

Examining an Out-of-Class Collaborative Writing in an Interdisciplinary Research
Project in Science and Technology Studies

by

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ABSTRACT

This dissertation explores the nature of collaborative writing in an interdisciplinary research context beyond classrooms. Most of the current studies in collaborative writing in second language contexts are based on collaborative writing in classroom-based contexts such as English as a Second Language courses with undergraduate students. Collaborative writing tasks are getting its popularity both in classrooms and beyond classrooms with various purposes and objectives. Thus, it is more likely that multilingual writers encounter some kinds of collaborative writing tasks in various contexts. For writing instructors and writing curriculum developers, it is important to understand various types of collaborative writing tasks and their writing practices.

The current study investigates the nature of collaborative writing in an interdisciplinary collaborative research project. The study examines the processes of a multilingual writer's literacy development in collaborative writing tasks. Based on a qualitative case study, the study focuses on identifying what literate activities were involved in, what effects from the writing collaboration were observed, and what factors influenced this multilingual writer's writing development. I analyzed various sources of data such as writing samples, writing journal notes, observation fieldnotes, project documents, and the interviews from the focal participant, the graduate student, and two other co-authors as informants in the study. Based on a multilingual writer's perspective, the findings show what the collaborative writing practices look like in an interdisciplinary research setting. The findings indicate that a multilingual writer's writing skills were constantly evolving while interacting with collaborators through various phases of

collaborative writing. Particularly tasks in collaborative revision process such as mediating the gaps between co-authors and responding to research members were crucial in developing awareness for audience and content organization. Drawing on a naturalistic qualitative study, this dissertation discusses that studies of collaborative writing in second language learning contexts needs to provide broader perspective and aspects of collaborative writing in various settings that multilingual writers engage in. The research concludes with a discussion of pedagogical implications, limitations of the study and future research.

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TABLE OF CONTENTS

	Page
LIST OF FIGURES	ix
LIST OF TABLES	x
CHAPTER	
1 INTRODUCTION	1
Statement of Problem	4
Overview of Chapters	7
2 REVIEW OF LITERATURE	9
The Definitions of Collaborative Writing	9
Collaborative Writing in L1 Settings	9
Collaborative Writing in L2 Settings	13
Major Research Findings	16
The Effects of Collaborative Writing on the Text	17
The Effects of Collaborative Writing on L2 Learning	20
Factors Influencing Collaborative Writing	24
Summary of Chapter 2	31
3 METHOD	34
Research Questions	34
Design of the Study	34
Context of the Study	36
Participants	39
Data Collection Procedure and Methods	42

CHAPTER	Page
Data Analysis Procedures.....	44
Analytical Framework.....	46
4 PRACTICES IN A COLLABORATIVE RESEARCH WRITING	49
The Interdisciplinary Research Project.....	49
Major Writing Practices in a Collaborative Research Setting.....	55
The First Year.....	55
The Second and Third Year	58
The Fourth and Fifth Year.....	64
Summary of Chapter 4	69
5 EFFECTS FROM COLLABORATIVE WRITING.....	70
Perceiving Tasks and Goals for Collaborative Writing.....	70
Transitioning from the Conflicted Feedback.....	73
Learning Narratives	77
Clarity of Writing	79
Writing for an Interdisciplinary Research.....	81
Gains from the Collaboration.....	85
Summary of Chapter 5.....	90
6 FACTORS INFLUENCING COLLABORATIVE WRITING.....	92
General Feedback at the Research Meetings.....	92
The Use of Online Database.....	94
Different Disciplinary Backgrounds	96
The Ambiguity in the Research.....	101

CHAPTER	Page
The Functions of Collaborators’ Feedback	106
Incorporating Key Ideas into Visualizations	109
Summary of Chapter 6.....	112
7 DISCUSSION, LIMITATIONS, IMPLICATIONS, AND	
FUTURE RESEARCH	114
Discussions	114
Implications	119
Limitations	124
Future Research	127
REFERENCES	130
APPENDIX	
A [INTERVIEW GUIDE FOR A GRADUATE STUDENT]	138
B [INTERVIEW GUIDE FOR FACULTY MEMBERS]	141
C [IRB PROTOCOL]	144

LIST OF FIGURES

Figure	Page
1. Feedback Given to the Leading Author	74

LIST OF TABLES

Table	Page
1. Demographic Description of Participants.....	41

CHAPTER 1

INTRODUCTION

Collaborative writing is a popular group activity in academic settings such as in writing classes or language learning courses. In educational settings, mostly the purpose of including collaborative writing tasks is to provide students with diverse learning opportunities while engaging with peers. Most of instructional exposures are based on teachers. Rather than mainly relying on teachers' input, collaborative writing in a group can create a space for learners to negotiate their views with peers and find ways to work together for completing a task. Especially in a writing instruction, it is important to writing specialists and curriculum developers to understand various practices in collaborative writing not only in classrooms but also beyond classrooms. Based on broader understanding collaborative writing tasks in academic settings, teachers can make informed decisions for incorporating collaborative writing tasks into their writing instruction and further make students be prepared for various kinds of collaboration in writing tasks beyond writing classes.

In the field of L2 writing, many classroom practices and research regarding collaborative writing have been designed based on a simplified type of collaborative writing. The underlying assumptions for classroom-based collaborations for writing are that collaborators are mostly student peers assumed with similar L2 proficiency levels and no consideration of writers' disciplinary differences. Another tendency from the previous research is the emphasis on specific writing process such as joint drafting in a group either through face-to-face or online collaboration settings. It is no doubt that the act of collaborative drafting is important component in collaborative writing but drafting

collaboratively may not be the most crucial element in defining collaborative writing in some contexts. Depending on scholars, their notions of collaborative writing vary. To extend our understanding of collaborative writing tasks, looking into those various notions is necessary for us to compare their differences and applications to collaboration tasks.

As the findings reveal in the study, the real authentic collaboration in writing beyond classrooms includes various stages of writing collaboration such as idea development, content development, revision, and editing can also be crucial components in the process of writing collaboration. Group members can flexibility for what can be achievable together in a group and decide what they can do collaboratively or individually. Then group members make decisions on what to select at the end from the group discussions.

Most of literature on multilingual graduate writers focuses on examining the characteristics of individual writers' written abilities and their practices in writing classes. However, graduate students often encounter writing tasks working together with their colleagues and faculty members for collaborative research projects in an outside-of-classroom setting as well as classroom-based writing tasks. Especially at the graduate level curriculum at any discipline, research and writing research paper are the key portion. At the graduate level writing or beyond graduate level, co-authoring is commonly seen in the academia. At some point of their academic or professional career, multilingual writers with no collaboration experience in writing may not fully perform their role as a writer and researcher in collaborative research contexts and may not

encounter challenges for writing a manuscript collaboratively. Investigating the characteristics of graduate-level collaborative writing tasks in a research team provides broader views on collaborative writing and its patterns of collaboration. Further the findings in the study help understand the features of collaborative writing tasks and feedback practices beyond classrooms. Looking into those features outside of classrooms would inform us what needs to be considered in incorporating collaborative writing tasks into L2 writing curriculum.

Considering the real work in collaborative writing beyond classrooms, it is important to provide a detailed picture of collaborative writing in a naturalistic setting. Thus, the writing curriculum in L2 writing can reflect the authentic aspects of collaborative writing and provide the foundation for transferring learned writing skills in class to the actual collaborative writing tasks in their disciplines or beyond their academic sites. One of the goals in L2 writing instruction is for L2 writers to be better prepared for various tasks in writing not only in classrooms but also beyond classrooms. With an attempt to help achieve some of the pedagogical goals in L2 writing instruction, the current study provides findings of collaborative writing in an interdisciplinary research setting. The study explores how a multilingual writer engaged in collaborative writing tasks and what factors were involved in relation to writing development. The current study focuses on the whole process of collaboration in writing in a research team. Looking at the group dynamics and their interactions, it examines the multilingual writer's perspective on collaborative writing in an interdisciplinary field of study. The focal participant's accounts based on his outside-of-classroom collaboration experience distinguish the aspects of collaborative writing for classroom practice from those with

real purposes. The findings from the study provide pedagogical implications how to design writing instructions that incorporate collaborative writing tasks for advanced-level multilingual writers.

Statement of Problem

More and more L2 writers will have opportunities for collaborative writing either in classrooms or beyond classrooms as part of classroom activities or writing project beyond classrooms. Typically, collaborative writing in L2 classrooms is designed for providing opportunities for scaffolded learning contexts between peers in performing writing tasks. It is useful to have basic scaffolding practices regarding collaborative writing in order to facilitate learning between peers. In those L2 learning contexts, often the students are with low or intermediate levels of L2 proficiency, learning how to write a good essay in in-class group settings. However, the tendencies of those studies are on mostly undergraduate multilingual students in separate sections of L2 only students in second language courses.

