "Title: Subtitle" is written in a large, bold, yellow font, and "Authors and affiliations" is written in a smaller, white font below it. Below the header, the poster is divided into five white rounded rectangular boxes with blue borders. The boxes are arranged in two rows: the top row contains "Introduction", "Figure 1", and "Summary"; the bottom row contains "Model" and "References". The "References" box also includes an "Acknowledgments" section at the bottom. Each box contains specific prompts or instructions for the student's content.

Title: Subtitle		
Authors and affiliations		
Introduction What the pattern you see is Why is it interesting	Figure 1 Maybe some descriptions of the figure	Summary What is the point? How will this help? What is something cool?
Model Really a hypothesis And explanation for the patterns you observe. You might want more figures.		References At least two per person Acknowledgments Who do you want to thank for this?

Figure 5.1 Poster template (36 x 42 inches; school logo is redacted in black; the font size of the instruction is increased from 44 to 64 points to enhance readability)

Beneath the title and authors' information, there were five white rounded rectangles which indicated the expected structural organization and required content of the poster presentation. The five frames were designated as *Introduction*, *Figure 1*, *Model*, *Summary*,

Reference, and *Acknowledgements*. Importantly, each section had brief instructions of the content to be included:

Introduction	What the patterns you see is. What is it interesting.
Figure 1	Maybe some descriptions of the figure.
Model	Really a hypothesis And explanations for the patterns you observe. You might want more figures.
Summary	What is the point? How will this help? What is something cool?
Acknowledgement	Who do you want to thank for this?

Of the five component boxes in the template, Figure 1 and Model were allocated a much larger space than the other three. Also, both Figure 1 and Model explicitly required the inclusion of at least one visual component as well as written captions for each of those figures. However, students were encouraged to redesign the default poster template to meet their own specific needs and content while maintaining the basic components and organizational structure. Two student-produced posters are presented below.

5.3 The Spatial Layout and Content of Students' Posters

Before going into detailed analyses of students' multimodal interaction in the poster presentation, I offer brief descriptions of the two posters created by the focal groups.

5.3.1 Leah and Emma's Poster on Uranus

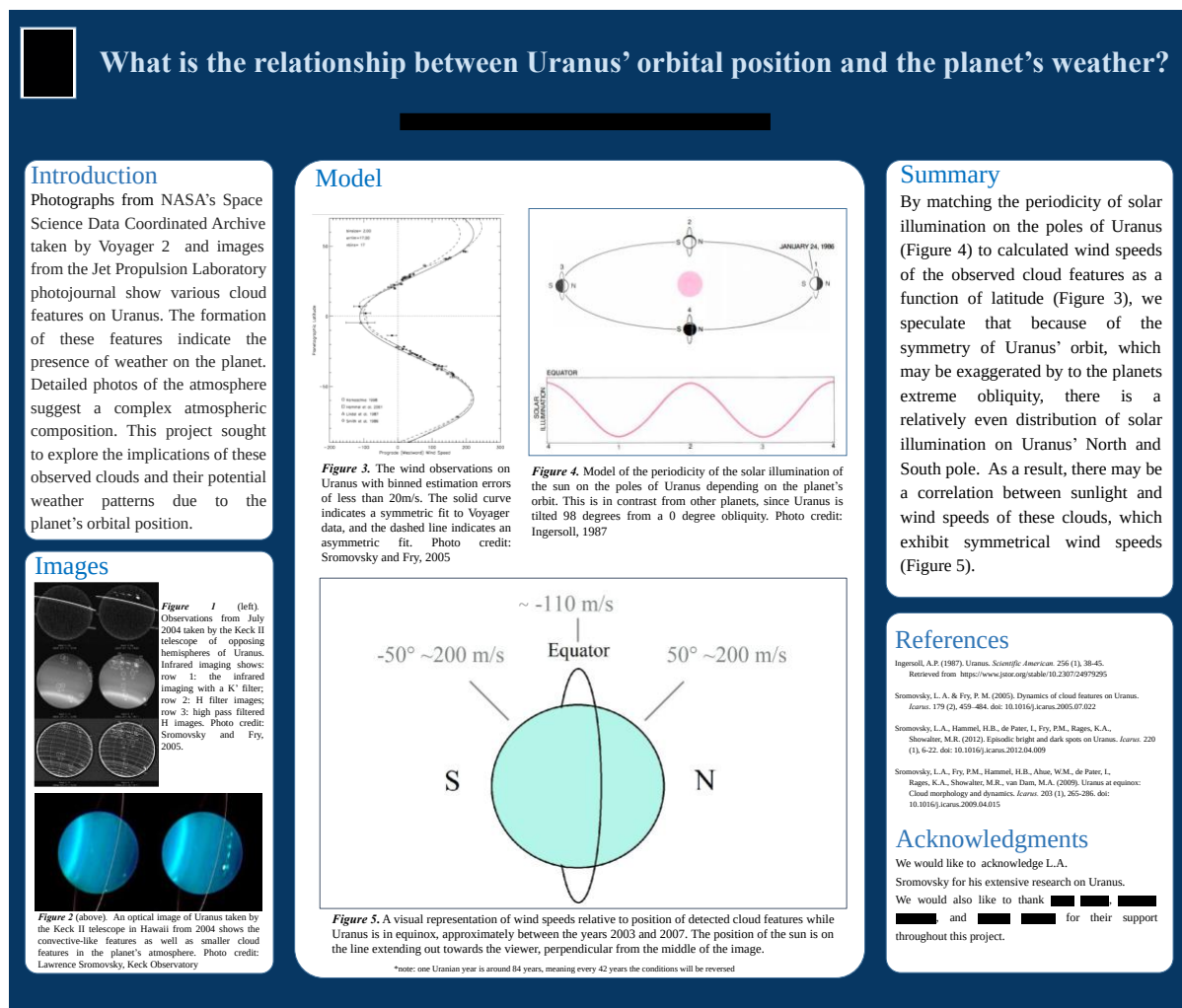


Figure 5.2 Leah and Emma's poster on Uranus

(identifiable information is redacted in black for anonymity)

The title of Leah and Emma's poster was "What is the relationship between Uranus's orbital position and the planet's weather?" Their poster was composed of five large sections (similar but not identical to the template shown in Figure 1): Introduction, Images, Model, Summary, and References / Acknowledgements. While Introduction, Summary, and References and Acknowledgements sections were highly text-dense without any visuals, Images and Model sections presented a total of five figures with small written captions. Among the five visuals, their Figures 3, 4, and 5—large images placed in the middle of the poster—appeared to be more frequently referenced by presenters than Figures 1–2 in their poster presentations. Even though

Figures 3 and 4 were framed within the “Model” section, these graphic figures appeared to be functioning more as two distinct data sets that informed the group’s hypothetical correlation between the solar illumination and the wind speed of the planet (see the written explanation in the Summary section of the poster).

5.3.2 Jack and Rachel’s Poster on the Ozone Layer Distribution

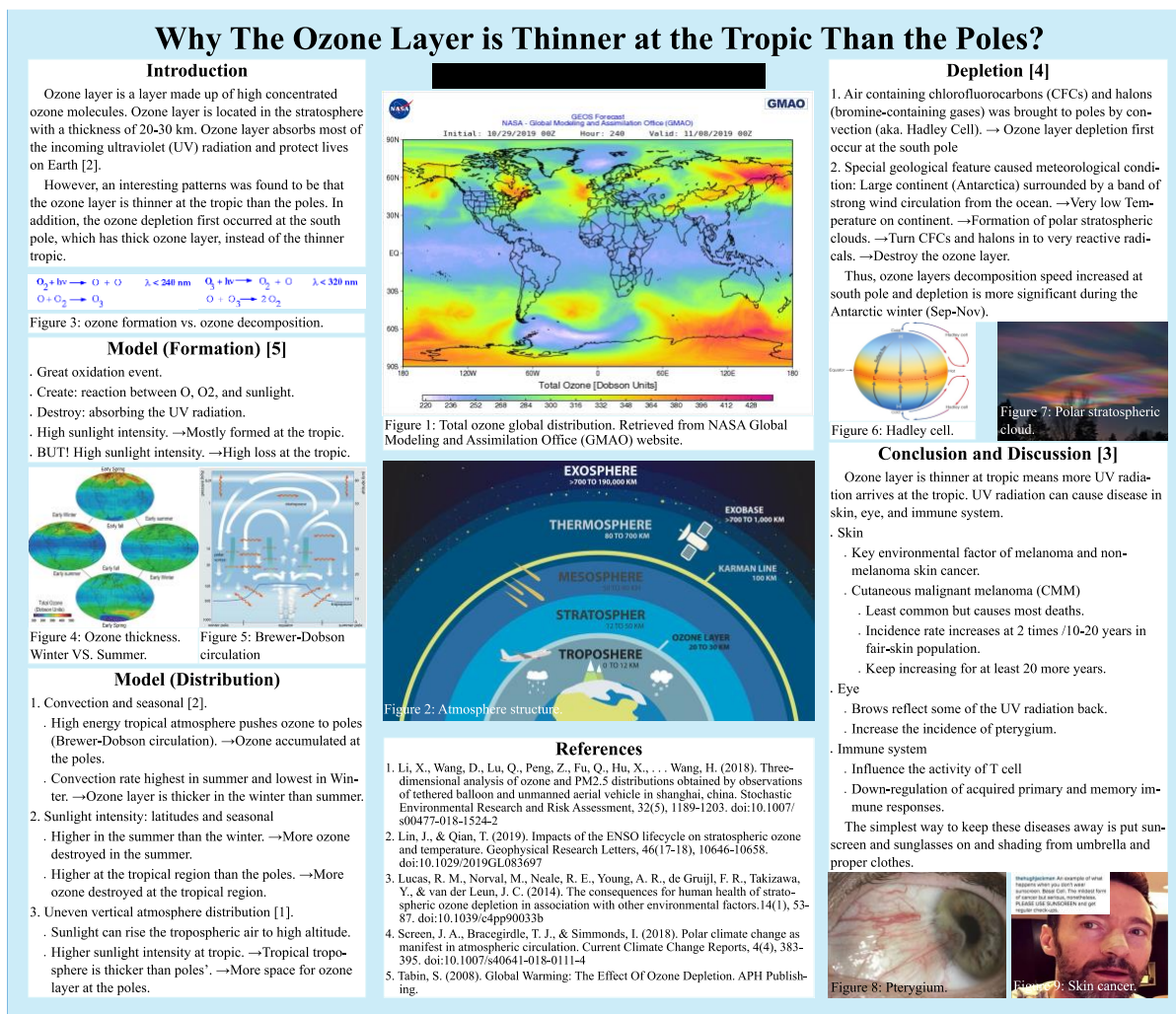


Figure 5.3 Jack and Rachel’s poster on the ozone layer distribution (identifiable information is redacted in black for anonymity)

The title of Jack and Rachel’s poster was “Why the Ozone Layer is Thinner at the Tropic than the Poles?” Their poster could be roughly divided into six large sections: Introduction, the Model of ozone formation, the Model of global ozone distribution (with Figures 4 and 5), the

Model of ozone depletion in the Poles (with Figures 6 and 7), Conclusion / Discussion (which primarily discussed the possible influence of uneven ozone distribution on human health), and References. In the middle of the poster were the two largest and most often referenced figures: Figure 1 was their data set that showed the global ozone distribution pattern and Figure 2 represented the vertical structure of Earth's atmosphere. Note that although Figure 3 presented chemical formulas for ozone formation and ozone decomposition, it was rarely referenced by the presenters throughout their one-hour poster presentation.

Thus, although the two posters were designed using the same template, their formatting differed somewhat. The first, for example, had Summary and Acknowledgements sections, which the second poster did not have. Both included considerable visual graphic material, but the second had much more colour and imagery, including graphs, photos, and maps.

5.4 Students' Multimodal Practices in Poster Presentations

Adapting Norris's (2004, 2019) multimodal interaction analysis, I provide in-depth analyses of the focal students' poster presentation performance. I do so by examining their reporting of the patterns (Section 5.4.1) and their interpretive explanations of geological, atmospheric, or planetary processes that might have caused the observed pattern (Section 5.4.2). Through the analyses, I illustrate how students orchestrated a wide variety of meaning-making resources—not just oral, written and graphic texts or images, but also deictic and iconic embodiment and movements—to construct and convey meanings in the geoscience poster presentation, just as they had been mentored to do by Robert.

5.4.1 Students' Deictic Gestures to Provide Observational Contexts for the Pattern

As previously discussed in Section 4.2.3.1, making and reporting observations of patterns in a given data set appeared to constitute an important facet of the geoscience poster presentation in EPS 251. In so doing, focal students actively deployed spoken and gestural deictics in coordination with the written and visual information to refer to, locate, and discuss the observable patterns in their own data set. The data also suggests that their multimodal performance was also mediated by moment-to-moment gaze and postural shifts. They typically first referred to a colour scale or axes in their data set to specify the contextual meanings of these

observational device. They then proceeded to describe the observable pattern(s) in their own data set by simultaneously coordinating spoken and gestural deictics to point to particular items. Notably, students' spoken and gestural deictics often demonstrated alignments with and animation of the observable patterns in their own data set. In what follows, two excerpts are analyzed to demonstrate how students communicated their own observations by multiple modes in the geoscience poster presentation.

5.4.1.1 Jack's Deictic Multimodal Coordination in Describing the Ozone Distribution

Context:

Excerpt 5.1 was taken from the beginning of the first round of the poster presentation by Jack and Rachel (the second poster described above) on ozone layer distribution. Here, Jack was taking a turn presenting the material (as co-presenters often did). Having briefly explained the function of the ozone layer prior to the excerpt (i.e., absorbing UV light from the sun), Jack started to describe the pattern of ozone distribution by making reference to the coloured map (his group's data set; see Figure 1⁶ adjacent to Excerpt 5.1 below). In so doing, he coordinated spoken and gestural deictics multiple times, just as Robert had done in his class throughout the term (see Chapter 4), to first describe the global ozone distribution and then ozone holes over the poles as two salient observable patterns. In addition, he made an explicit spoken and gestural reference to the color scale bar beneath the map data set, again demonstrating the importance of scales (not only of size but also colour) described in Chapter 4. The images indicated in Excerpt 5.1 (<Pic 1, 2, 3....>) are shown beneath the excerpt.

⁶ The figure numbers correspond to the numbers originally presented on the poster.

Excerpt 5.1

- 01 J: based on: the: (1.1) graph we found (0.7) from
 02 NASA's website, xx uh (1.1) we found
 03 a pattern that (0.9) the ozone layer- as you can
 04 see (0.5) is thicker (0.8) at poles but - thinner (0.9) in
 05 tropical region. (0.8) and also, (0.8) we found
 06 a depletion (1.2) in (0.8) south pole.
 07 so (1.0) uh basically this is our (0.5) topic.

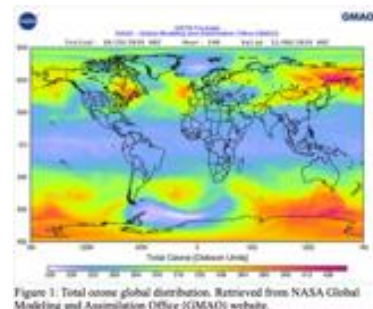


Figure 1
Total ozone global distribution



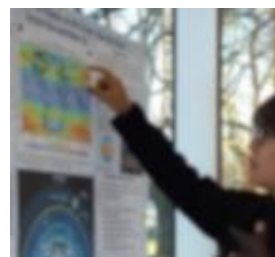
Picture 1 "we found a pattern"



Picture 2
"ozone layer is-"



Picture 3
"as you can see"



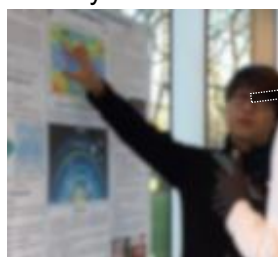
Picture 4
"thicker at the poles"



Picture 5
"thicker at the poles"



Picture 6
"but thinner"



Picture 7
"in the tropical region"



Picture 8
"we found depletion"



Picture 9
"depletion in South Pole"

Analysis

Having introduced the original source of his data set (lines 1–2), Jack continued to report the pattern of ozone distribution by emphatically uttering “*we found the pattern*” shown in lines 2–3. Concurrent with his spoken utterance, he moved his right hand in front of Figure 1, with his right palm facing the map as captured in Picture 1.

Immediately after the utterance “*pattern*” (line 3), Jack then produced the utterance “*the ozone layer*” while pointing to the centre of the colour map with his right hand (Picture 2). Here, as the attached dash in the transcript demonstrates, Jack produced an immediate cut-off after uttering the word “*the ozone layer,*” which appeared to suggest his immediate self-correction. After this, Jack swiftly moved his right pointing finger down to the right end of the colour scale and uttered “*as you can see*” in his attempt to make spoken and gestural reference to the scale (lines 3–4; Picture 3). Here, there are three important points to be noted regarding his spoken and gestural reference to the colour scale bar. First, the colour scale represented the thinness (left side, cold colours) and thickness (right side, warm colours) of the ozone layer along a coloured continuum, which was an important reference point for facilitating observations and for eventually making interpretations of the pattern. Second, his cooccurring spoken and gestural deictics appeared to complement each other in the moment-to-moment meaning-making process (Kress, 2015; van Lier, 2004): While Jack’s spoken utterances did not specify the visual referent, his pointing gesture appeared to play an important deictic role to specify the colour scale as the object to be seen. Third, his pointing hand was specifically located at the right end of the coloured continuum (i.e., higher ozone density) as a reference point for his further descriptive reporting.

After making reference to the scale (right end in particular), he extended his right arm and produced a pinching gesture in front of the red upper-right area of Figure 1 by emphatically uttering “*thicker at poles*” (line 4, Picture 4). He also swiftly moved his hand to point to other red-coloured zones on the map (e.g., lower-middle area, Picture 5).

Following his next spoken utterance “*but*” which appeared to mark the contrast with the preceding and proceeding speeches, Jack emphatically uttered “*thinner in the tropical region*” while horizontally moving his wide-open right hand along the wide-stretching blue zones (lines 4–5; Picture 6). Concurrent with the spoken and embodied descriptions, Jack shifted his eye gaze

from his poster to his viewer for approximately 1.0 second, which was followed by the (single) viewer's silent multiple nods that might have bodily signaled the viewer's understanding of Jack's explanation (Picture 7).

Having described the ozone distribution pattern, Jack reoriented his upper body to the poster and uttered the word "*also*" to mark the addition of new information in lines 5–6. After a 0.8-second pause, he pointed to the lower middle of the map with his right index finger (Picture 8) and offered his second observation orally regarding the ozone depletion over the Antarctic region. Two important points need to be noted here. First, Jack specifically pointed to the large lower-middle area on the map coloured in white or light purple. Here, recall that those two colours were defined by the colour scale to represent the low ozone density in this specific data set. Second, following his spoken and gestural deictics, he circled the lower-middle zone with his right pointing finger (Picture 9). The series of spoken and embodied explanation was achieved with his concurrent viewer-oriented gaze shift, which was once again, followed by the viewer's silent multiple nods that appeared to have indicated their comprehension of Jack's explanations.

To sum up, Jack actively orchestrated spoken and gestural deictics (among many other modes) in order to make reference to and locate the observable patterns and features in his visual data set. Not only did he point to patterns or objects (typically with an index finger), but Jack also simultaneously represented the shapes and widths of the referenced observable patterns and features in his coordinated explanations.

5.4.1.2 Leah's Active Multimodal Animation of the Observable Periodic Trend

Context:

Excerpt 5.2 was taken from Leah and Emma's second round of their poster presentation on Uranus' orbital position and its weather (i.e., the second presentation in a row in the same class period but to different viewers). In this short excerpt, Leah explained how the group had ended up choosing the topic through their observation of the two similar periodic trends in two distinct graphical data sets (i.e., Figure 3 and Figure 4⁷). Prior to Leah's extracted speech, she

⁷ The figure numbers correspond to the numbers originally presented on the poster.

had briefly explained Uranus's unique obliquity of 98 degrees (cf. Earth's obliquity of 23.4°) and the group's hypothesis about the relationship between the planet's tilt and weather:

Leah: So, we looked at the relationship between Uranus' orbital position and the planet's weather. As you may know, Uranus has a very interesting tilt. It's 98 degrees whereas compared to like, Earth is like 22 degrees. So what we want to do is to look at the, the, uh relation between its obliquity and weather. But we found that kind of difficult. However, we did notice that there seemed to be some sort of relation between its orbit around the sun and wind speed.

Having provided this brief introduction, Leah continued to provide her descriptions of the observable patterns in their data sets as shown in Excerpt 5.2.

Excerpt 5.2

01 L: so if you look at this- uh: (0.9) picture here, - this is
 02 <Pic 1> <Pic 2> <Pic 3>
 03 wind speed, (0.6) along the x axis, and latitude, (0.6)
 04 <Pic 4>
 05 along the y axis, and there is a ve::ry, like, - periodic
 06 <Pic 5>
 07 trend that kind of arises there. we also noticed that
 08 <Pic 6> <Pic 7>
 09 was really similar (0.5) to (0.8) the trend of (0.7)
 10 <Pic 8>
 11 the solar illumination (0.6) throughout its orbit.

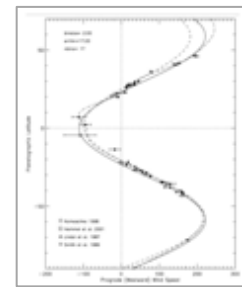


Figure 3
The wind observations on Uranus

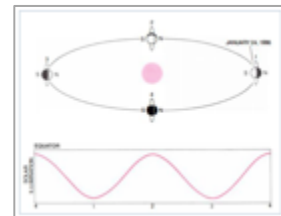


Figure 4
*The periodicity of the
solar illumination of the
sun on the poles of
Uranus*



Picture 1
“if you look at this”



Picture 2
“uh::”



Picture 3
“this is wind speed,
along the x axis”



Picture 4
“latitude along the y
axis”



Picture 5 “there’s a ve::ry
like, periodic trend”



Picture 6
“kind of arises there”



Picture 7
“we also noticed that”



Picture 8
“similar to the trend”

Analysis

Having provided the general background information of Uranus, in Line 1, Leah continued to offer a brief description of Figure 3 that showed the relation between Uranus’s wind speed (X-axis) and its latitude (Y-axis). Concurrent with her spoken utterance “*if you look at this,*” Leah extended her left arm to point to Figure 3 with her left index finger (Picture 1). Her pointing was followed by a sudden cut-off of the word “*this-*,” a noticeably extended filler “*uh::*” and a 0.9-second pause. During this noticeable pause (which appeared to have been caused by her sore throat), Leah produced wide circular left-hand movements twice over the graphical data (Picture 2), which might have served as an embodied “filler” before uttering the next word.

In lines 1–3, Leah first attempted to provide the contextual definition of two axes in the graphic data by coordinating spoken and gestural deictics. Having shifted her gaze quickly from her poster viewers to the poster, Leah swiftly moved her left hand below the x-axis and then performed multiple back-and-forth horizontal movements (Picture 3) in coordination with her spoken utterance “*this is wind speed along the x-axis*” (lines 1–2). Leah then moved her hand toward the left end of the x-axis and then moved it upward along the y-axis, again subsequently performing multiple back-and-forth vertical movements (Picture 4). The vertical pointing hand movements were concurrent with her spoken utterance “*and latitude along the y-axis*” (lines 2–3) as well as her gaze and postural reorientation to the poster viewer.

Having provided the contextual meaning of the two axes, Leah then started describing the observable periodic pattern in their data set (lines 3–4; Figure 3). Concurrent with her emphatic and stretched utterance “*there’s a ve::ry, like, periodic trend,*” Leah placed her pointing finger at the intersection of the x-axis and the lower end of the curve line and then swiftly moved it upwardly tracing the observable pattern as in Picture 5. Having reached the upper end of the curve line, Leah reoriented herself to the viewer and uttered “*that kind of arises there*” (line 6) to describe the wavy visual characteristic of the graphic data.