Currently, the understanding of collaborative writing in L2 contexts are lopsided. First, most of studies in collaborative writing are mostly focused on classroom-based contexts. Most of practices in collaborative writing in L2 classrooms have shown the tendency of providing relatively static and simplified images of peer collaboration in an assigned group. The collaborators are peer undergraduate students with similar L2 proficiency levels. Although students have different socio-cultural backgrounds, that kind of individual factors are not considered as a significant element because all of students are L2 learners in a separate section for L2 learners. Little is known how advanced-level or graduate-level multilingual writers work together in collaborative writing tasks beyond

classrooms such as their disciplinary research contexts. Considering multilingual writers' collaborative writing tasks in their disciplinary context would broaden our current understanding of collaborative writing in the field of L2 writing. Further, it is important to note that because collaborative writing also happens outside of classrooms with various purposes and with diverse writers, L2 writing instructors, researchers, and curriculum developers should consider including some aspects of collaborative writing in various contexts into their collaboration tasks. Given the diverse contextual aspects, it is worthwhile to examine the collaborative writing practices beyond classrooms where a multilingual writer with advanced L2 proficiency is engaged in.

Second, most of the writing prompts given in the collaborative writing tasks are quite general and they don't seem to particularly initiate intensive level of collaboration. Depending on the intensity of collaborative work implied in the prompts, the patterns of group work or the level of collaboration can be different. It would not be just the factors of individual writers' work style. If the prompts are not created for the necessity of group collaboration, students would easily lose their interests or motivation for writing collaboratively. Examining prompts or writing objectives in the collaborative writing tasks needs to be paid more attention to have a deeper understanding of the collaboration context. Deeper understanding of task types and writing prompts in collaborative writing is instrumental because it can reveal what elements are situated in the writing objectives and further shed light on how those objectives are related to the outcome of collaborative writing.

Third, the current literature only seeks answers for the limited aspects of collaborative writing. The existing research in collaborative writing tends to focus on

mostly linguistic accuracy in drafts such as error correction rate made in collaboratively produced texts or textual fluency that are crucial to low or intermediate proficiency level learners. The effects from the collaborative tasks are compared to that from individual writing. Simple evaluation of comparing collaborative versus individual writing does not tell us much about the aspects of collaborative writing. Because the results from collaboration in writing are not only the text focusing on surface-level analysis but also the content in the text focusing on arguments. What we need to extend more is the detailed analysis of how arguments are created and revised through collaboration. Multilingual writers with limited collaboration experience would feel difficulty in negotiating ideas with writers from various backgrounds. To better assist the needs of multilingual students for collaborative writing performance, it is worthwhile to examine arguments and content development more closely during the collaboration process. In this light, it is important to provide a more comprehensive understanding of collaborative writing in an authentic academic setting to better prepare L2 writers for their future applications of collaborative writing beyond classrooms. Investigating various aspects of collaborative writing happening outside of classrooms can inform us with pedagogical implications that help us prepare our L2 learners for various writing tasks in their disciplines.

To bridge the gaps from the literature in collaborative writing research in L2 contexts, the current study explore the nature of collaborative writing practices in an interdisciplinary research project in Science and Technology Studies. Drawing on Lave and Wenger's (1991) notion of legitimate peripheral participation in CoP and situated learning as an analytical lens, feedback practices, negotiations and interactions in

collaborative writing are examined. This qualitative case study identifies what literate activities in collaborative writing are involved related the particular disciplinary research practice. It reports how a multilingual writer in the collaborative writing negotiates with other writers and how those activities influence collaborative writing. Investigating factors that influence collaborative writing in an interdisciplinary research sheds light on how the multilingual writer incorporates previous L2 knowledge, L2 writing skills and disciplinary knowledge into writing tasks in the collaborative writing project. The findings provide pedagogical implications on how to design writing instructions and incorporate collaborative writing tasks for advanced-level proficiency students or multilingual graduate-level students. I hope to provide detailed descriptions on what collaborative writing in a graduate level project looks like, what factors are involved in a collaborative project and how a multilingual writer works with other collaborators

Overview of Chapters

Below I outline five chapters in the project. In Chapter 1, I introduce the dissertation study and the motivations of the research. In Chapter 2, first, I discuss the definitions of collaborative writing frequently used in collaborative writing research and bring up my working definition of collaborative writing for the study. Then, I discuss the gaps from research findings and their focuses in previous studies. In Chapter 3, I outline the method used in the research. It covers research design, research questions, participants, data collection, and data analysis. It provides details about how data was collected and analyzed in order to illustrate the collaborative writing practices in interdisciplinary research project beyond classrooms. Chapter 4, 5, and 6 report the findings of my research questions. The findings reveal the nature of collaborative writing

in an interdisciplinary research. It provides findings with details of the writing process and practices from investigating the multilingual writer's engagement in an interdisciplinary research context. The effects from the collaborative writing and factors that influenced the focal writer's collaborative writing were analyzed. Finally, Chapter 7 wraps up the dissertations by summarizing the major findings and contributions to the field of second language writing. It concludes with a discussion of pedagogical implications, and future research.

CHAPTER 2

REVIEW OF LITERATURE

In this chapter, I review previous literature in collaborative writing. First of all, to have a clear notion of what definition I employ for this study, I take a look at various notions of collaborative writing used in L1 and L2 writing studies. I review how the definition of collaborative writing has been moved along in L1 context. The reason is that to some extent, the writing instructions in L2 contexts has been influenced by L1 composition studies. It is important to have a comprehensive view on the definitions of collaborative writing both in L1 and L2 contexts. Then, I discuss theoretical and pedagogical backgrounds regarding employing collaborative writing tasks in writing instructions. The following part is the findings of previous studies of collaborative writing in L2 contexts. I discuss the findings with several categories. Then, I address what the current study contributes to the knowledge of collaborative writing.

The Definitions of Collaborative Writing

Collaborative Writing in L1 Settings

In the literature of L1 composition studies, the definitions of collaborative writing are broadly defined or narrowly defined depending on its disciplinary orientations and instructional purposes in classroom contexts. The definitions mostly used in L1 writing studies seem to appear in the continuum of two ends, ranging from a broad to a narrow side. The broadest definitions can be found from that Bruffee (1984) and Harris (1994). Both are located in the broadest end of the continuum. That is, they consider that all writing is collaborative to some extent because writing is done considering a certain reader in mind and some level of collaboration is involved in various writing stages. In

their interpretation, the aspects of intertextuality and the connectedness of previous ideas to new ideas seem to consider collaboration in writing.

Another definition taken from Ede & Lundsford (1990) is based on “group writing”. In their research, they refer to “group writing,” or any group writing activity done with other students collaboratively, as collaborative writing. Their notion of collaboration is more specific and emphasizes writers’ joint efforts to produce a text. In their view, the key elements are producing a text collaboratively and sharing responsibilities for completing a collaborative task. In doing so, their definition does not limit certain patterns of collaboration among writers. In the notion of referring “group writing” to collaborative writing, the assumption is that all members are working toward co-authoring processes but it allows room for flexibility in groups’ collaboration styles. That does not mean that all members should produce a sentence or a text together. Each member’s role can be cooperative, which assumes each member contributes their efforts to complete jointly-owned text. Particularly, in terms of writing process, the term includes planning and revising but it does not necessarily mean drafting collaboratively.

There seems to be clear differences in how collaborative writing is used in L1 and L2 activities. Collaborative writing refers to involving two or more writers who work together to produce a joint product (e.g., Ede & Lunsford, 1990). Basically, it emphasizes writers’ joint efforts for production not a jointly-produced text generation.

Different scholars have classified collaborative writing into several categories. For instance, collaborative authoring (DuFrene & Nelson, 1990), group authorship (Ede & Lundford, 1990), and team writing (Bovee & Thill, 1989). Some scholars (e.g., Lowry, Curtis & Lowry, 2004) indicate that the potential benefits from this kind of collaboration

can be an idea development, shared learning, developing writing competence, being socialized into specific discourse community, and building up the abilities of collaboration and negotiation. In their definition, collaborative writing is “an iterative and social process that involves a team focused on a common objective that negotiates, coordinates, and communicates during the creation of a common document” (p. 72). Their notion includes pre-and post-writing activities around collaborative writing. The scope of views on collaboration in L1 contexts is much broader and inclusive. In this light, studies in L1 tend to focus on practices and strategies in negotiation and coordination in group work. For the collaborative task, team or group members may negotiate, coordinate, and communicate their common objectives. Contrary to the frequently employed notion in L2 research, the notion in L1 assumes individual strategies used and group related strategies which are reaching group consensus or taking some group responsibility for a final co-authored product. Witte (1992) argues that the common document is socio-culturally mediated through collaborative practices of team or group members in a particular setting. In L2 contexts, the setting of the collaborative writing is dominantly language-oriented courses but findings in L1 research draws on more content-based and mainstream courses.

In the process of the joint production, the group members may negotiate, coordinate, and communicate their common objective in writing (e.g., Lowry, Curtis, & Lowry, 2004). As such, collaborative writing in L1 writing studies emphasizes the social nature of writing, interaction, and negotiations and decision-making processes among group members. In earlier studies on collaborative studies in L1 contexts, the focus was placed on developing writers’ abilities in analytical and critical reading and writing skills

(Nystrand & Brandt, 1989) and fostering reflective thinking (Higgins, Flower, & Petragila, 1992). Research on collaborative writing in foreign and second language contexts has tendency to focus on the final stage, the peer review, and error corrections at the word or sentence level (e.g., Nelson & Carson, 1998; Villamil & de Guerrero, 1996).