After the spoken and bodily description of Figure 3, Leah then continued to describe another visual image which represented the wavy periodic pattern of the solar illumination on the poles of Uranus (Figure 4). When she attempted to proceed, Leah orally uttered “*we also noticed that was very similar to the trend of. . .*” (lines 4–5). Here, when she uttered a word “*that*” in line 4, Leah momentarily tapped Figure 3 that had already been previously described in her presentation (Picture 7). Given the visual similarity of the two periodic trends shown in the data sets, her momentary touch could be interpreted as her bodily attempt to establish a link between the two figures under discussion. Indeed, in her contiguous spoken utterance, Leah demonstrated her second wavy deictic bodily movement by tracing the observable periodic pattern horizontally in the graphical data under discussion (see Picture 8).

To sum up, similar to Jack, Leah also coordinated spoken and gestural deictics in order to describe and deliver the observable patterns and features in her graphical data. In her multimodal explanation, Leah actively animated the observable periodic patterns in her own data set presumably to demonstrate similarity between the two. In other words, Leah’s gestural deictics, spoken descriptions, and the two periodic patterns were in alignment with each other to communicate the observable similarity in the two distinct data sets. The following section discusses how the understanding of those observable patterns were constructed and conveyed in the poster presentation.

5.4.2 Use of Iconic Gestures to Explain the Atmospheric/Planetary Process

As discussed in Section 5.2, the ultimate goal of the poster presentation task was for students to construct and provide their scientific accounts for the observable patterns and features in their own data set. To do so, students attempted to explain geological, atmospheric, oceanic, or planetary processes that could have caused the observable patterns and features under discussion

(see also Section 4.2.3.3). Overall, my observations of the video-recorded data suggest that, despite the presence of at least one visual representation of the model, those geoscientific processes were largely communicated through the moment-to-moment coordination of spoken explanations, iconic gestures, visual data sets, and occasional gaze and postural shifts in their poster presentation. In other words, socialization into this scientific discourse community and its practices required attention to complex multimodal communication, modelled initially by the instructor in his lectures and then enacted by poster presenters. In what follows, two excerpts are analyzed to demonstrate how students orchestrated a myriad of different modes in order to provide scientific explanations of planetary, geographical and atmospheric processes. Other multimodal interactional features are also discussed.

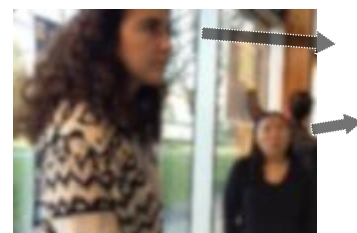
5.4.2.1 Leah's Multimodal Turn-giving and Emma's Multimodal Explanation of the Relation between the Orbital Position and the Weather of the Planets

Context

Excerpt 5.3 was extracted from a question period following the sixth round of Leah and Emma's poster presentation. Having wrapped up their explanations as presenters, Leah and Emma were asked by one of their viewers a question on the potential influence of planets' orbital position on the weather (see line 1 for the question of the viewer, who is identified as V). While it was Leah who had first reacted to the viewer's question, she appeared to express her uncertainty about her own response and bodily sought assistance from Emma (lines 2–3). Having seen Leah's embodied sign of uncertainty, Emma began providing her explanations of the relation between the periodicity of and weather on the planets through the coordination of spoken utterances and iconic gestures (lines 5–16).

Excerpt 5.3

- 01 V: to x like, xx planets these like orbital positions xxx just
like any other planet like- do you think xxx for the
planet's weather?
<Pic 1>
- 02 L: oh orbital position? well the amount of sun it gets,
<Pic 2>
- 03 like, (0.7) I would say yes that's ((laugh)) a huge
<Pic 3> <Pic 4>
- 04 (0.5) factor in it? you know?=
<Pic 5>
- 05 E: =sorry what was the [question again?
<Pic 6>
- 06 L: [the- if the - orbital position
<Pic 7>
- 07 has an effect on the weather - [on- on most planets
- 08 E: [on other planets?=
<Pic 8>
- 09 L: =yeah.
- 10 E: uh: - normally it does. I mean, if you look at- like, the
<Pic 9> <Pic 10>
- 11 tilts of our - Earth, like, around the sun, sometimes
<Pic 11>
- 12 like- when we're - facing or tilted inwards like the
<Pic 12>
- 13 poles are colder, - or like as we talked about in class,
<Pic 13>
- 14 like depending on where you are, (0.5) and how it's –
<Pic 14>
- 15 rotating around the sun, your (0.5) weather
<Pic 15>
- 16 would change,



Picture 1
Leah & Emma listening to
a viewer's question



Picture 2
"amount of sun it gets"



Picture 3
"like"



Picture 4
"I would say yes"



Picture 5
"you know"



Picture 6
"what was the question
again?"



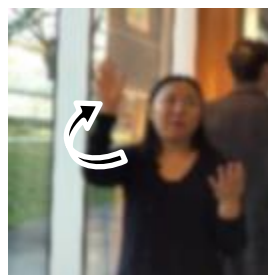
Picture 7
"orbital position"



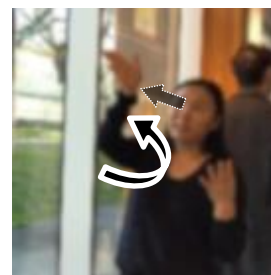
Picture 8
“at- like”



Picture 9
“tilts of our Earth”



Picture 10
“around the sun”



Picture 11
“we’re facing or tilted inwards”



Picture 12
“poles are colder”



Pictures 12
depending on where you
are



Picture 13
“how it’s rotating
around the sun”

Analysis

After their poster presentation, Leah and Emma opened the floor for questions. A student viewer immediately posed a question, and Leah and Emma attentively listened to them by gazing at and leaning toward them slightly (line 1; Picture 1). Having repeated part of the viewer’s question, Leah oriented her upper body and extended her left arm toward the poster, uttering “*the amount of the sun it gets*” presumably in her attempt to provide an answer for the question (Picture 2). The coordinated action was followed by a filler “*like*” and a noticeably long 0.7-second pause, which coincided with her quick gaze and postural reorientations to the poster viewer as well as her vertical arm movement as in Picture 3. Notice in Picture 3 that Leah’s left arm was held for approximately 1.0 second straight up, with her left palm open facing her own face and slightly bent outwardly. This hand shape appeared to indicate her implicit signal of uncertainty about the disciplinary knowledge. In fact, in her contiguous utterance in lines 3–4, she employed a hedged spoken expression “*I would say*” and provided a spoken response “*there’s a huge factor in it, you know*” that demonstrated some vagueness. Importantly, even though her spoken response was directed to the poster viewer, Leah’s coordination of postural shift, a mutual eye gaze with Emma, and her upward arm movements in Pictures 4–5 together

suggest that she was actually bodily seeking assistance from Emma in the face of her own knowledge gap. The series of Leah's bodily movements resulted in Emma's spoken question "*sorry what was the question again?*" and Leah's subsequent repetition of the question she had been asked (lines 5–7; Pictures 6 and 7).

With her concise spoken response "*normally it does*" in line 10, Emma took the primary role in responding to the viewer's question. Concurrent with her spoken utterance "*look at- like,*" Emma raised her right arm straight vertically (Picture 8) and then continued to utter "*the tilts of our Earth*" in lines 10–11. Notably, this ensuing utterance "*the tilts*" co-occurred with her slight inward tilting arm movement as in Picture 9. Together with her spoken utterance, Emma's slight inward tilting arm movement could be interpreted as an iconic gesture that represented the obliquity of the Earth.

Following her coordinated iconic gesture and spoken explanation, Emma moved her hand to show the back of her right hand (i.e., her palm facing her own face) and then swiftly demonstrated a rotational hand movement to reverse the two sides of her right hand (i.e., the back facing Emma's own face, versus her palm facing outside as in Picture 10). A series of the rotational hand movements coincided with Emma's spoken utterance "*around the sun*" (line 10), which together suggest that it was representational of the Earth's rotational motion but presumably less of its obliquity.

A similar type of rotational iconic gesture was demonstrated in Emma's ensuing spoken utterance, presumably with greater attention paid to the obliquity of the embodied Earth. After producing a cut-off filler word "*like-*" in line 12, she continued to offer a spoken and embodied follow-up explanation. Namely, she extended her right arm upper-right and bent her right wrist and elbow to produce the hand shape that can be seen in Picture 11. Then, Emma co-produced her spoken utterance "*we're facing or tilted inwards*" and a rotational hand movement by slightly pushing her lower palm forward while locating the tip of her right middle finger at a fixed position in the air as the pivot of this rotation. Indeed, the embodied obliquity appeared to be drawn on in a number of Emma's later multimodal explanations when she divergently extended both of her arms uttering "*poles are colder*" (line 13; Picture 12), attempted to demonstrated multiple dimensions of the Earth (line 14; Pictures 13), and co-produced the orbital and rotational motions of the Earth around the sun (line 14; Picture 14).

Taken together, Emma demonstrated simultaneous coordination of spoken utterances and iconic gestures in order to provide her explanation of the planetary process by which the obliquity might have influenced the weather of the planets. Here, Emma's embodied action suggested that her single iconic gesture (e.g., Picture 11) might have in fact represented multiple facets of the embodied object under discussion: the obliquity, the poles of the planet, the rotational and orbital motions around the sun, and its directionality, among other possible interpretations.

5.4.2.2 Rachel's Multimodal Explanation of the Atmospheric and Geographical Processes that Cause the Ozone Depletion in the South Pole

Context

Excerpt 5.4 was taken from the third round of Rachel's poster presentation, wherein she provided two scientific explanations for the formation of large ozone holes over the South and North Poles (i.e., ozone depletion). When she attempted to provide her atmospheric (lines 6–11) and geographical (lines 11–20) accounts of ozone depletion, Rachel first reminded her viewers of the observable pattern of ozone distribution in Figure 1 ⁸and then proceed to offer her hypothetical account of those processes that might have caused the pattern. Importantly, in this poster session, Robert was one of the poster viewers. Prior to this, Rachel had provided some scientific explanations for the general uneven distribution of ozone layer (that is, ozone is thinner around the equator and thicker in the polar regions; see Figure 1).

⁸ The figure numbers correspond to the numbers originally presented on the poster.

Excerpt 5.4 Rachel's Multimodal Explanation of the Atmospheric and Geographical Processes

01 R: so: - then we come to another question. since, - since
 <Pic 1>
 02 the ozone layer is thinner at the: (0.6) tropical and
 <Pic 2>
 03 thicker at the two poles. but why the depletion first
 <Pic 3>
 04 occur at the, (0.5) thick tro- uh- thick poles. not at the
 05 tropical region.
 06 so: - the first is - similar: to- similar to the: the
 <Pic 4>
 07 convection. it's also the convection. the pollutions.
 08 the CFCs and halons, (0.5) was produced at the: (0.7)
 09 uh a-: ab- above (0.7) the north part of the earth.
 10 but it's pu- pushed (0.5) by the at- atmosphere to
 <Pic 5>
 11 the: two poles and accumulated there. and second
 12 reason, is uh: is about the: geologic feature (0.6) at
 13 the south pole. so: we know- uh: (0.5) we know the:
 14 depletion at the south pole is more serious than the
 <Pic 6>
 15 north pole. (0.6) because north pole is, we know it's a
 16 big piece of ocean. but at the South Pole it's- uh: (0.5)
 17 a large piece of continent surrounded by the
 <Pic 7> <Pic 8>
 18 ocean. (0.6) and the wind comes from the ocean
 <Pic 9>
 19 will form a band, - like wind wall and surround the
 <Pic 10>
 20 continent.

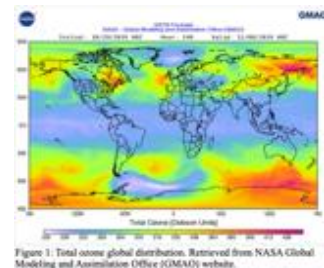
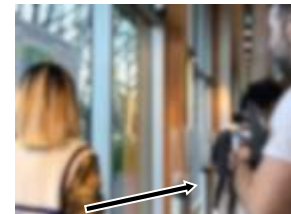
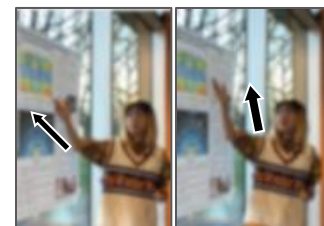


Figure 1
Total ozone global
distribution



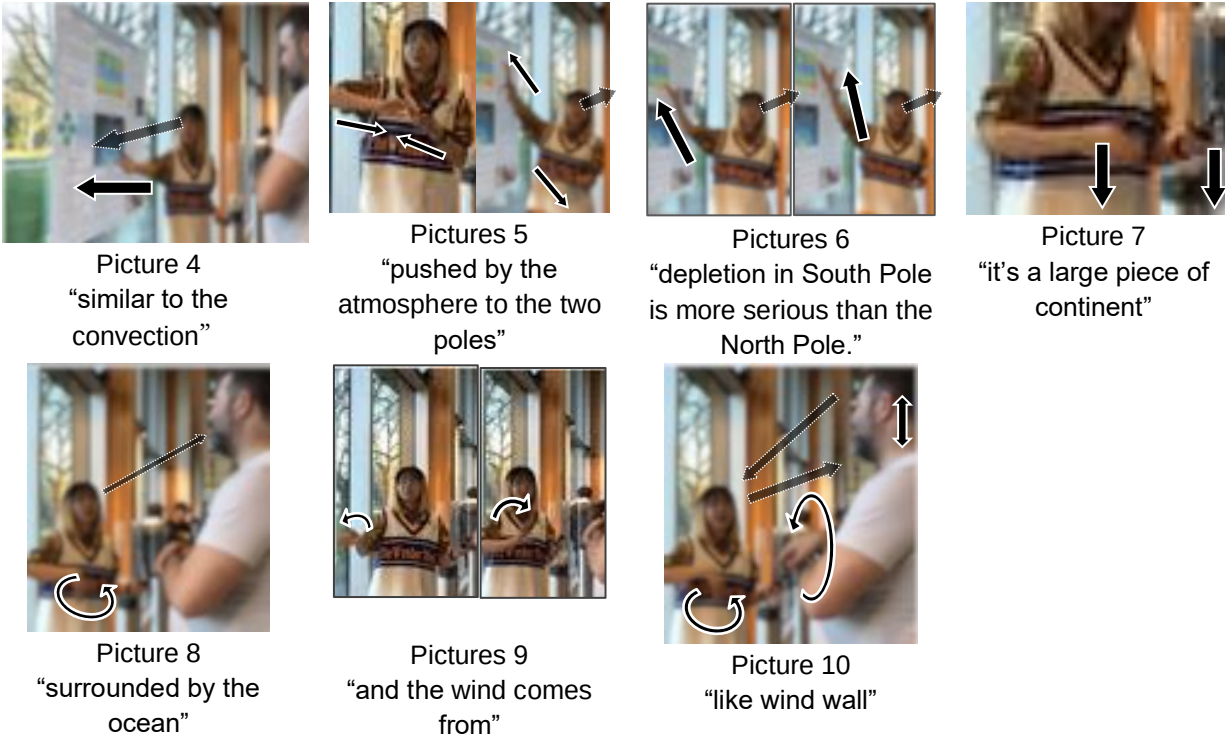
Picture 1
"then"



Pictures 2
"ozone layer is thinner at the
tropical region and thicker at
the two poles"



Picture 3
"but why the depletion first
occur"



Analysis

Having completed her explanations of the ozone distribution pattern, Rachel marked a topic shift by uttering "*so then we come to another question*" while also physically repositioning herself to the opposite side of her poster (line 1; Picture 1). Following her oral and gestural recapitulation of the observable pattern (line 2; Pictures 2), Rachel posed a question to address an important paradoxical observation in her data set, namely, "*why the depletion first occurs at the thick poles not at the tropical region*" (lines 3–5). Here, Rachel markedly stressed the spoken word "*why*" and concurrently shifted her gaze to Robert, which together suggests that she might have highlighted the paradoxical observation as an important gap to be addressed in her presentation.

In lines 6–11, she offered a detailed multimodal explanation of the atmospheric process that might have contributed to the formation of ozone depletion over the poles. First, by coordinating her spoken utterance "*the first is similar to the convection. it's also the convection*" and her extended right-arm deictic gesture together with her gaze and postural shifts (lines 6–7; Picture 4), Rachel attempted to draw on an atmospheric model that she had previously explained to her viewers. The atmospheric model referenced by Rachel here was called Brewer-Dobson

circulation, wherein multiple divergent white-bold arrows were drawn to represent the outward flow of the air from the equator to the direction of the poles (Figure 5.4).

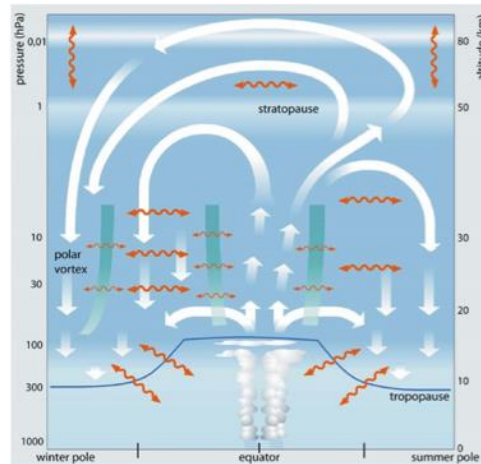


Figure 5.4 A ‘model’ visual that represented divergent atmospheric movements (Brewer-Dobson Circulation; Figures 5 in Jack and Rachel’s poster)

After naming several pollutants that caused the ozone depletion (e.g., CFCs and halons), Rachel once again orchestrated her spoken and gestural modes in her attempt to bodily and orally explain the atmospheric process that resulted in the accumulation of the pollutants in the poles. Concurrent with her spoken utterance *“it’s pushed by the atmosphere,”* Rachel first folded both of her hands inwardly in front of her chest and then released them to the two opposite directions simultaneously with her contiguous utterance *“to the two poles”* (lines 10–11; Picture 5). Her divergent bodily movement seemed to suggest that Rachel attempted to represent the atmospheric process of “pushing” through her iconic embodiment.

After providing her atmospheric explanation, Rachel continued to offer her next geographical account of the ozone depletion in the South pole in lines 11–20. Before doing so, Rachel first made spoken and gestural reference to the observable ozone distribution pattern. Here, she coordinated her descriptive spoken utterance *“the depletion at the South Pole is more serious than the North Pole”* and two deictic gestures to point to lower and upper parts of the map in Figure 1 (lines 13–15; Pictures 6). Importantly, Rachel uttered the respective words *“the South Pole”* and *“the North Pole”* concurrently with her lower and upper deictic gestures.

Having described the geographical feature of the North Pole as *“a big piece of ocean,”* Rachel contrastively described the South Pole as *“a large piece of continent surrounded by the*

ocean” (lines 15–18). Concurrent with this latter spoken description in line 17, Rachel produced the hand shape as in Picture 7 that appeared to frame a certain space in the air with a slight vertical hand motion. Immediately after this, Rachel then performed the horizontal circular right-hand movement around the gesturally framed space concurrently with her spoken utterance “*surrounded by the ocean*” and her upward gaze shift to Robert (lines 17–18; Picture 8). Here, a series of her gesturally and orally coordinated explanations seems to suggest that the initial framing gesture was representational of the Antarctic continent while her subsequent horizontal circular hand gesture may have represented the ocean that surrounded the continent. Indeed, Rachel appeared to make further use of this horizontally framed space in explaining the wind flow in and around Antarctica with her outward, inward, and reproduced circular hand motions (lines 18–20; Pictures 9–10).

To sum up, in their geoscience poster presentations in EPS 251, as illustrated by these two pairs, students attempted to communicate their own interpretive accounts of geological, atmospheric, and planetary processes that might have caused the observable patterns and features. In so doing, students deployed an array of meaning-making resources that included but were not limited to spoken language, iconic gestures, visual images, and occasional gaze and postural shifts in their poster presentation. Notably, students often demonstrated iconic gestures in coordination with spoken explanations to simultaneously represent multiple elements of the embodied objects —(relative) positions, shape, directionality, angle (or obliquity), or movement—to represent geological, atmospheric, and planetary processes. These synchronized multimodal resources not only facilitated communication about complex processes and phenomena, but also constituted essential elements of geoscience knowledge, practice, and discourse that students were being apprenticed into. Their presentations and responses to questions also demonstrated the improvisational, contingent nature of poster presentations that involve social and discursive coordination and interaction between presenters and with various audience members, and which vary unpredictably with each new round of presenting the content. (Sometimes there were half a dozen rounds of presentation of the same poster in one class period.) For this reason, poster presentations constitute a dynamic mode of constructing, conveying, and questioning knowledge in social context.

5.5 Summary of the Chapter

In Chapter 5, I reported on the major findings that are specifically related to the characteristics and multimodal enactment of two focal groups' poster presentations in the geoscience course. In response to Research Question 3, I first provided descriptions of the task requirement of the geoscience poster presentation in EPS 251 (logistics, content, spatial layout) and ways in which students were socialized into geoscientists' academic practices (e.g., seeking reliable data sources and interesting patterns, formulating appropriate research questions, displaying knowledge on the poster). To address Research Question 4, I provided in-depth analyses of moment-to-moment multimodal practices performed by two pairs of poster presenters. Specifically, I analyzed how student presenters communicated their observations and interpretations in the poster presentation. From an ecological perspective, students' posters were replete with multimodal meaning-making affordances (i.e., written language, visuals including Data Set(s) and Models). They served as *action potential* as a poster presenter acted and interacted *in* and *with* the social environment. From an SCT perspective, social interaction mediated by a wide repertoire of action potential is key to individuals' development because learning is theorized to take place first *interpersonally* in interaction and then *intrapersonally* within the individual (Vygotsky, 1978 Wertsch, 1995). Given the reciprocity between affordances and social interactions as a locus of learning (van Lier, 2004; Vygotsky, 1978; see also Section 2.2.4), therefore, participation in multimodal meaning-making practices and use of these resources in interaction is a crucial aspect of learning. Chapter 6, the concluding chapter of my thesis, summarizes the major findings of the study and discusses the interrelationships between the meso-, macro- and micro-level social actions that are examined in Chapters 4 and 5.

Chapter 6:

Conclusion and Implications

6.1 Introduction

In this concluding chapter, I summarize the findings related to the culture, values, and multimodal practices observed in the geoscience course (Chapter 4) and the insights obtained from my moment-to-moment multimodal interaction analysis of students' geoscience poster presentation in the classroom (Chapter 5). I then discuss those findings in terms of the Douglas Fir Group's (DFG, 2016) transdisciplinary framework, which portrays the dynamic interrelationships among micro, meso, and macro levels of social processes that shaped and were shaped by individuals' multimodal meaning-making practices. Discussions of implications for pedagogy and future research follow. In my concluding remarks and reflections, I consider my own academic discourse socialization into the geoscience classroom through my ethnographic case study as a novice applied linguistics researcher.

6.2 Overview of the Study

This study was motivated by the two underexplored areas in the existing applied linguistics literature: multimodal dimensions of ADS and the poster presentation as a complex but pervasive academic task (D'Angelo, 2016). Drawing on the three mutually informing sociocultural theories (i.e., language socialization, Vygotskian sociocultural theory, and van Lier's ecological approach; Duff, 2007; van Lier, 2004), my ethnographic multiple-case study examined second-year undergraduate students' multimodal academic discourse socialization in a geoscience course and their multimodal practices in the poster presentation that took place in the geoscience classroom (and related spaces). This study was guided by the following research questions:

1. What are some of the valued forms of scientific thinking promoted in the undergraduate geoscience course and observed in classroom interaction? How are students socialized into thinking, learning, viewing, and communicating like geoscientists?

2. What multimodal practices are promoted and enacted in this geoscience classroom to socialize students into geoscientists' ways of observing and interpreting? What are some of the disciplinary norms, values, and practices that underlie those multimodal practices?
3. What are the characteristics and expectations of the poster presentation task assigned to and performed by undergraduate students in the geoscience classroom? How were geoscience poster presentations linked to the multimodal practices and scientific thinking modelled by the instructor in the geoscience classroom?
4. What kinds of meaning-making resources do student presenters incorporate and act upon in their poster presentations according to the nature of their topic and their immediate interactional needs? More specifically, how do they orchestrate different kinds of available multimodal meaning-making resources to communicate their observations and interpretations of identifiable "patterns" on their posters?