More flexibility is allowed in the patterns of collaboration in L1 classroom settings. For instance, Saunders (1989) focused on the nature of tasks involved and the role and responsibilities that writers assume as they negotiate collaborative writing tasks together. He listed five collaborative writing activities from the composition literature. The five different collaborative activities are co-writers, co-publishers, co-responders, co-editors, and writer-helpers. Depending on the nature of each activity, he categorized what kinds of writing tasks are assigned. For instance, co-writers do planning, composing, review, and correcting together. In the case of co-publishers, they do all of tasks together except composing. Co-responders only do reviewing together and co-editors do correcting. Then, in writer-helpers, a writer has all the responsibilities and peers may provide voluntary informal collaboration for four writing process tasks. Considering his categorization, in L1 composition literature, depending on which writing tasks are assigned, collaborative activities can be organized into five patterns. Co-writers do all the processes together such as planning, composing, reviewing, and correcting, which is the same kind of what Storch's definition refers to. The different styles are identified in L2 composition literature. In the co-publishers' case, writers do not compose together but are in charge of their own assigned section for a collective document.

Collaborative Writing in L2 Settings

In defining collaborative writing in L2 contexts, the assumption of the most crucial factor with this activity is the act of joint drafting. The drafting is for the very first draft in writing processes. The most dominantly used definition of collaborative writing in L2 writing is from the work of Storch (2005, 2013) and Storch and Wigglesworth (2007). Storch defines that collaborative writing refers to mutual engagement with a coordinated effort by all members in a group or pair for producing one text together. In that, she clearly states that she excludes collaborative prewriting stages before joint drafting and peer editing after drafting for being part of a joint drafting.

Although Storch acknowledges that it is expected that all writers' full participation and engagement in all stages of writing processes, the critical element in her conceptualization of collaborative writing is whether or not a joint drafting act is involved by all writers. Employing her notion in many studies in L2 contexts, studies tend to dominantly examine the joint drafting process and the verbal interactions or group patterns while drafting together. It would be possible that the commonly adopted notion of collaborative writing in L2 settings may provide students with static images of the collaborative writing and patterned writing practices in class. With instructional purposes, the current notion of collaborative writing typically employed in classroom settings does not seem to allow various styles of collaborative writing practices. For instance, the notion of collaborative writing does not include flexible collaborative writing practices in terms of collaborative process. It also provides impression that other writing processes such as planning, revising, and editing are peripheral writing stages and joint drafting is

the most crucial stage. Little research is conducted in extensive work of collaboration occurred in collaborative revising or editing process after the initial joint drafting.

Another essential part of her definition is the emphasis of requiring all writing members' joint act for drafting and having equal amount of responsibility and contribution for creating a text to claim an ownership for their collaborative work. If no joint drafting act is included, it is not collaborative writing. For instance, if all members participate in planning and editing process but not in drafting, then it is not considered as collaborative writing in Storch's definition. Her rigid notion of collaborative writing does not allow various types of collaboration and contribution while producing one text together.

There seems to be two conflicting values in her notion of collaborative writing, which lead to some confusion on what conditions can be called collaborative writing. First, it is about ownership. Storch stated that in terms of obtaining an ownership for a text, it is necessary for writers to require an equal amount of collaboration, responsibility, and contribution throughout the all writing processes. More precisely, her assumption is that writers' ownership results from the act of joint drafting. From her definition, such narrowly defined collaboration is expected as a default condition for claiming an ownership. However, in many real-life collaborations, the ownership can often be negotiated considering various factors among writers such as the task types, the level of expertise, and the degree of collaboration. So, there are cases that the ownership cannot be simply given or assumed due to the dynamic nature of collaboration in various contexts.

Second, besides writers' textual contribution for a co-constructed text, there seems to be an issue of what other types of contribution counts in collaborative writing. That is closely related to what kinds of group members' of contribution such as feedback or discussions that influence the development of text. Collaboration can occur in many different forms while writing. Not just drafting together in a group but also planning, prewriting, revising, and editing can be equally important in the process of collaborative work. Therefore, setting such rigid idea on ownership and collaboration may lead to consider only the narrow type of collaborative writing. The static notion of collaborative writing may hinder L2 writers' application of such collaborative tasks in outside of classrooms or in a professional context. It is important to address those limitations to L2 writers who may develop limited views on collaboration and experience a partial exposure of collaborative writing in L2 classrooms. Thus, it is necessary to extend L2 writers' understanding of collaborative writing by providing a broader picture of collaboration. Various factors and types of collaboration can exist and can be negotiated.

Some L2 scholars attempt to differentiate between peer-related activities employed in solitary writing process and peer activities embedded in collaborative writing. Peer planning or peer editing activities are often incorporated in the process of solitary writing to facilitate individual writing process in L2 writing. For instance, Hirvela (2007) argued that peer planning or peer editing occurring in a solitary writing should be called 'collaborative approaches to writing', not collaborative writing. It seems that his idea, just like Storch's definition of collaborative writing that emphasizes the act of joint drafting, highly values a joint-drafting act that distinguishes peer activity with collaborative writing.

Regarding the tendency of researchers' supporting collaborative writing in L2 learning, two major theoretical backgrounds are based on cognitive and socio-cultural perspectives for L2 learning. Their preferences of incorporating collaborative activities into writing tasks may come from the pedagogical view that highlights collaborative learning approach and communicative language learning. Regarding cognitive aspects, L2 researchers argue that collaborative writing is conducive to language learning, expressing ideas, and providing necessary support to peers (e.g., Brooks & Swain, 2009; Storch, 2008; Storch & Wigglesworth, 2007; Swain & Lapkin, 2000; Watanabe & Swain, 2007). While saying and reflecting on what other writers said, learning can occur and collaborative writing tasks can provide environments for developing cognitive skills.

Another view with the notion of collaborative writing in L2 contexts has the orientation in the social constructivist view of language learning. Researchers who view writing as a process of meaning-making and social activity employ the theoretical concepts from Bakhtin (1981), Halliday (1978), and Vygotsky (1978). In Vygotsky's notion of socio-cultural theory, language serves as a mediator of developing thinking skills and bridging the gap between what one can do and what he or she can get from others' assistance. From such shared views on language learning, social interaction with others and the function of language use are considered important elements in L2 collaborative writing classes.

Major Research Findings

In this section, I categorize the major research findings into four major categories; the effects on the textual quality, the effects on L2 learning, factors influencing

collaborative writing, and other studies that covered some issues with practicing collaborative writing in L2 contexts.

The Effects of Collaborative Writing on the Text

Focused on L2 performance and L2 usage, researchers have examined effects of collaborative tasks on the quality of text. The major evaluation criteria for textual improvement are accuracy, fluency, and syntactic complexity. Based on such surface-level textual evaluation, many studies provided positive evidence of collaborative writing particularly on grammar accuracy. For instance, some results indicated that learners' texts showed increased accuracy over fluency and syntactic complexity (e.g., Storch, 1999, 2005; Storch & Wigglesworth, 2007; Wigglesworth & Storch, 2009; Kuteeva, 2011). Those studies showed mixed results on the improvement in fluency and syntactic complexity. They added that learners generally paid attention to language forms and exchanged their dialogues about linguistic accuracy a lot more than other aspects of writing such as content, genre, audience, and purposes (e.g., Swain & Lapkin, 2001; Storch & Wigglesworth, 2007; Elola & Oskoz, 2010).

In most of studies, fluency and syntactic complexity had mixed results or did not show recognizable improvements on their texts. In measuring fluency, the typical way of measurement is the length of text. The results reported that among low or intermediate level students, fluency was better than accuracy. But among advanced level learners, accuracy was more significantly improvement than fluency. In Storch's (2005) classroom-based study among advanced groups of L2 writers, the results confirmed the tendency of increased accuracy in advanced level L2 students. The research indicated that pairs produced shorter texts but their texts were more accurate and syntactically complex.

Wigglesworth and Storch (2009) found that no statistically significant differences between texts produced individually and those by groups. However, texts produced by pairs were more accurate. This confirms the results that more accurate texts were produced by group writing.

Other studies with advanced proficiency level students reported on the types of learners' attention in the collaborative writing tasks (e.g., Storch & Wigglesworth, 2007). The more proficient in L2 usage, the more attention given to language issues and meaning-focused tasks. They revealed that the advanced ESL learners elicited more attention to lexical choices than accuracy. It is noteworthy that with the advanced-level learners, accuracy in lexical choices in the content matters more than accuracy in grammar. The researcher reported that the advanced learners have already mastered in grammatical structures, so that their negotiation was centered around lexical choice. Although the research focus was made in issues with contents, they did not provide how the advanced-level writers work collaboratively to mitigate their different views and what factors were associated in their decision process in a group. It can be assumed that in the view of accuracy, most research attends to grammatical accuracy than accuracy in meaning. This is something we need to consider for further research. There is little information on the relations between grammar accuracy and clarity of text focusing on meaning. Measuring grammar accuracy over fluency and syntactic complexity from collaborative writing does not provide enough information on particularly advanced level writers' improvement. More detailed analysis on text is needed. It also seemed that research findings basically have equally distributed measuring categories with textual analysis. So many findings from the collaborative writing have shown mixed results.

Another tendency of research observed from the literature is the comparison of positive results on texts between individual and group writing. Some research (e.g., Wigglesworth & Storch, 2009; Strobl, 2014) provided evidence in the differences in individual versus group writing. Their findings showed that the improvements in fluency was a lot better in pair or group writing compared to texts produced by individual students. In those contextual comparisons, mostly contents and organization in texts are much more improved than syntactic complexity or grammar accuracy. In the comparison of individual and group writing. Group writing did not result in producing longer texts. For syntactic complexity, there was no significant differences. The significant differences appeared in accuracy. Pairs produced error-free T units because they pooled their grammar resources and reached the correct forms during the collaborative writing activity.