In what follows, I provide answers to each of the four research questions in relation to the multiscale transdisciplinary framework proposed by DFG (2016).

6.2.1 Macro Level: "Thinking as Geoscientists"

According to DFG (2016), the macro level has to do with beliefs and values that are often invisible, taken-for-granted, and shared by individuals or groups of individuals. Circulating throughout all the levels of macro-meso-micro social activities, the macro-level beliefs and values "influence the ways in which individuals view their worlds, guiding how they act within them and how they interpret the actions of others" (p. 37).

The discussion of this macro-level phenomenon corresponds to Research Question 1, that is, ways of *thinking and viewing as geoscientists* that had disciplinary salience and thus were promoted in the undergraduate geoscience classroom. As shown in Chapter 4, one important recurrent classroom practice was *observation* and *interpretation* activities. The two activities were always sequenced, and students were scaffolded to make a clear separation of *observations* as archival objective data and *interpretations* as their own hypothetical assumptions. To put it differently, the separation and sequencing of observations and interpretations constituted a crucial dimension of disciplinary norms and practices pertaining to knowledge construction and

praxis, and students were immersed into the valued ways of viewing and interpreting as geoscientists (DFG, 2016).

6.2.2 Meso Level: Multimodal ADS in the Geoscience Classroom

DFG (2016) defines the meso level as sociocultural institutions and communities within which individuals' social acts and interactions are situated. Individuals' learning is shaped in and through participation in those particular sociocultural institutions or communities. As Duff (2019) states, however, the macro-level disciplinary and ideological norms and values are also instantiated at the meso level and influence the way in which semiotic resources are taken up, perceived, interpreted, and performed to create meanings in the classroom. Therefore, individuals' engagement in and with the social, multimodal, and embodied practices and resources of the classroom were key to their successful socialization into their new academic community. Institutionally, too, instructors must give assignments in courses for which students earn course grades and which allow the instructor to assess learning. The fact that the poster assignment was chosen as the final assignment for this course (with peer assessments as well as the instructor's own assessments) also signals the perceived importance of this form of knowledge construction, representation, and communication. This is another meso-level or institutional aspect of the course that also aligns with both the macro-level ideologies and priorities in geoscience and with the micro-level practices that were promoted and observed.

Research Questions 2 and 3 pertained to the meso-level social activities in the geoscience classroom. The former specifically focuses on the kinds of multimodal practices that were locally promoted and enacted in the classroom, according to disciplinary norms and values at the macro level. As shown in Chapter 4, *observations* and *interpretations* were enacted at the beginning of class and always carefully sequenced in such a way that students gradually learned to distinguish between them. The observational activity constituted socialization of geoscientific viewing, that is, finding *patterns* in the visual data and listing them as descriptive observations. On the other hand, interpretation required a synthetic scientific thinking specifically to account for geological *processes* that might have caused the observable geological patterns. In these meso-level classroom processes, students were socialized into forms of geoscientific observation and interpretation in highly multimodal ways.

Research Question 3 explored the characteristics and expectations of the poster presentation, as well as its linkage with the multimodal practices promoted in this particular geoscience classroom. As I discussed in Chapter 5, task-related documents (i.e., the poster template and the task description) specifically required inclusion of two kinds of visuals in the poster, namely, the *data set* and the *model*. While the data set was intended to motivate the formulation of a research question based on the observable pattern within it, the role of the model was to help construct interpretive explanations of the observable pattern on the data set. To put it differently, the data set motivates observations of the patterns in the particular data set, whereas the model corresponds to the multimodal explanation of the *processes* that might have caused the observable pattern. Thus, these two particular types of visuals were closely linked to the multimodal classroom practice of observations and interpretations promoted in EPS 251. In summary, not only did the macro-level disciplinary norms and values circulate in the classroom multimodal practices, but they also appeared to influence the way in which the poster presentation in this classroom was organized.

6.2.3 Micro Level: Moment-to-Moment Multimodal Practices

Micro-level social action is defined by DFG (2016) as social action and interaction, wherein individuals draw on a multitude of internal capacities as well as external linguistic, multimodal, and embodied resources to make meanings for communication and learning. As noted above, the macro- and meso-level phenomena manifest and influence the way in which micro-level social actions and interactions are organized at a particular moment (Duff, 2019) and these micro-level phenomena also serve to construct meso and macro contexts (e.g., disciplinary and institutional norms, values, and practices). The micro-level social actions and interactions are always situated and mediated by linguistic and other multimodal affordances available in the immediate interactional environment, vis-à-vis the broader meso-institutional and macro-disciplinary norms and values. It is in and through the ongoing moment-to-moment social processes that individuals learn and are socialized into multimodal and embodied practices of the meso and macro level phenomena (DFG, 2016; Duff, 2019).

Research Questions 2 and 4 pertained to the micro-level, moment-to-moment multimodal practices in the geoscience classroom. As discussed earlier, Research Question 2 was related to the enactment of multimodal practices in the classroom. In Chapter 4, I presented my

observations and interpretations of multimodal and embodied practices performed by the instructor and his students in the classroom *observations* and *interpretation* activities. In the observational activity, on the one hand, they typically deployed spoken and gestural deictics to point to specific observable geological patterns and features on the visual image. In the interpretive activity, on the other hand, they coordinated iconic gestures and spoken utterances to account for the geological process that might have caused the pattern in highly embodied ways.

Research Question 4 sought to provide more fine-grained descriptions and analyses of the micro-level multimodal practices performed by two pairs of student presenters. As discussed in Chapter 5 and above, I decided to shed further light on how they communicated their *observations* deictically and *interpretations* iconically by deploying a myriad of meaning-making resources in the poster presentation. For the former, students not only pointed to *patterns* or objects, but their deictic gestures also represented and dynamically animated the shapes and widths of the specific referenced patterns and features. For the latter, in coordination with spoken explanations, students bodily demonstrated and animated multiple elements of the embodied objects simultaneously to represent and account for geological, atmospheric, and planetary processes. Going beyond an ancillary role in facilitating communication about complex processes and phenomena, those multimodal and embodied practices constituted essential elements of geoscience knowledge, practice, and academic discourse that were linked to thinking, viewing, and representing knowledge *like geoscientists*, and as their instructor had modelled throughout the course.

To conclude this section, I have modelled the interrelationships between the disciplinary norms and practices at the macro level, classroom multimodal processes at the meso level (*observations* and *interpretations*), and moment-to-moment multimodal practices at the micro level in Figure 6.1.

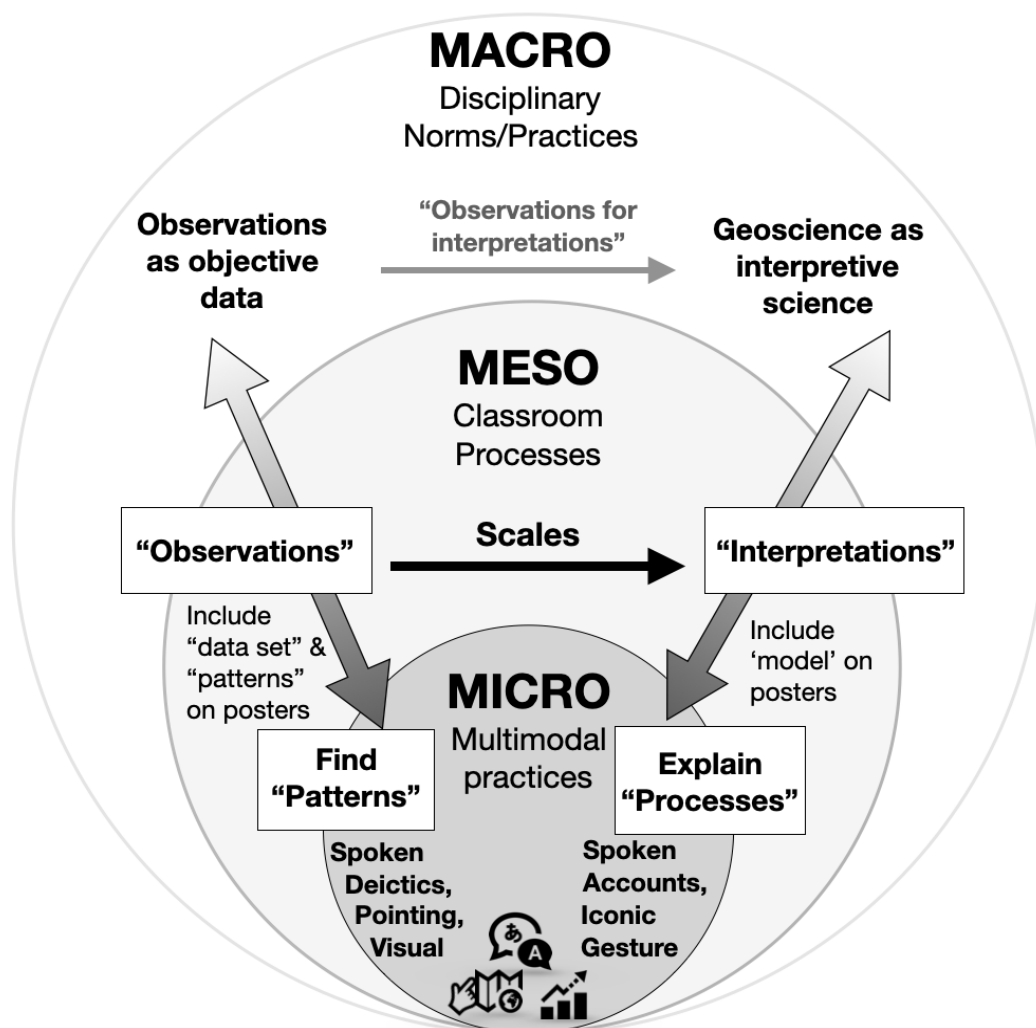


Figure 6.1 Relationship between disciplinary norms, classroom processes, and moment-to-moment multimodal practices. Model adapted from the Douglas Fir Group (2016)

6.3 Implications for Pedagogy

Findings from Chapters 4 and 5 demonstrated that multimodal enactments constituted a crucial dimension of disciplinary practices and values connected with learning to think, view, and represent knowledge *like geoscientists*. The complex geoscience phenomena and processes were communicated in highly dynamic, embodied, and multimodal ways both in class discussions and in poster presentations. In light of those findings, I offer some implications for pedagogy.

Firstly, both educators and students across disciplines can benefit a great deal from an enhanced awareness of the communicative and pedagogical roles and potential of multimodal meaning-making resources. In the first place, multimodal resources can facilitate disciplinary communication and learning about complex ideas. In the context of math instruction, for example, Canagarajah (2018) demonstrated that the multimodal coordination of visuals, inscriptions, and gestures was key to the excellent math lecture he described. In that context, the production of high-quality “board work” and acting upon it were perceived as more effective than speech in isolation. As one of his TA participants put it, “[s]ome instructors might talk more clearly and fluently. But if their board work is poor, the talk doesn’t help at all” (p. 273). This insight appears to echo Morita’s (2000) participants in language education, who expressed the effectiveness and importance of strategic use of visuals (e.g., PPT) in academic presentations. Importantly, as my study suggests, multimodal practices not only facilitated communication, but also constituted crucial dimensions of ways of thinking, viewing, constructing, and representing knowledge like disciplinary experts. Taken together, extant research findings offer the major pedagogical implication that an enhanced awareness of multimodal practices is key to effective academic knowledge construction, communication, and hence multimodal ADS across disciplinary borders. However, it is unlikely that this is given sufficient emphasis in teacher education; it is more likely to be tacit knowledge gained through experience that could (and should) be made more explicit to novices, just as academic discourse or written genres might not be part of teachers’ explicit knowledge base without training about those.

Secondly, the use of multimodal resources might be particularly beneficial for multilingual students and instructors who are additional language users and learners of the medium of instruction (English or other languages). Major findings from extant research have shown that multilingual students and instructors often experience challenges in engaging in academic speech activities (lectures, presentations; Morita, 2000; Zappa-Hollman, 2007). However, their teaching or presentation performances often received highly positive uptake from their viewers (Canagarajah, 2018; Morell, 2015; Morita, 2000; Zappa-Hollman, 2007)—not (necessarily) because of the clarity and fluency of their speech but because of their excellent use of multimodal meaning-making resources to scaffold their communication. In fact, the above-mentioned interview excerpt from Canagarajah (2018) involved a Chinese-speaking math instructor who used English as an additional language. The same interviewee also described

another L2-English math instructor as follows: “*One of our Chinese professors doesn’t speak much, but because her board work is good, we like her teaching a lot*” (p. 273). Thus, I concur with Matsumoto’s (2019) insightful pedagogical implication that strategic use and planning of multimodal resources could enhance multilingual students’ and instructors’ presentations and their disciplinary socialization.

In addition, greater awareness of and explicit instruction about the pedagogical significance of multimodal meaning-making resources might be valuable in L2 and disciplinary teacher education programs. Going beyond the moment-to-moment interactional role, this may be particularly pertinent to the notion of “*thinking and viewing as disciplinary experts*” as discussed in Chapter 4. The teaching and learning of language and disciplinary content is often associated with the memorization of the factual content and the deductive application of the taught knowledge, as well as the academic discourse and genres involved. To put it differently, students are often implicitly socialized into the prevalent notion that content-oriented memorization or mastery of academic texts constitutes legitimate or even preferred scientific knowledge construction and can be obtained through countless hours of observations of teachers’ instruction (i.e., the apprenticeship of observation; Borg, 2004). However, as exemplified in the *observation and interpretation* activity (Chapter 4), careful and strategic incorporation and sequencing of multimodal practices might open up other pedagogic possibilities that may be more dynamic, inductive, and process-oriented akin to ways in which disciplinary experts construct knowledge. Therefore, teacher education programs and mentoring programs within university disciplines seeking greater instructional efficacy could offer explicit instruction that raises awareness of pedagogical affordances that multimodal meaning-making resources have to help students “*think as disciplinary experts.*” One other important point is that for the poster activity, the instructor in this study and his teaching assistants provided a great deal of support to students throughout the course, in addition to modelling and explicit instruction of the course content: from the selection of suitable topics or data sets, to the shared templates of posters (which were later printed for students within the department), to prior poster activities in the course that helped prepare and involve them in self/other-assessments of the advantages and disadvantages of certain features of poster construction and presentation. Thus, their final assignments represented the culmination of much preparation in the course that would help

ensure students' success. The instructor's recognition as a master teacher for a diverse range of students was well deserved.

6.4 Directions for Future Research

Throughout the study, I identified several points that need to be considered in future research. First, future ADS research could shed light on the roles and affordances of digital technologies, such as Google Document, Google Slides (Kobayashi et al., 2017), and virtual learning platforms such as Zoom or Collaborate Ultra/Canvas in the process of ADS. This suggestion originated from my own in-class observation that the great majority of students appeared to utilize such synchronous, cloud-based collaborative tools in the co-production of their posters. My interviews with the focal students made it evident that those synchronous tools mediated both face-to-face (in-class preparations) and out-of-class virtual collaborations. (Note that this research project preceded the COVID-19 pandemic pivot to online teaching only, which must have increased the importance of these tools exponentially since then, as well as new learning by instructors and students about how to maximize their affordances.) Moreover, the focal participants made use of more than one synchronous tool in a single collaborative project, that is, they initially brainstormed and discussed their ideas on Google Document and then co-produced their posters by means of Google Slides. In the contemporary era of digital technology and online education, an examination of how students engage with, develop, and co-construct discursive practices and disciplinary knowledge through both synchronous and asynchronous collaborative digital tools could provide useful insights into the nature of students' (and instructors') ADS and how to better mediate it.

Second, future research could examine how poster presenters and their viewers co-construct dynamic social actions and interactions with each other to communicate and co-produce meanings in poster presentations. To put it differently, the spontaneous, interactive and contingent nature of poster presentations could be further explored. This could be achieved through the micro-level examination of more conversational or dialogic interactions between presenters and viewers, wherein their multimodal interaction is more symmetrical, exploratory, proleptic, and thus contingent and transformative (van Lier, 1996). Given van Lier's (1996) argument that it is "jointly managed talk that has the potential to change learning situations, role relationships, educational purposes and procedures" (p. 180), the investigation of contingent

multimodal interactions would yield pedagogically, theoretically, and empirically important insights into the nature of ADS.

Finally, this study explored just one subject area: geoscience. In order to understand how the principles discussed in this thesis, including the ways in which macro-, meso-, and micro-level factors map onto ADS in any given context (not just multimodality but other aspects of discourse as well), it would be helpful to expand research to include other disciplines. Furthermore, this study featured just one instructor's approach to ADS in his field of expertise, but other instructors might have emphasized other elements. The instructor in this study enjoyed the reputation of being an excellent teacher and mentor. Therefore, it would also be interesting to see how he worked with fellow instructors to help them teach in innovative ways in the manner demonstrated in this study.

6.5 Personal Reflection: Thinking like a Geoscientist as an Applied Linguist

Before I conclude, I would like to dedicate this section to a short reflection on my own socialization into geoscience discourse and into geoscientists' ways of thinking and viewing as a novice applied linguist, an outsider to the researched discipline.

My personal reflection could not start without telling my personal background and identity as an L1-Japanese, L2-English user. Born and raised in Japan, I have spent most of my time in Japan, surrounded mostly by Japanese-speaking monolinguals. Even though I enjoyed English classes in junior and senior high schools in Japan, grammar-centred, initiation-response-feedback oriented English instructions was, I had perceived, little help to cultivate a good communicative command of English. Therefore, I had very limited opportunities to use English either inside or outside the classroom until the age of 18. It was only in my undergraduate English-medium classes that I had chance to use English and expose myself to spoken and written academic discourses in English.

In my second year in Canada, this ethnographic case study took place. As a relative newcomer to an entirely English-speaking environment at my university, I experienced some challenges in engaging in spoken and written communications in English, even in casual conversations or academic discussions on applied linguistics, a topic that is familiar to me. The challenge became even more acute when I started my classroom observations in EPS 251, a second-year geoscience course. There are a number of interrelated reasons. First, this was the

first geology course I had ever observed, and I had no background knowledge about concepts, terminology, and disciplinary practices fostered in geoscience. Second, EPS 251 was my first undergraduate course outside Japan, and I was unfamiliar with the CMU classroom practices, discourse, and communication patterns with undergraduate students in EPS 251. My perceived limited command of English further amplified my nervousness during classroom observations in the new, unfamiliar disciplinary context. In addition, I always felt the real or perceived need to negotiate my multiple identities throughout the study—identities as a graduate student (a relative academic expert for the EPS 251 students), a language education expert, and above all, as a researcher in the course using the data for my MA thesis. My written comment in the margin of my fieldnotes illuminates this sense of nervousness: “*As a researcher, don't know how it is it possible for me to mingle with the students. I didn't talk with anyone in the class yet! (except for Robert and his TAs)*” (Fieldnotes, 09/18/20).

As a disciplinary outsider using English as an additional language, the only thing I could initially do was to quietly observe and take notes of the classroom processes and multimodal practices, without fully understanding what was actually happening there. Some utterances were barely audible because of the generally fast speech rate and physical distance between the students and instructor and me. Facing multiple linguistic, logistical, and disciplinary challenges, I attempted in my notes to carefully separate what I saw and what I could barely hear in class (i.e., my observations) and what *I thought* people were doing, in the margins (i.e., my own interpretation). As a result, I was able to take notes of what they *said* (some spoken keywords, such as “patterns” and “scale”) and what they *did* (embodied practices that often cooccurred with spoken utterances). Those eventually helped me to become aware of the classroom processes reported in Chapters 4 and 5 (i.e., the observation–interpretation sequence, the role of scales).

As I continued my classroom observations, I began to see some similarity between what I was doing as an ADS researcher and what they were doing as geoscientists. To be more specific, while they were learning to separate observations and interpretations of geology in class, I was learning to differentiate my own observations and interpretations of their practice during regular classroom observations. In other words, as a novice ADS researcher, I was being socialized into this field and this course specifically (and into ethnographic research practices) through the observation of geoscience students’ recurrent *observation* and *interpretation* activities.

As a result of my regular presence in class, I was gradually able to get to know and casually talk with ESP 251 students, especially focal participants who agreed to participate in this study. On reflection, displaying my genuine interests and tentatively listening to their insights were important parts of this process, and this process was achieved not only linguistically, but also mediated by numerous conscious and subconscious multimodal practices (e.g., eye gaze, head movements like nodding, body postures, etc.) and people (Robert, TAs, students). As a gesture of my appreciation as well as a strategy to engage in conversations with students, I brought a box of candy to class every week. This turned out to be a good starting point to initiate casual conversations and get to know students before and after class. This also opened up opportunities to obtain their insights as geoscience insiders. By the time the end-of-term poster presentations took place, I was able to enjoy the comfort of engaging in casual and academic conversations with the people in class despite my initial anxiety. The warm and generous support of the instructor was also key, though he was careful not to exert pressure on students to participate in the study if that was not their wish.

Here, I must acknowledge that these research processes constantly posed a great challenge to me because “there are a lot of terminologies, and sometimes I could not understand what was going on in class” (Researcher’s Reflection, Fieldnotes, 09/18/20). In my attempt to overcome those linguistic and disciplinary challenges, I employed several strategies. First, I would study geoscience English vocabulary in my spare time using a bilingual Japanese-English dictionary and vocabulary notebook to get acquainted with the specialized words (e.g., *obliquity*, *lineation*, *convection*, *depletion*). To familiarize myself more with the content and the language of geoscience, I would often watch YouTube videos related to geoscience to visually learn the complex disciplinary concepts and processes (e.g., Earthquake 101, Solar System 101 in National Geographic 101 Series on YouTube). Moreover, I also sought assistance from Robert and the TAs before or after class when I had questions about the content, language, as well as disciplinary and classroom practices that are related to multimodal ADS. Therefore, my own socialization as an L2-English applied linguist in a geoscience classroom was a dynamic process that was mediated largely by multimodal resources and a myriad of interactions with individuals in the research site. I am not the first language socialization researcher to become immersed in other disciplines or professions for the sake of research (e.g., past research in the areas of law, medicine, architecture, or military defence; Duff, 2017); however, doing so does add to the

complexity of the research process. Someone with a geoscience background might have focused on quite different aspects of the course, or multidisciplinary teams of researchers might have provided some interesting, triangulated accounts of ADS in this setting (Duff, 2019).

6.6 Final Remarks

This study sought to explore the nexus of two interrelated, underexplored areas in the extant body of ADS literature: multimodal dimensions and poster presentations. The development of this MA thesis project could not have succeeded without the invaluable assistance and encouragement from individuals whom I was incredibly fortunate to meet. My sincere hope is that this study conveys my genuine appreciation for their contributions and what they taught me. I believe that this study has made important contributions not only to research and pedagogy in ADS, but also to my personal and professional growth as an applied linguist, a novice geoscience learner, and as a human being that goes far beyond the fulfilment of a requirement for my Master's degree in TESL.

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Appendix A

Recruitment Notice for Instructors

Dear [Instructor's full name],

My name is Masaru Yamamoto and I am currently a graduate student in the Department of Language and Literacy Education at the University of British Columbia. This year I will be conducting a research project on university students' perceptions of and performance in academic poster presentations, an increasingly popular form of knowledge exchange and assessment. This research will be conducted as part of the requirements for my master's program (and MA thesis) under the supervision of Dr. Patricia Duff, a professor in the Department of Language and Literacy Education.

Presently, I am in the process of looking for a university course in which a poster presentation is used as a course assignment. This research project seeks to explore how university students create and successfully deliver their poster presentations. More specifically, I am interested in how university students interpret, create, and actually perform their academic poster presentations in a given disciplinary classroom context. This research will also investigate how students' poster presentations are perceived by their peers, instructor, and teaching assistant (if any). To explore this topic, I would like to invite you to participate in this research project, which asks the following sorts of questions:

- What do students perceive as important, helpful, or challenging aspects in preparing for and giving their poster presentation?
- How do students communicate using verbal language and other resources in their presentation context?
- What kind of poster presentation is perceived as effective by audience members (including peers, the course instructor, and teaching assistants)?