Other studies focused on investigating the effects on textual elements with incorporating online affordances in class such as wikis or Google Doc for collaborative tasks using online affordances in class. Those studies (e.g., Arnold et al., 2009; Kessler, 2009) indicated that writers tend to focus on accuracy on wiki texts although more discussion were made on content and structure of texts. The findings reported that learners used chat for discussing contents and structures and tended to negotiate the organization of their writing and putting their writing together in wikis. In analysis of learners' interaction in wikis, studies revealed that collaborative writing using online tools has similar results in textual improvement in accuracy. The fluency and syntactic complexity are shown mix results. It is noteworthy that whether collaborative writing in face-to-face or online contexts, the results are quite similar in textual improvements. The

only difference would be learners have more chances to discuss more about their opinions on each member's work by exchanging chats online, which allowed learners to exchange their opinions extensively. It seems there were more chances for discussing online but the actual results on textual gains showed similar tendency with offline-based collaboration.

The Effects of Collaborative Writing on L2 Learning

In many L2 language classes, collaborative writing task is used as a facilitating tool for promoting learners' interactions and cognitive process. Due to this reason, task types in collaborative writing seem limited and are mostly based on grammar activities. Task types can affect L2 learners' dialogues focusing on forms and language related episodes (LREs). For instance, cloze exercise, dictogloss, text reconstruction, and jigsaw tasks are commonly used for collaborative writing tasks. Those tasks are reported to be useful to promoting peer collaboration and LREs (e.g., Alegria de la Colona & Garcia Mayo, 2007; Kim, 2009; Storch, 1998, 1999; Swain & Lapkin, 1998, 2001). However, those language concerns can be related to much more broader aspects of writing when more open-ended prompts are given to students. It is necessary for L2 researchers and instructors to provide a wide range of writing task for collaboration. Studies employed collaborative writing have shown a tendency of focusing on linguistic accuracy on word or sentence level features rather than macro-level features in writing.

Some research was particularly designed for examining the relationship with L2 acquisition and collaboration (e.g, Kuiken & Vedder, 2002, Kim, 2008; Nassaji & Tian, 2010). The results for the relationship are conflicting and do not show clear evidence of the knowledge gains. For instance, Kuiken and Vedder (2002) and Kim (2008) used a

dictogloss task and analyzed the number of LREs. In their pre- and posttest, Kim's research had positive evidence for L2 acquisition in collaborative condition but Kuiken and Vedder's research obtained contradictory results for L2 acquisition. In Nassaji and Tian's research with a cloze and editing task showed that although L2 pair groups produced more accurate texts than individual learners, the vocabulary pre- and posttest did not show a clear evidence for language improvement from collaborative writing tasks.

As part of providing evidence for learning from SLA perspectives, examining the effects of collaboration on group interaction in collaborative tasks were observed in many studies. In SLA research, it has a long history of looking at L2 students' interactions and various tasks types to explore how language works as a mediating tool and what task types provide opportunities for language learning. For instance, during 1980s and 1990s in SLA, pair and group work were influenced by Long's (1996) interaction hypothesis and communicative approaches to L2 class and most tasks were oral tasks. While learners' interacting to each other in language class, Swain (1993, 1995) noted that learners can process language more deeply, notice gaps and reflect on language use. Not only oral input and output but also written input and output can reinforce learners' acquisition of target knowledge. In Mackey & Gass (2006), their study focusing on a small group's interaction demonstrated that learners engaged in the negotiation of meaning to make their output comprehensible and more target-like. Thus, learner interaction is considered as more comprehensible and more accessible than teacher feedback. Ortega (2007) pointed out that the potentials of interaction is to provide more learning opportunities in L2 writing.

Researchers who examined writers' interactions while carrying analyzed writers' interaction patterns and dialogues between writers. Mostly linguistic focus was the area for discussion. For instance, Storch (2001), Swain and Lapkin (2001) reported that while learners try to complete tasks, languaging which refers to language related episodes such as grammatical form, lexical choices, mechanics can vary depending on the types of writing tasks. Storch (2008) pointed out that the majority of studies focused on the quantity of language-related episodes, not their quality. She mentioned that deeper engagement in language negotiation would affect language development and better quality of writing.

Researchers speculate relations with dialogue patterns and a jointly produced text (e.g., Storch, 2002; Storch & Wigglesworth, 2007; Watanabe, 2008). Those studies concluded that groups' collaborative patterns affected the quality of joint text. The majority of data is based on analyzing oral interactions in L2 contexts. The findings provide the four main interactional patterns such as collaborative, expert/novice, dominant/dominant, and dominant/passive. The most effective collaboration occurred in collaborative or expert/novice patterns. The collaborative and expert/novice patterns seem to be conducive to L2 learning.

Studies have shown the benefits of collaborative writing. For example, the activity helps foster reflective thinking, a greater awareness, and understanding of the audience. Another benefit is that learners can have opportunities to make their thoughts vocalized. Swain's (2000) study informed by Vygotsky (1978) illustrated jointly built performance can surpass individual competence. She pointed out the importance of collaborative dialogue while working collaboratively. She argues that 'languaging', defined as "the

process of making meaning and shaping knowledge and experience through language” (Swain, 2006, p. 89), is a source of L2 learning. The term, ‘languaging’ refers to what learners engaging in collaborative activity produce in a metalinguistic conversation with their peers while performing a group work. She demonstrated how the metalinguistic conversation can facilitate collaborative writing and its cognitive aspects to language learning.

Furthermore, a considerable number of studies in collaborative activity have examined learners’ interaction focusing on language related episodes (LREs). LREs mean learners’ dialogue when learners have grammatical and lexical difficulties (Swain & Watanabe, 2012). The analysis of LREs shows that learners are able to get correct solutions and co-construct new language knowledge by pooling learners’ linguistic resources (e.g., Leiser, 2004; Storch, 2007; Swain & Lapkin, 1998; Williams, 2001). For instance, those factors are task types and sociocultural and individual factors such as L2 learners’ proficiency level (Kim & McDonough, 2008; Leiser, 2004; Watanabe & Swain, 2007, 2008; Williams, 1999, as cited in Dobao, 2012). When learners rely on each other to solve problems, their performance for scaffolding can be maximized.

Regarding the effects from collaborative tasks, the benefits of collaborative tasks and scaffolding are the major attention. The tendency is that scholars mostly examine evidence that shows meaning for learning from the tasks and the gains while performing tasks. The collaboration in writing in L2 classroom mainly mean peer collaboration for a joint writing. So scaffolding among peers is the main source of researchers’ analytical angle. For instance, Brooks and Swain (2009) studied the effects of collaborative tasks on language learning and attempted to find the most effective source of learning among

adult ESL learners. Interestingly, the findings were that peers were the most effective source of expertise. The results can be understood in the sociocultural perspective and they implied the potentials of the learners' zone of proximal development (Vygotsky, 1978). The feedback given by a teacher would be far beyond the learners' developmental stage, which may not be effectively understood by learners. The researchers suggested that accessible feedback from peers was useful to L2 writers.

Students' attitude toward collaborative activity can be a crucial factor that influences the results of their collaborative text. (e.g., Carson & Nelson, 1996; Nelson & Carson, 1998; Storch 2005). Students' initial attitude prior to collaborative tasks seem to affect the collaboration in group writing. In some cases, students' negative views on collaborative work changed after experiencing collaborative tasks.

Finally, studies reported the advantages of group writing. For instance, Weissberg (2000) argues that adult learners were more likely to produce new syntactic forms in their writing than in their speaking tasks. Cumming (1990) and Harklau (2002) maintained that in writing tasks, the provision and subsequent noticing of corrective feedback are more feasible with writing. Further, Weissberg (2006) argued that integrated tasks with speaking and writing like collaborative writing may be more conducive to language learning than solitary writing. Weissberg discussed the potentials of taking multiple roles while writers perform collaborative tasks.

Factors Influencing Collaborative Writing

Regarding studies that investigate the factors that influence collaborative writing, researchers explore mainly learners' cognitive aspects in performing collaborative writing through analyzing writers' interactions between learners or qualitative interview data.

Major factors found from the literature are learners' L2 proficiency levels, L2 knowledge application in group work, group interactions for collaboration, students' perceptions on group work, and contexts in collaboration task.

Studies focused on how writers' L2 proficiency affected the results of collaborative writing. Regarding L2 proficiency factors, de la Colina and Garcia Mayo's (2007) study on EFL learners reported that the low-proficiency level learners were able to provide one another with using mutual scaffolding although some language related episodes were resolved incorrectly. The collaborative writing tasks seemed to be used successfully in drawing learners' attention to language. Depending on the difficulty levels and task types, students with various L2 proficiency can participate in the collaborative tasks. Most studies examine collaboration performances among writers with the same or similar level of L2 proficiency. The majority of research participants was in intermediate level of L2 proficiency. There are a few studies that examined collaborative writing in L1 and L2 mixed-group classes. For instance, Leki's (2001, 2007) work examined collaborative writing on the mixed-language groups in mainstream courses in L2 contexts. In Leki (2001), two ESL students had negative experience when working with NES peers due to the conflicts on different working styles between them and being treated as novices from their NES counterparts. Leki's work revealed what sorts of conflicts can occur in mixed-language contexts. Not only L2 proficiency factors but also different cultural and working styles can influence the way students collaborate. Leki's (2007) longitudinal study showed that a Polish ESL student in an American business school participated in a collaborative task by providing computer skills not with writing tasks. Her two studies

brought up issues that need to be considered when collaborative writing tasks are involved in content-based courses.

Another line of research focus is about L2 knowledge application during collaborative work. Other studies regarding sociocultural factors associated in collaborative writing found that learners pay more attention to changing content than grammar while working on drafting process. One of the factors that influences learners' decisions on content development over grammar was based on learners' socio-cultural backgrounds. In Mak and Coniam's (2008) work, students in Hong Kong thought that changes of grammar on peers' writing would be considered as losing face in their cultural practices. It reported that the most of contributions by individual learners was found in adding to content with making few error corrections in grammar. Other similar cases were reported in Kessler's (2009) study. In this study, students' revisions were mostly made in content and style rather than form. Those revisions in form were mostly about word choice and spelling. Students did perform in collaborative writing but the revision process does not seem to increase in grammatical accuracy significantly. It is noteworthy that writers did not change much from their drafts. The revision process was very similar to editing. Checking word choices and checking meaning were the main tasks after drafting collaboratively.

Some studies reported various collaborative writing performances caused by groups' interaction styles. For example, among group members, there were different group styles in presenting ideas into words, uncertainties, negotiation styles between peers, and feedback styles (e.g., Storch, 2002, 2009; Watanabe & Swain, 2007; Kim & McDonough, 2008). The learners deliberated about language choices, articulated their

uncertainties, provided suggestions, counter-suggestions, and explanations, and gave and received feedback (e.g., Storch, 2011). Learners negotiate more on lexical items.

Meaning-focused tasks while drafting elicited more attention to lexis. Editing tasks generated more grammar episodes (Storch, 2002, 2009; Kim & McDonough, 2008). In the research from Watanabe and Swain (2007), their findings demonstrate that regardless of their partners' proficiency level, collaborative pattern of interaction was a crucial factor in their comparison of the students' posttest scores. This line of studies provides evidence that group collaboration patterns resulted from various types of group interactions were crucial in the collaborative writing process.

Another factor was from the dynamics in a group formation. The group dynamics may affect students' motivation, groups' interaction and even the final text from the collaborative writing. For instance, McAllister (2005) investigated students' benefits from three group types such as permanent group, changing group and individual group. The findings revealed that students either in permanent or in changing groups produced better quality texts than that of an individual group. Students who did collaborative writing in groups improved their writing and they exchanged ideas in a more active way. In his study of three types group, the permanent group provided an essential environment for collaboration, building a trust between members and interpersonal strategies.

Students in a permanent group talked significantly more about writing, felt that they learned more about writing, and improved their writing significantly than changing group. Students built more trust and developed interpersonal relationships for collaboration, which can affect the interaction and the collaborative tasks. These findings indicate that social relations between members and emotional aspects were crucial

factors. which also influence students' perception on learning. Most of students in a permanent group felt that they learned a lot from others.

Students' perception on collaboration work. The challenges in L2 contexts were mostly based on students' perception. Several studies argue the importance of learners' attitudes toward collaborative writing and its impact on learners' performance. For instance, Watanabe (2008) reported that learners' past experiences of collaborative work influence their attitudes on collaborative work. The negative experience of having collaborative work might make collaborative writing ineffective. Studies from Mak and Coniam's (2008) and Storch (2011) revealed that the willingness to contribute and collaborate in a coauthoring activity may take time to develop. The findings from Storch (2005)'s identification of students' challenges in collaborative writing indicated that there were a combination of several factors caused students' negative attitude; lack of confidence for collaboration tasks, difficulties of critiquing others' work and receiving negative feedback, and reservations for collaborative work due to learners' preference for solitary writing. Students' hesitance to trust each other in sharing their work in a group caused students' skeptical attitude on collaborative group work. In carrying out collaborative writing, it is important to note that instructors' knowledge on students' prior experience with collaboration may bring different approaches in applying collaborative writing to learners. Surveys or brief information check can be helpful to know students' previous experience with collaboration and their attitude on sharing peer work in planning to include collaborative writing tasks into writing curriculum. It seems that preparation for collaboration tasks would help maximize the benefits of collaborative writing in class. In other words, with skeptical attitudes, students may not rely on their

peers to pool linguistic resources to work collaboratively although the tasks have various instructional benefits on learning various writing tasks. Little is known how students' personal relation with collaborators affect performances in collaborative writing.

Researchers investigated contextual factors on collaborative writing. Some studies examined collaborative writing highlight the contextual factors on performing collaborative writing either in face-to-face settings or online-based settings with technological assistance such as wiki or Google Doc. Those studies mainly examine effects on texts and writers' interactions with peers with technological influence on collaborative writing. The findings from this line of research seem to focus on interaction patterns online when performing collaborative writing. Those studies did not provide significant differences between face-to-face and online collaboration regarding the overall processes of collaborative writing. Typically, studies with technological influence how writers participated in collaborative drafting and compared the results between face-to-face collaboration and computer-based collaboration. Some research focuses on different levels of learners (e.g., Elgort, Smith, & Toland, 2008; Wilkoff, 2007) in the general education. According to their study, wikis encouraged learners to read others' contribution and respond to others' writing. Elgort et al. (2008) reported that in wiki writing, students appeared to be more encouraged to write but learners had limitations in synthesizing information from interactions in wiki. The additional benefits with the affordances from technology such as wiki can be all users can contribute their writing by using the wiki website and it records all contributions. That is, the major distinction with the contextual features between face-to-face and wiki-based collaborative writing is to track writers' changes in text and observe chatting between writers. Most of research

focused on examining the interactions between peers while collaboratively drafting. As indicated in the wiki-based collaboration in writing, the effects on text and individual writers are not conclusive. Those studies did not provide a holistic picture of processes in collaborative writing.

As discussed in previous research in collaborative writing, little is known about collaborative writing in interdisciplinary research contexts. Most studies were conducted in classroom contexts and the purpose of collaborative writing was mainly for learning L2 writing. When collaborative writing, particularly in the context of the interdisciplinary research, the goals in collaborative writing is not pedagogically oriented but practically oriented. That is, collaboration is the way of interdisciplinary research and collaborative writing is the outcome of interdisciplinary research. Collaborative writing with real objectives and goals can be a lot more different than that with instructional purposes. The fundamental differences exist on what is expected from the results of collaborative writing. In the cases of collaborative writing for pedagogical purposes, the design of collaboration is constructed around what is planned to be taught for learners. In contrast, collaborative writing in a collaborative research project, the primary goal is placed on the actual outcome from the collaboration. For instance, the case that I will present here is collaborative writing research in a research context. In this project, the goals are to publish a co-authoring research paper and write up a research report from the group. Pooling different expertise from people who participate in a collaborative writing is to come up with a new solution or ways of thinking to a complex problem.

Few studies examined features of collaborative writing in an interdisciplinary research context. Little is known about what kinds of tasks are associated and how

collaboration work is distributed and what makes crucial factors for shaping co-authorship. We need to extend our understanding of collaborative writing beyond the classrooms and with more advanced-level L2 writers. For instance, at the graduate level, co-authoring papers and collaborative research are common as part of graduate program requirement or part of extended research activities in graduate program. Collaborative writing for multilingual graduate students would disciplinary writing and research. In the case study by Canagarajah's (2018), he examined how an international STEM scholar utilized various semiotic resources using in L1 and L2. His study also looked at non-classroom research contexts where international STEM scholars work together for collaborative writing. His study focuses on those scholars' communicative practices in a broad perspective. Some findings provide some aspects of using multilingual resources strategically for collaborative writing. But the study didn't provide in-depth information on how the collaborative writing processes takes place in a group and how writers interact with collaborators from diverse disciplines.

Summary of Chapter 2

As discussed earlier, I divided the major research findings of collaborative writing in L2 contexts into three categories; the effects on textual improvement, the effects on writers or group regarding their L2 language use, and factors affecting collaborative writing tasks. First, studies examine the effects on collaboration/collaborative writing based on surface-level features and textual quality. Accuracy, fluency, syntactic complexity are the major criteria for measuring textual quality (e.g., Elola & Oskoz, 2010; Fernandez Dobao. 2012; Storch & Wigglesworth, 2007; Swain & Lapkin, 2001). There are other aspects of writing regarding the quality of writing such as genre, idea

development, argument development, audience awareness. But most studies tend to consider the linguistic gains from surface-level textual improvement that were clearly measurable from the results in pre-test and post-test scores.

Second, evidence from studies on effects of collaborative writing on writers is mainly analyzed with a lens of cognitive aspects from the collaboration activities by investigating peer dialogues. In this line of research, collaborative writing studies in L2 learning contexts explore how individual learners' cognitive processes are activated during the collaborative writing and their interaction. Investigating effective patterns for collaborative writing was another related line of research. Typically, those effects on writers or groups are multifaceted pedagogical effects such as improved oral interaction, learners' language related attention in peer dialogue, heightened attention to linguistic accuracy, and writers' interaction patterns in collaboration (e.g., Swain, 1993, 1995; Storch, 2001; Swain & Lapkin, 2001). Many studies investigated mainly interactions during collaborative writing by analyzing peer dialogues. The concerns were paid on the themes emerged while exchanging views with peers. For instance, language related episodes (LREs) in peer dialogue was one of research focus. The analysis of LREs shows how a particular attention among linguistics features can contribute to overall language acquisition and developments. This seems relevant mostly in the face-to-face classroom contexts. In realistic situations of collaborative writing, those types of verbal interactions on LREs may or may not occur depending on the groups' goals for the collaboration tasks.