In order to achieve these research goals, I would like to:

- Video-record and audio-record your students' poster presentations in class;
- Regularly observe your class, if possible;
- Collect documents that are relevant to your class, particularly to the poster presentation, such as a (photographed) copy of students' poster and the assignment requirement sheet (e.g., assignment instructions, evaluation criteria);
- Meet with you twice for 30-45 minutes respectively (before and after presentations) to hear about your expectations for the poster presentation task and your mentoring practice in the course;
- Contact you by email to gain clarification about my observations.

Interview schedules and locations will be arranged at your convenience. Your participation is entirely voluntary, and you have the right to withdraw from the study at any time without giving a reason.

To say thank you for your participation, a \$20 gift card (UBC Bookstore) will be offered to you (each person participating in an instructor/TA role) after the second interview. It is hoped that your participation will be beneficial for your future academic development through in-depth reflections on your oral presentation practices. It is also hoped that participation in this study will be a window onto your students' and your own engagement in poster presentations through an in-depth analysis of their poster preparations, performance, and post-presentation reflections.

If you wish to know more about this project, please contact me by email at [REDACTED]. I would be very happy to provide more details about the purposes and details of the research and answer any questions you might have.

If you have other questions or concerns, you can also contact the Principal Investigator:

Dr. Patricia Duff, Professor
Department of Language and Literacy Education
Email: [REDACTED] Phone: [REDACTED]

Thank you in advance for your time and consideration of this request.

Sincerely,

Masaru Yamamoto
MA student
Department of Language and Literacy Education
The University of British Columbia
Email: [REDACTED]

Appendix B

RECRUITMENT NOTICE

Dear **Course Name** Students,

My name is Masaru Yamamoto. I am currently a graduate student in the Department of Language and Literacy Education at the University of British Columbia. I am interested in poster presentations in educational settings, an increasingly popular form of knowledge exchange and assessment. More specifically, I would like to examine how students create and successfully deliver course poster presentations. I am planning to do research on this topic for my master's thesis project. To explore this topic, I would like to invite you to participate in this research project, which asks the following sorts of questions:

- What do you perceive as important, helpful, or challenging aspects in preparing for and giving your poster presentation?
- How do you communicate using verbal language and other resources in your presentation context?
- What kind of poster presentation do you perceive as effective as an audience member?

In order to achieve these research goals, I would like to:

- Video-record and audio-record your poster presentation in class, and if possible, observe your poster preparations outside the class;
- Collect documents that are relevant to the poster presentation, such as a copy of your poster, task requirement sheet (e.g., assignment instructions or course outline), and your notes;
- Meet with you for 45-60 minutes to hear about your experience in preparing for and doing a poster presentation;
- Contact you for email exchanges to gain clarification about my observations.

Interview schedules and locations will be arranged at your convenience, and your participation in this project will be kept confidential. Your participation is entirely voluntary, and you have the right to withdraw from the study at any time without giving a reason.

To say thank you for your participation, a \$20 gift card (UBC Bookstore) will be offered to you after the post-presentation interview. It is hoped that your participation will be

beneficial for your future academic development through in-depth reflections on your oral presentation practices.

If you want to know more about this project, please contact me by email at:

[REDACTED]. I would be very happy to provide more details about the purposes and details of the research and answer any questions you might have.

If you have other questions or concerns, you can also contact the Principal Investigator:

Dr. Patricia Duff, Professor

Department of Language and Literacy Education

Email: [REDACTED]

Phone: [REDACTED]

Thank you in advance for your time and consideration of this request.

Sincerely,

Masaru Yamamoto

MA student

Department of Language and Literacy Education

The University of British Columbia

Email: [REDACTED]



Appendix C

Department of Language & Literacy Education

Faculty of Education

6445 University Boulevard, Vancouver, BC

Canada V6T 1Z2

Tel: (604) 822 5788

Informed Consent Form Background Information for Students

Title of the study:

Meaning making in the poster presentation: A multimodal analysis of university students' task perceptions and performance

Principal Investigator:

Dr. Patricia Duff, Professor

Department of Language and Literacy Education, UBC, Faculty of Education

Email: [REDACTED] Phone: [REDACTED]

Co-Investigator:

Masaru Yamamoto, MA student

Department of Language and Literacy Education, UBC, Faculty of Education

Email: [REDACTED]

This study will be conducted in fulfillment of Masaru Yamamoto's MA thesis research in Teaching English as a Second Language.

Purpose: What is this study for and about?

The purpose of this study is to explore university students' performances in and perceptions of poster presentations in an English-speaking educational setting at a Canadian university. Specifically, we would like to learn how university students prepare for, use language and other meaning-making resources, and perceive each other's performance in the poster presentation.

Study procedure: What is involved in your participation?

If you agree to participate in this study as a *focal participant*, you will be asked to allow the researcher to video-record and/or audio-record your poster presentation inside, and if possible, your poster preparation outside the class. You will also be asked to participate in an individual face-to-face interview with Masaru Yamamoto to reflect on your poster presentation



performance and respond to Masaru Yamamoto's questions. The interviews will take up 45-60 minutes and be audio-recorded with your permission. These audio-recorded and video-recorded data will be transcribed and later analyzed. The exact interview time and location will be arranged at your convenience. These interviews will be conducted in English. After the interviews, you may be contacted by Masaru Yamamoto for email exchanges in order to obtain clarification about your poster presentation. You will be asked to allow Masaru Yamamoto to collect course documents relevant to your poster presentation task, which may include your poster, a written script, academic papers referenced in your poster, and other supporting materials and documents. Your presentation may be commented on by other students, your instructor, and/or teaching assistant in the course, but it will not lead to any negative repercussions. At the end of the post-presentation interview, you will be given a \$20 UBC Gift Certificate. If you agree to participate in this study *as a non-focal participant*, you agree to be observed, video and/or audio-recorded during your roles as viewers/audience members in class presentations, and also agree to take part in a 20-30 minute interview following the poster sessions (regarding your views on academic poster presentations). These audio-recorded and video-recorded data will be transcribed and later analyzed. The exact interview time and location will be arranged at your convenience. These interviews will be conducted in English.

In sum:

Focal participants: will allow Masaru Yamamoto to video/audio-record their poster presentations and preparations and collect documents relevant to poster presentations and will take part in an interview before and after the presentations. You will be given a \$20 gift card at the end of the study.

Non-focal participants: will allow Masaru Yamamoto to video/audio-record their participation in poster sessions as viewers (audience members) and will be willing to be interviewed about their views on academic poster presentations.

Non-participants: do not wish to take part in any aspect of the study and will not be video-recorded as class members.

Your responses to the items on the final page of this form will indicate if and how you wish to participate in this study.

Publication: What will be done with the information collected in this study?

This research project will be conducted as part of Masaru Yamamoto's Master of Arts degree, and thus will be accessible to the general public in the form of a master's thesis. In addition, the findings of the study will be presented at conferences and published in research journals. In order to protect your identification, pseudonyms will be employed for your name, course, and



institution for all publications. For the visual representation of you presenting a poster, your face will be blurred by Masaru Yamamoto so that you are not recognizable. No results of the research project will be made public until the course grades have been submitted by the instructor.

Risks: Are there any risks of your participation?

There are no foreseeable significant risks related to your participation in this study although you may initially feel awkwardness and self-consciousness being video-recorded and audio-recorded, and if you are a focal participant, your classmates may be aware of your participation in the study due to the presence of recording devices. Participation in this study is entirely voluntary, and you have the right to refuse to participate and to withdraw from the study at any time without giving a reason and suffering negative consequences.

Confidentiality: How will your information and identity be kept safe?

Your identity and privacy will be protected both during and after the study by employing the following strategies: (1) pseudonyms will be used to substitute any real names and identifiable information of people (including you), institutions, and other social groups mentioned by participants to ensure confidentiality; (2) for the visual representation of the data in the thesis and publications, participants' faces will be blurred to protect their identity; (3) all hard copies of study documents will be scanned, digitized, and then shredded; (4) all digital data (including digitized copies of the study documents, video-recordings, audio-recordings, transcriptions and other relevant data) are encrypted and then stored in a password-protected folder on Masaru Yamamoto's encrypted, antivirus-programmed laptop computer and a portable HDD or USB drive; (5) the portable HDD or USB will be kept in a locked cabinet in the Principal Investigator's (Dr. Patricia Duff's) UBC office, and will only be accessible to Dr. Patricia Duff and Masaru Yamamoto. Others will have no access to the data. The collected data will be retained for a minimum of five years after the date of publication. Regarding the destruction of data, an irreversible method will be used to ensure secure destruction of research data. The Principal Investigator will be responsible for the data. The transcriptions will not contain any identifiable information pertaining to participants, instructors, or institutions, and will not be distributed to any third parties.

Compensation and benefits: What are the benefits of participating?

Your participation will lead to an enhanced understanding of university students' presentation practices in an academic setting and may make an important contribution to the field of education, applied linguistics, and other relevant areas. As a gesture of appreciation for your time and effort devoted to the research project, a \$20 UBC Gift Certificate will be offered to FOCAL participants after the post-poster-presentation interview. It is also hoped that your participation will be beneficial for your future academic and professional development through in-depth reflections on your presentation practices.



Contact: Who can you contact when you have questions or concerns?

If you have any questions regarding this research project, please feel free to contact Masaru Yamamoto ([REDACTED]) or Dr. Patricia Duff (email: [REDACTED] / phone: [REDACTED]) any time. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at [604-822-8598](tel:604-822-8598) or if long distance e-mail RSIL@ors.ubc.ca or call toll free [1-877-822-8598](tel:1-877-822-8598).

Consent

Your participation in this study is entirely voluntary, and you have the rights to refuse to participate and withdraw from the study at any time without giving a reason or suffering for any negative consequences.

Your signature on the next page indicates that you have received a copy of this consent form for your own records.

Your signature and indication of willingness to participate indicate that you consent to participate in this study.



Student Statement of Informed Consent
(copy to keep)

I have read and understand the attached letter regarding the project entitled: “*Meaning making in the poster presentation: A multimodal analysis of university students’ task perceptions and performance.*” I understand that, even if I consent to participate in the study, **I can opt out of the study** at any time. I have kept a copy of the letter describing the project and a copy of the permission form (Statement of Informed Consent). **Fulfilling the four conditions with asterisks (*) below means that you agree to participate as a focal participant.**

Please check (with X) all that apply.

Note: the reason for seeking to videotape is to see verbal and non-verbal forms of communication in poster sessions (the latter of which audio does not capture):

Please check (with X)
all that apply.

I agree to be **audiotaped as an audience member** in poster presentations. _____

I agree to be **videotaped as an audience member** in poster presentations. _____

*I agree to be **audiotaped as a presenter** in a poster presentation. _____

*I agree to be **videotaped as a presenter** in a poster presentation. _____

*I agree to participate and be **audiotaped in a post-poster-presentation interview.** _____

I agree to be **audiotaped during my poster preparation outside the class.** _____

*I agree to allow the researcher to collect course documents. _____

Participant Signature

Date

Printed name of the participant signing above

Optional: If you wish to receive a summary of the research results, please write your email address in the space below:

Email address



Student Statement of Informed Consent
(copy to be returned to researcher)

I have read and understand the attached letter regarding the project entitled: “*Meaning making in the poster presentation: A multimodal analysis of university students’ task perceptions and performance.*” I understand that, even if I consent to participate in the study, **I can opt out of the study** at any time. I have kept a copy of the letter describing the project and a copy of the permission form (Statement of Informed Consent). **Fulfilling the four conditions with asterisks (*) below means that you agree to participate as a focal participant.**

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all that apply.