Third, researchers investigate various factors that influence collaboration and collaborative writing. Those factors are varied depending on students' L2 proficiency,

socio-cultural backgrounds, group interactions, task types and contexts. The tasks given as writing prompts were simple and mostly designed for linguistic accuracy. Some studies used cloze exercise, dictogloss, text reconstruction, and jigsaw tasks and reported the usefulness of fostering peer interaction (e.g., Alegria de la Colona & Garcia Mayo, 2007; Kim, 2009; Storch, 1998, 1999; Swain & Lapkin, 1998, 2001). The simplified writing prompts are mostly designed for low or intermediate level L2 proficiency learners for the purpose of facilitating their writing practices. Most studies tend to focus on undergraduate students, classroom-based, formal instructional contexts. The majority of research tends to focus on L2 undergraduate students in ESL oriented language courses, or EAP courses.

It was observed that there seems to be a binary view in conceptualizing writing into only either individual writing or collaborative writing with a particular constraint. Writing is done either by one person writing a text or two or by more people producing a text. It creates a binary distinction of a solitary writing by individuals or a collaborative writing by many writers for one text. The notion of collaborative writing in L2 context requires all writers in a group to participate in producing a text together and contribute their equal amount of responsibility and contribution for sharing mutual ownership for a text (e.g., Storch 2003, 2005, 2013). With such binary notion of individual writing and collaborative writing, it would result in students' creating static impressions with individual and collaborative writing tasks. Thus, it can be noted that it is necessary to examine collaborative writing in a more situated and contextualized setting to provide a clearer and more comprehensive understanding of various types of collaborative writing that a multilingual writer engages in.

CHAPTER 3

METHOD

The goal of the study is to explore the nature of L2 collaborative writing in the outsidess of classroom in an interdisciplinary research context. In order to provide the insights into the nature of collaborative writing, I observed the practices and processes of collaborative writing in an interdisciplinary research project at a research center affiliated in Science and Technology Studies. The case study investigated the literacy development of a multilingual writer who engaged in collaborative writing tasks, particularly for writing for publication. Below are the research questions that guided the study.

Research Questions

To provide detailed information on the nature of collaborative writing in an interdisciplinary research project beyond classrooms, I address the following three questions:

- (1) What do the practices of collaborative writing outside of classrooms look like?
- (2) Based on a multilingual writer's perspective, what are the effects of collaborative writing in an interdisciplinary research?
- (3) What factors have influenced the multilingual writer's participation and his writing skills while collaborating with other co-authors?

Design of the Study

This study employs a qualitative research whose process is inductive (Creswell, 2013), which allows the researcher to explore data and create understanding. Particularly, this kind of research aims to build thoughts, concepts, or theories (Marriam, 1998) rather than testing hypothesis in a study. Through inductive approach to the study, I can explore

the nature of collaborative writing with a close examination on the collaborative writing practices and provide thick descriptions on various features shown in collaborative practices. In the field of second language writing, many studies report the value of naturalistic contextualized inquiry to describe the complex and situated nature of writing context (e.g., Casanave, 1995; Hyland, 1998; Prior, 1995; Lee & Schaller, 2008). For instance, these researchers have employed a qualitative approach to provide more comprehensive understanding of the academic enculturation process or L2 writers' literacy development in naturalistic settings. In this sense, adopting a qualitative approach is necessary because the research questions in this study inquire a multilingual writer's literate experience in co-authored writing for publication.

Among the broad category of qualitative inquiry, a case study approach is suitable. According to Yin (2009), a case study can be appropriate when a researcher explores "a contemporary set of events over which the investigator has little or no control" (p. 4). So the choice of case study research is to explore, describe, or explain events or phenomena in a real-world context (Yin, 2014). Particularly, the case is an example of collaborative writing practices in an interdisciplinary research project in Science and Technology Studies.

Using the qualitative case study facilitates the examination on the specific context-based phenomenon based on various sources of data. Using multiple data sources provides a diverse pool of information resources to draw (Yin, 2014). Because relying on a single data source would not fully capture the nature of certain event or phenomenon, it is necessary to collect multiple sources of data and triangulate them for further analysis.

Ultimately, to better understand many facets of the collaborative writing practices, the qualitative case study is suitable to explore the features in collaborative writing through multiple angles. Case studies are “intensive descriptions and analyses of a single unit or bounded system” (Merriam, 1998, p. 19). As Merriam described the strength and usefulness of doing a qualitative case study, it promotes a deep, comprehensive description and analysis of a study. Thus, the results can offer ample insights to the existing research of collaborative writing. Few studies examined naturalistic collaborative writing settings beyond classrooms. For instance, the study of Canagaraja (2018) employs a qualitative case study to examine the international STEM scholars’ semiotic competence in collaborative work.

Given the naturalistic context of the study, the purpose of this qualitative case study is to understand the nature of collaborative writing beyond classrooms. The research design helps provide the evidence on its collaborative practices and factors that affect collaborative writing. Expanding the knowledge on collaborative writing, this study could advance L2 writing specialists understanding of the significance in collaborative writing in a disciplinary research setting.

Context of the Study

My investigation of collaborative writing in an interdisciplinary research project took place under a large research center, ABC (pseudonym) located in Arizona. The objective statement says, “ABC aims to enhance the contribution of science and technology to society’s pursuit of equality, justice, freedom, and overall quality of life”. To achieve this goal, the research center is affiliated with a university’s several interdisciplinary programs and initiate various research collaborations involving experts,

practitioners, policy makers and citizens. Researchers, faculty members, and field practitioners write a proposal and engage in research opportunities and work for better outcomes. The majority of research funding is funded by the National Science Foundation and many research fellows were affiliated with The Science and Technology Studies Program. The program encourages its graduate students to get involved in various projects and actively participate in interdisciplinary research opportunities to gain deeper disciplinary knowledge and research practices. Combined with the Science and Technology Studies programs, the research center across U.S. has led research project with other cities or universities. The research topics are as follows: responsible innovation, sustainability, science and technology policy, complex socio-technical systems, education and engagement. The affiliated research collaborators in the projects came from a wide range of disciplines including science, engineering, and social science. Below, the brief introduction of this research institute is as follows taken from on the project description website.

The ABC is an intellectual research network aimed at enhancing the contribution of science and technology to society's pursuit of equality, justice, freedom, and overall quality of life. ABC creates knowledge and methods, cultivates public discourse, and foster policies to help decision makers and institutions grapple with the immense power of science and technology as society charts a course for the future. ABC is the only intellectual consortium dedicated to understanding the linkage between Science and Technology and its effects on society, and to developing knowledge and tools that can more effectively connect progress in Science and Technology to progress toward desired societal outcomes. The Consortium draws on the intellectual resources of Arizona State University and other institutions for the scholarly foundation to assess and foster outcome-based policies across a broad portfolio of publicly funded scientific research. The Consortium's core commitment is generating useable knowledge for real-world decision making.

As described in the research center's introduction, this research organization seeks practical outcomes from scientists and policy makers to facilitate public understanding toward the effects on society and the related issues between Science and Technology. In this research group, researchers from various disciplines and institutions, governmental organizations, and field practitioners come together to tackle issues of how science and technology affect our world and how they are affected by public decisions. Researchers and faculty members who are affiliated to this research center work collaboratively for the projects. Under the large research projects funded by the National Science Foundation, one of the research project, called, the Urban Resilience to Extremes Sustainability Research Network (UREx SRN) was my study context. This collaborative research focused on integrating social, ecological, and technical systems to devise, analyze, and support urban infrastructure decisions in the face of climatic uncertainty. There were nine UREx network locations including six continental U.S. and three Latin American cities to work towards creating sustainable futures by co-creating decision-support tools.

This interdisciplinary research started in fall 2014 and continued for five years. The collaborative research that the multilingual writer participated in was ended October 2019. The research group consisted of faculty members, postdoc fellows, graduate fellows and core practitioners in each assigned city location. Being part of leading institutions receiving funding from the National Science Foundation, the interdisciplinary research team in this study participated in monthly research meetings working collaboratively with other network institutions across the U.S. and held regular research

meetings to share research progress with core members in several local research centers. Particularly for their research outcome, the co-authored paper for publication was the major task in the interdisciplinary research project. Many doctoral students in Science and Technology Studies involved in the research project along with their graduate courses. The doctoral students who were involved in this research project had dual tasks working on their graduate coursework and the interdisciplinary research at their research center. Doctoral students were often funded from the research center for their doctoral study and they work as a research fellow in the research group to gain extensive research experience in various research topics which is considered crucial elements in the field of Science and Technology Studies.

Participants

Participants in this study were three researchers: one graduate research fellow, and two faculty researchers. Two faculty researchers were full professors at this institution. I describe the backgrounds of each of the participants in the study.

Ken. Considering the aim of the study examining a multilingual writer's perspective in this collaborative writing practice, a multilingual writer, Ken (pseudonym) is the focal participant. Ken was a doctoral student in Science and Technology Studies at a large public research university located in the Southwest United States. Prior to his doctoral program, he completed his bachelor's degree in Law and received his MA degree in Urban Planning in South Korea. Before starting a doctoral program in US, he worked as a researcher in a government institution for environment and policy in South Korea for five years. During his doctoral program, he worked as a research assistant in several interdisciplinary research projects funded by the National Science Foundation.

His research focuses on environmental policy, specifically infrastructure resilience and policy, including the analysis of infrastructure systems and infrastructure governing institutions, the water-energy nexus, and the challenge of improving urban sustainability and resilience to climate change. He had participated in collaboration with science and engineering research teams via interdisciplinary research grants from the US National Science Foundation.

The background information on his L2 proficiency is that his TOEFL score was 100 and the GRE writing section was 4.0 at the time of his entrance to the graduate program. He had learned English for about 7 years before his university education. In his undergraduate and graduate programs, he never took any English classes but he read many academic articles and documents in English for his content-based courses. He had intensive legal writing training with his L1 during his undergraduate study. While studying in a graduate program and working as a researcher at a government research institution, he did not have chance to write a document in English but did a lot of extensive English journal reading for his research. The only writing instruction that he had was five workshop sessions for preparing for TOEFL writing tests at a private English academy. During those sessions, he learned some formulaic English phrases that could be used for connecting ideas in the paragraphs and transitional words.

Two faculty collaborators. There were two full professors as co-authors who participated in collaborative writing. The co-author 1, Alex (pseudonym), was Ken's academic advisor and supervisor of Ken's project. He received his BS and PhD in Electrical Engineering. His research interests are based on science, technology & globalization. His research includes a wide range of issues related to science and

technology such as science policy, engineering ethics, renewable energy, energy policy, nanotechnology, and solar energy systems. He wrote about issues posed by new and emerging technologies and the social sustainability of transitions in complex, large-scale, socio-technological systems. Another co-author 2, Robin (pseudonym), was a professor in Environmental History and Sustainability. As a historian, his work focused on water and energy history, and renewable energy policy and development and actively participating in sustainability initiatives. Both of collaborators published many journal articles and books in their disciplinary fields.

Table 1

Demographic Description of Participants

Participants	Educational Background	Years of Research Experience	Collaborative Writing Experience
Ken	MA and doctoral course work, Doctoral student in Science and Technology Studies	Five years for only individual research	No (No publication but a few in-class collaborative writing)
Alex	PhD in Electrical Engineering, Professor	Over 25 years for both collaborative and individual research	Over 20 years
Robin	PhD in History, Professor	Over 30 years for both collaborative and individual research	Over 25 years

Data Collection Procedure and Methods

To answer my research questions, a longitudinal qualitative case study was chosen because it can provide thick descriptions on the features of collaborative writing practices and its effects on multilingual writer's literacy development. The case study can show one of collaborative writing processes in an interdisciplinary research project and reveal the characteristics of collaborative writing practices beyond classrooms. The primary data sources for this study include semi-structured interviews, background information questionnaires, writing samples, writing notes, informal observations and project documents. The following outlines the data sources and data collection procedures.

Semi-structured Interviews. Before the interviews, I obtained the permission from the IRB board for the research. Semi-structured interview can be useful to obtain in-depth and detailed descriptions on the writer's perspectives and experience in collaborative writing. Along the guided questions in the interview, this semi-structured interview allowed interviewees freely to talk about topics as they wanted to add. When interesting topics appeared during the interviews, I also followed up the themes and topics to obtain more data by asking more questions related to the topic. I interviewed a multilingual doctoral student and two faculty members in a research group. I prepared a list of questions to participants prior to the interview sessions. The details of guided questions can be found in Appendix (A) and (B). Each interview session usually took mostly 50-60 minutes. With a focal participant, the semi-structured interview sessions were scheduled and conducted three times. Clarifications and additional questions were asked via emails or during casual meetings whenever the focal participant had some questions or things to

share. The interview sessions with a multilingual writer were conducted in both English and Korean. There were no constraints for two language use during the interview because the goal of the interview is to describe his exp I am a bilingual speaker of both languages. So the focal participant answered interview questions either in English or Korean. he focal participant answered in English and Korea. All interviews with two faculty members were conducted in English. I scheduled one interview session with each faculty members at the end of the writing task. All interviews were audio-recorded and transcribed.

Background Information Questionnaires. Prior to the first interview session, background information questionnaires were distributed to the participants. Those questions were about their academic backgrounds, expertise in their field, positions in the research team.

Writing Samples. I got the permission from the focal participant that I had the access to the project writing samples at the project database. I collected six writing samples throughout the research project period. On the research project database, I had the access to view the writing drafts were uploaded in a chronological order and the general comments from the research members.

Journal Writing Notes. The multilingual writer shared his writing notes that he had written since his first year of the graduate program. The writing notes was voluntarily written by the participant. The focal participant had a writing routine that he wrote down important things in his writing. For instance, in the notes, he summarized something what he learned from his writing feedback and a list of things he heard repeatedly from the

fellow researchers. And he freely expressed his opinions or some ideas for research. The writing notes were kept both in English and Korean.

Observation Fieldnotes. I observed the group meetings for collaborative writing and the actual collaborative writing process. In every year, three times of observation were conducted and the fieldnotes were kept during the observation and right after the observation. The fieldnotes focused on the major tasks and practices, and themes of the discussions among the collaborators.

Project Documents. I collected several project documents related to the research project from the focal participant. There was a project description document for research members and a research proposal that was proposed at the time of project . Those documents provided information on the project objectives, goals, expected outcomes.

Choosing a single research design for the study would be limited to represent a holistic picture of collaborative writing occurred outside classrooms. Different procedures for data collection have strengths and limitations. To overcome the limitations that each method has, I triangulated by utilizing multiple sources of data. Multiple data from various sources were collected. Semi-structured interviews with a multilingual graduate writer and faculty members, writing notes from the focal participants and written drafts were collected. The semi-structured interviews were audio-recorded and transcribed by the researcher. The multilingual writer had personal writing notes based on his writing experience approximately for four years. He shared his writing notes with me.

Data Analysis Procedure

This study employs qualitative analysis from multiple sources of data. I attempted to describe major practices occurred in the overall processes of collaborative writing

beyond outside of classrooms by analyzing interview data, writing notes, and writing samples. Analysis of data employed an emergent, inductive approach (Thomas, 2006). I attended to a L2 multilingual writer's interactions and negotiations with collaborators while drafting and revising through analyzing their feedback practices in both oral and written interactions and verbal exchanges at research meetings. The analysis procedure has two stages. First, I collected and reviewed all the data. After completing transcribing audio recordings and collecting writing notes, I conducted multiple readings of the transcripts and collected documents to figure out emerging themes and outline categories. I analyzed the data from the transcriptions using inductive analysis. From the multiple sources of data, I looked for evidence and made a code for the three categories; collaborative writing practices, effects from collaborative writing, and factors affecting collaborative writing. I identified recurring theme and patterns in collaborative writing practices. Based on the documents, and interview data, the recurring themes were categorized into the yearly base practices. For effects from the writing collaboration, I analyzed the interview transcriptions and identified themes that were related to what the multilingual writer reported as outcomes. And I also include textual improvements, learner's strategies, and learner's perceptions on collaborative writing process. I examined the participant's perception on collaborative writing tasks. To do so, I looked for emerging themes from the interview transcription data. I read and re-read the data set to make a list of categories of the themes. I repeat the process of data analysis and categorization until themes get redundant. As the themes appear, the coding and analysis procedure develop accordingly. For factors influenced writing collaboration, I focus on contextual factors and individual factors.

In the second stage, to obtain reliability of the data analysis, I invited a doctoral student in Applied Linguistics as a second coder to crosscheck our data analysis results. I randomly chose three sections of interview data transcription and asked her to make codes for analysis based on a list of categories for coding. Then I asked the second coder to identify practices, effects, and factors involving collaborative writing. we compared the each other's answers to see the matching rate for coding. Her identification of three categories with mine reached at 98% which is very high. Some of discrepancy in coding was detected in looking evidence for gains and strategies. The two words contain overlapping meanings in referring to what a multilingual writer has learned and applied to other writing tasks. For instance, the gains were what the focal participant had described as new realizations after the collaborative writing. Additionally, the focal participant sometimes clearly articulated what he gained from the writing collaboration, which helped minimizing the interpretational gaps between the two coders. The strategies that a multilingual writer constantly used were categorized as the effects of learning in collaborative writing. From the multiple meetings with the second coder, we were able to narrow some gaps in interpreting gains and strategies that the first author used. We put these two under the same categories of effects from the collaborative writing.

Analytical Framework

Discourse Community and Community of Practice. For the analysis of the collaborative writing practices in a research setting, I perceived the two notions are relevant to the research context. The notion of discourse community is a relevant theme to the interdisciplinary collaborative research team. The definition of discourse community by Swales (1990) is employed in this study. The collaborative research group

is a discourse community that a group of people involved in and communicated about particular topics or issues in a particular field. Swale mentioned some characteristics of discourse community. Based on Swales' notion of discourse community, this collaborative writing group can belong to several discourse communities such as interdisciplinary studies of Science and Technology Studies or an interdisciplinary research project group. This discourse community shares common genres, genre knowledge and communication mechanisms like research project meetings, written or oral feedback, or writing an interdisciplinary research paper.