I agree to be **audiotaped as an audience member** in poster presentations. _____

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*I agree to be **audiotaped as a presenter** in a poster presentation. _____

*I agree to be **videotaped as a presenter** in a poster presentation. _____

*I agree to participate and be **audiotaped in a post-poster-presentation interview.** _____

I agree to be **audiotaped during my poster preparation outside the class.** _____

*I agree to allow the researcher to collect course documents. _____

Participant Signature

Date

Printed name of the participant signing above

Optional: If you wish to receive a summary of the research results, please write your email address in the space below:

Email address



Appendix D

Department of Language & Literacy Education
Faculty of Education

6445 University Boulevard, Vancouver, BC
Canada V6T 1Z2
Tel: (604) 822 5788

Informed Consent Form

Background Information for Instructor / Teaching Assistant

Title of the study:

Meaning making in the poster presentation: A multimodal analysis of students' task perceptions and performance

Principal Investigator:

Dr. Patricia Duff, Professor

Department of Language and Literacy Education, UBC, Faculty of Education

Email: [REDACTED] Phone: [REDACTED]

Co-Investigator:

Masaru Yamamoto, MA student

Department of Language and Literacy Education, UBC, Faculty of Education

Email: [REDACTED]

This study will be conducted in fulfillment of Masaru Yamamoto's MA thesis research in Teaching English as a Second Language.

Purpose: What is this study for and about?

The purpose of this study is to explore university students' performances in and perceptions of poster presentations in an English-speaking educational setting at a Canadian university. Specifically, we would like to learn how university students prepare for, use language and other meaning-making resources, and perceive each other's performance in the poster presentation.

Study procedure: What is involved in your participation?

If you agree to participate in this study, you will be asked to allow Masaru Yamamoto to videotape and audiotape your students' poster presentation in your class, and if possible, to conduct regular classroom observations without any audio- or video-recordings. You will also be



asked to participate in two individual face-to-face interviews with Masaru Yamamoto to talk about your expectations for and perceptions of your students' poster presentations and about your mentoring practices in the course in relation to poster presentations. Each interview will take up approximately 30 minutes and be audio-recorded with your permission. Audio-recordings will be transcribed and later analyzed. The exact interview time and location will be arranged at your convenience. After the interviews, you may be contacted by Masaru Yamamoto by email for any further clarification about poster presentations, although these will be kept to a minimum. These interviews will be conducted in English. You will also be asked to allow Masaru Yamamoto to collect course documents relevant to your classroom instruction and to the poster presentation task, which include a course outline, a presentation guideline, evaluation criteria, and power-point slides.

Publication: What will be done with the information collected in this study?

This research project will be conducted as part of Masaru Yamamoto's Master of Arts degree, and thus will be accessible to the general public in the form of a master's thesis. In addition, the findings of the study will be presented at conferences and published in research journals. In order to protect your identification, pseudonyms will be employed for your name, course, and institution for all publications. For the visual representation of your students presenting, and you viewing their posters, all the participants' faces will be blurred by Masaru Yamamoto so that they are not recognizable. No results of the research project will be made public until the course grades have been submitted by the instructor.

Risks: Are there any risks of your participation?

There are no foreseeable significant risks related to your participation in this study and you may enjoy discussing your pedagogical practices in relation to posters. Participation in this study is entirely voluntary, and you have the right to refuse to participate and to withdraw from the study at any time without giving a reason or suffering negative consequences.

Confidentiality: How will your information and identity be kept safe?

Your identity and privacy will be protected both during and after the study by employing the following strategies: (1) pseudonyms will be used to substitute any real names and identifiable information of people (including you), institutions, and other social groups mentioned by participants to ensure confidentiality; (2) for the visual representation of the data in the thesis and publications, participants' faces will be blurred to protect their identity; (3) all hard copies of study documents will be scanned, digitized, and then shredded; (4) all digital data (including digitized copies of the study documents, video-recordings, audio-recordings, transcriptions and other relevant data) will be encrypted and then stored in a password-protected folder on Masaru



Yamamoto's antivirus-programmed laptop computer and a portable HDD or USB drive; and (5) the portable HDD or USB will be kept in a locked cabinet in the Principal Investigator's (Dr. Patricia Duff's) UBC office, and will only be accessible to Dr. Patricia Duff and Masaru Yamamoto. Others will have no access to the data. The collected data will be retained for a minimum of five years after the date of publication. Regarding the destruction of data, an irreversible method will be used to ensure secure destruction of research data. The Principal Investigator (Dr. Patricia Duff) will be responsible for the data. The transcriptions will not contain any identifiable information pertaining to participants, instructors, or institutions, and will not be distributed to any third parties.

Compensation and benefits: What are the benefits of participating?

Your participation will lead to an enhanced understanding of university students' presentation practices in an academic setting and may make an important contribution to the field of education, applied linguistics, and other relevant areas. It is also hoped that participation in this study will be a window onto your students' and your own engagement in poster presentations through an in-depth analysis of their poster preparations, performance, and post-presentation reflections. As a gesture of appreciation for your time and effort devoted to the research project, a \$20 gift card (UBC Bookstore) will be offered to you after the post-poster-presentation interview.

Contact: Who can you contact when you have questions or concerns?

If you have any questions regarding this research project, please feel free to contact Masaru Yamamoto ([REDACTED]) or Dr. Patricia Duff (email: [REDACTED] / phone: [REDACTED]) any time. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at [604-822-8598](tel:604-822-8598) or if long distance e-mail RSIL@ors.ubc.ca or call toll free [1-877-822-8598](tel:1-877-822-8598).

Consent

Your participation in this study is entirely voluntary, and you have the rights to refuse to participate and withdraw from the study at any time without giving a reason or suffering for any negative consequences.

Your signature on the next page indicates that you have received a copy of this consent form for your own records.

Your signature and indication of willingness to participate indicate that you consent to participate in this study.



Instructor / Teaching Assistant Statement of Informed Consent
(copy to keep)

I have read and understand the attached letter regarding the project entitled: “*Meaning making in the poster presentation: A multimodal analysis of university students’ task perceptions and performance.*” I understand that, even if I consent to participate in the study, **I can opt out of the study** at any time. I have kept a copy of the letter describing the project and a copy of the permission form (Statement of Informed Consent).

Initials

I consent to participation in this study. _____

I consent to videotaping of my students’ poster presentations (with their consent). _____

I consent to audio-recording of my interview. _____

I consent to the collection of course documents. _____

I consent to regular observations of my class. _____

Participant Signature

Date

Printed name of the participant signing above

Optional:

If you wish to receive a summary of the research results, please write your email address in the space below:

Email address



Instructor / Teaching Assistant Statement of Informed Consent
(copy to be returned to researcher)

I have read and understand the attached letter regarding the project entitled: “*Meaning making in the poster presentation: A multimodal analysis of university students’ task perceptions and performance.*” I understand that, even if I consent to participate in the study, **I can opt out of the study** at any time. I have kept a copy of the letter describing the project and a copy of the permission form (Statement of Informed Consent).

Initials

I consent to participation in this study. _____

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I consent to audio-recording of my interview. _____

I consent to the collection of course documents. _____

I consent to regular observations of my class. _____

Participant Signature

Date

Printed name of the participant signing above

Optional:

If you wish to receive a summary of the research results, please write your email address in the space below:

Email address:

Appendix E

Focal Student Interview Guide

Focal students: 30-45 minutes

A. Background Information	
A1	What is your name? Could you spell it for me?
A2	What is your major? / What program are you in? What year of study are you in?
A3	Are you a Canadian student or an international student? If the latter, how long have you studied at a Canadian institution (high school or university)?
A4	What language(s) do you use with your family and friends? Do you identify English as your first language or is it an additional language?
B. Poster Presentation Task	
B1	Have you ever done any Power-Point or poster presentations before this course? How were any previous PPT/poster presentations different from the ones in this course?
B2	What do you think are some of the characteristics of a good poster presentation—in general and then specifically for this course?
B3	What do you need to do in order to <i>make</i> a good academic poster for this course?
B4	What do you need to do in order to <i>perform</i> a good poster presentation?
B5	Why do you think your instructor gave you this assignment? (What do you think the purpose is of doing the poster presentation?)
C. Poster Preparation	
C1	How did you prepare for the poster presentation?
C2	How did you choose the topic (and group members)?
C3	What did you do to make the poster?
C4	How did you decide to include the particular visual image(s) and the information (tables, written text) in ways that were presented in the poster?
C5	Did you rehearse your poster presentation? If so, how? If not, why not?
C6	If the poster presentation is a group project, did your group assign your roles? How?
C7	What did you find particularly effective or ineffective in your preparation? What was the outcome of the action?

C8	What were some of the challenges that you faced in preparing for the poster presentation?
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D. Poster Presentation Performance/Perceptions	
D1	How do you now feel about your presentation? How would you evaluate it?
D2	What were some of the aspects that you perceived particularly successful/effective in your poster presentation?
D3	What were some of the aspects that you perceived particularly unsuccessful/challenging in your poster presentation, or that you would do differently next time?
D4	As a presenter, among all the components in your poster (visual images, diagrams, tables, written texts, etc.), what were some of the most and least helpful resources for you in delivering your poster presentation?
D5	As a viewer, among many components (visual images, diagrams, tables, written texts, etc.), what were some of the most and least helpful and interesting resources for you in understanding your peers' poster presentations?
D6	What advice would you give to students working on poster presentations based on your experience in this poster project (e.g., in a course such as this next time it's offered)?

Appendix F

Instructor / Teaching Assistant Interview Guide

Two 30-minute interviews (approximately 60 minutes)

A. Background Information	
A1	Could you tell me a little bit about yourself and your experiences teaching here at the university?
A2	How long have you taught university students (both in and outside the university)?
A3	Have you noticed demographic or other changes (e.g., level or type of students' disciplinary backgrounds) in the composition of your courses since you started? Please explain. How have you responded to such changes?
B. The Researched Course	
B1	What do you expect your students to learn or to be able to do as a result of taking this course?
B2	What assignments are students required to do for the course? Could you talk about the purpose of the assignments and how they are linked to the course objectives?
B3	How is the poster presentation task linked to the objectives and other assignments of the course? Have you been using posters for a long time in this course? Why?
C. Instructor Expectations	
C1	What do you think are some of the characteristics of a good academic poster?
C2	What do you think are some of the characteristics of a good poster presentation?
C3	What do students (or others) need to do to make a good academic poster?
C4	What do students (or others) need to do to give a good poster presentation?
C5	What makes a poster academic?
C6	What makes a poster presentation academic?
C7	What is the purpose of requiring students to do the poster presentation?
C8	What do you consider to be important and challenging aspects of the poster presentation assignment?
C9	What do you consider to be the purpose(s) of student poster presentation in undergraduate/graduate courses like this?
C10	In what ways do you expect your students to prepare for their poster?

C11	How do you expect your students to perform their poster presentation?
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D. Instructor roles in the poster presentation

D1	What roles do you think you played in students' poster presentations? If they are group presentations, how are the groups composed? Do issues regarding group composition ever arise?
D2	How did you help students accomplish their poster presentation tasks in or out of class?
D3	How did you evaluate students' poster presentations?

E. Students' poster presentation performance

E1	What are your overall impressions of your students' poster presentations this year?
E2	Whose posters did you think were very effective in terms of design and content? Please name some of your students and their poster(s) and explain why.
E3	Who (or which groups) did you think were effective poster presenters? Please name some of your students and explain why.
E4	What did you think of [FOCAL STUDENT(s) / FOCAL STUDENT GROUP(s)] poster and their poster presentation performance?

F. Other questions

F1	What kind of role do you think poster presentations play in your field?
F2	Is there anything else I should know about this course, your students, and the poster presentation task?

Appendix G

Transcription Conventions

[	Left bracket	The beginning of overlapping speech, shown for both speakers; second speaker's bracket occurs at the beginning of the line of the next turn, rather than in alignment with previous speaker's bracket
=	Equal sign	For "latched" utterances; indicates speech across turns without any pause or break; shown for both speakers.
(#)	The length of the pause	(0.2) is 2/10 of a second; (2.0) is two seconds
(words)	Unclear utterance	The words in parentheses were not clearly heard; (x) = unclear word; (xx) = two unclear words; (xxx) = three or more unclear words.
<u>words</u>	Underline	Speech with emphasis
WORDS	Capital letters	Loud speech
((words))	Double parenthesis	Researcher's comments
:	Colon	Lengthened sound or syllable
.	Period	Terminal falling intonation.
,	Comma	Rising, continuing intonation.
?	Question mark	High rising intonation, not necessarily at the end of a sentence.
-	Unattached dash	A short, untimed pause (e.g., less than 0.4 seconds).
word-	One-sided attached dash	A cut-off, often accompanied by a glottal stop (e.g., a self-correction)

Adapted from Duff (2008, p. 157)