Another notion that can be related to analyzing this community's activity is 'Community of Practice' and 'situated learning' introduced by Lave and Wegner (1991). This notion captures the kinds of activities involved in the community and cognitive processes that participants (especially a newcomer) develop over time. It refers to any activities that confirm identities of a community. In a community, there are newcomers and old-timers. Not all members have equal power and levels of membership. Usually old-timers who have more experience and knowledge perform central role of their activities and newcomers do not have much background knowledge and therefore, their roles and performances can be limited in a community. Depending on how contextual boundaries are made, each member role can be realized differently. The researchers in a team seemed to have hierarchical orders to some extent but at the same time, for research collaboration, the hierarchical status in their position did not seem to matter much. For instance, the professors and postdoctoral fellows are old-timers. Alternatively, doctoral students who had been in this research group are also old-timers. A new research fellow (a multilingual graduate researcher) in the group is a newcomer. The essential part of

what Lave and Wenger illustrate is the enculturation process in the CoP (Communities of Practice) by explaining how members in a community gain their knowledge and skills to be a full-fledged member from a novice and peripheral legitimate member. It can be interpreted that members had different levels of knowledge and skills in interdisciplinary research projects.

In this collaborative writing activity, the multilingual writer developed knowledge of academic writing for publication and interdisciplinary writing out of what Lave and Wegner (1991) called *legitimate peripheral participation* in a community of practice. Lave and Wenger stressed the cognitive apprenticeship that a newcomer or novice scholarly writer may develop in a discourse community. From the writing collaboration, the novice writer developed their strategies of working collaboratively for a co-authored paper by participating in research work sharing, research meetings, discussions with researchers and professors' one-on-one appointments, and writing papers. In the following sections, more detailed illustrations on this multilingual writer's disciplinary enculturation and his literacy development from the writing collaboration will be discussed.

CHAPTER 4

PRACTICES IN A COLLABORATIVE RESEARCH WRITING

In this section, I investigated the interdisciplinary research project, expected goals, assigned tasks to the focal group, and the major writing practices of collaborative writing that the participants participated in. The writing practices are categorized into yearly writing period.

The Interdisciplinary Research Project

At the stage of proposal submission for interdisciplinary projects, various specialists and practitioners for Science and Technology Studies across the nation participated in proposal writing process, which means that the nature of the research is interdisciplinary and collaborative. This is related to the research funding sources that support collaborative research projects. Due to various factors involved in the proposal writing stage such as main proposal writers and research PIs and their expertise, funding size, and the goals of the proposed research project, the research's principle investigators assigned the research project themes to the team. The interdisciplinary research had several topics to work on and the focal participant conducted a research in 'A Water and Climate Sustainability' (WSC) project to analyze the complex interdependencies of water and energy infrastructures in Arizona and the impacts of climate change on the water-energy nexus. In this topic, the multilingual writer's research task was to analyze the interdependence of infrastructure processes and systems with resilience perspective. This research task was an important part of research team members. Other members from engineering department could test integrative models of complex urban systems,

including water, energy, and transportation, comparatively across several US cities by incorporating social scientists' inputs into their engineering modeling process.

Goals in the Collaborative Project. It is worthwhile to take a close look at the goals of the research project to better understand how the writing tasks were situated and carried out by the research members. The interpretations of the stated objectives and goals in the project can be crucial elements for researchers' collaboration work and further designing the goals of the outcome for authentic collaboration tasks. They can provide writers with more situated aspects of looking at writing tasks with more concrete elements that shape particular writing tasks such as identifying the rhetorical purposes and examining research descriptions to better align research directions to the goals of the research.

Mainly the goal of the project was to draw together climate researchers and city practitioners from six US cities and three Latin American counterparts to improve the uptake of research into infrastructure resilience decision-making. In particular, the goals and objectives in the interdisciplinary project highlight collaboration of research and co-production of knowledge to solve problems in urban areas by promoting participation from various levels of experts and practitioners. In the interdisciplinary research proposal, the strategic goals of the project are to:

- **Build a network** of cities, institutions, and students, postdoctoral, and faculty researchers to explore resilience of cities to extreme weather events.
- Develop novel theoretical frameworks that express a vision of sustainable, integrated urban infrastructure.

- **Work with practitioners and decision makers**, as well as a cadre of graduate and postdoctoral fellow, to **co-produce knowledge** that facilitate data-driven visioning and ultimately transitions to a sustainable future for urban infrastructure and, by extension, the fabric of urban social-ecological-technological sustainability.
- Create a model for incorporating assessment, learning, and adjustment in response to evaluate feedback in a large, **transdisciplinary, multi-institutional, multi-national research network**.

As described in the collaborative research project, the collaboration research project highlighted collaboration objectives and outcomes that would be achieved from their research collaboration. The bold words indicate the key points valued in the research. Those are building networks with collaborating cities, working with practitioners and decision-makers, and co-producing knowledge. Those phrases indicate what collaboration would bring as part of the project outcomes. The vocabulary such as ‘transdisciplinary, multi-institutions, multi-national’ imply the nature of interdisciplinary research project. These collaboration objectives were clearly highlighted in the research proposal. One of the key outcomes from the collaboration research project is the co-construction of knowledge among research collaborators and presenting and publishing a co-authored paper fulfills the most important objective in a project.

Tasks in a Research Project. In the beginning, his advisor told him to prepare for research papers and journal articles out of the research project. There were other tasks relevant to the research project; attending a regular research meeting, writing a proposal,

presenting papers at local and international conferences, reporting research progress to team members, and collecting qualitative data through interviewing local practitioners and field experts. In the beginning of Ken's participation, Ken's research task as a graduate research fellow was broadly assigned. They were doing bibliographical research for resilience related research and several writing tasks for research reports and papers. The introduction of the goals in the proposal was not clearly shared with Ken. Some of members in the group had been working similar research tasks and knew the goals and objectives of the projects. So, it seemed that there was no reason to go over those proposal again to old members in the team. For newcomers to the group, clearly sharing those objectives to the whole members can be helpful but it did not happen. The reason would be the project team members were the similar group of members in other projects and they had already been aware of the new project objectives. However, Ken was a new member (a newcomer) in this new project and did not have a chance to educate himself about the goals and objectives from reading the proposal documents. The proposal was circulated among a few higher-level of research fellows. Those old timers did not feel the need to review the objectives for newcomers. Ken also did not know what actions could be taken to identify research objectives and goals, and what resources were available to him at that time. He knew that there was a project website but it was not under his attention in identifying the research objectives. This kind of big collaborative research project was Ken's first experience.

At the beginning of Ken's participation in the project, he was indirectly introduced to the overall agenda and goals of the project but his research focus or specific

role was roughly identified. That is, his position was a research fellow in the group. He had writing assignments under the broad topic theme, resilience work. The project description on the website provided some ideas of the research direction. Still the specific directions of how to outline resilience research were Ken's task. At the beginning of Ken's participation, Ken's disciplinary knowledge on Science and Technology was limited to fully understand the project objectives. In other words, by reading the description of the project, he got some senses about the research theme but the understanding of implied directions or arguments in the proposal took some time to be part of his understanding.

The Ken's literacy related to a disciplinary knowledge such as Science and Technology Studies was gradually developed as the newcomer gradually immersed into the disciplinary practices of interdisciplinary collaboration research project. The general goal in the project was providing balanced view for improving urban resilience. He knew that his research work had to do with 'resilience' but the problem he encountered at first was that he did not have much knowledge on this topic. His research task was not something that he had been worked on previously. However, the supervisor saw the relevance of Ken's previous research activity with this new project. Ken's disciplinary knowledge and research experience with water policy were closely related to what the team planned to do in the city of Phoenix. Analyzing water systems in Arizona was one of assigned research to the team. Ken's experience of water system analysis was highly relevant to the team's case study.

No one had background of working on resilience work in this group particularly with a lens of social science perspective. This is my main task as a collaborative research project member. I am excited to join this research group but at the same time, no one has worked on my research. I should find ways of how to argue in this topic. I feel quite challenging. I wish I have some people who can guide me with how resilience in the social science had been developed.

(P1, Interview, December 2014)

As shown from the interview, Ken got the sense of what the project was about but understanding the target audience for the paper was not clear. Ken's work at the first year was focused on arranging interviews with water and energy specialists at Arizona and collecting interview data for the project.

As a multilingual graduate student, most of tasks seemed quite challenging such as getting in touch with specialists and asking for their permissions for participating in our research interviews because he had never done those tasks using a second language. Ken developed interview questions and arranged interview schedules. One of the senior researchers, a postdoctoral researcher, gave him some comments on interview questions and how to initiate the interview permissions. Those additional comments were helpful for developing Ken's rhetorical knowledge. After the first session of interview, he collected the interview data and worked on identifying institutional networks. The analysis task of his research interview data was a crucial part in the group research. Then, the following tasks were working on conceptualization of resilience in water management and verification of the institutional interactions. The tasks in the research setting were integrated part of collaborative writing.

Major Writing Practices

In this section, I report the major practices occurred during the collaborative writing. I grouped the major practices into a yearly time frame. When the major tasks were continued more than a year, I grouped those years together with the major practices observed to present the salient features observed from the long-term based collaborative writing.

The First Year: Preparing for Writing and Designing Research

In the first year, the major research activities were kind of preparation stage for research writing and constructed based on what needed to be done prior to the actual writing in a group. The first year was mostly on outlining the research project, defining the issues and designing stages. The focal participant participated in monthly group meetings with researchers who are working on their parts. The researchers presented their monthly progress briefly in a 20-minute long individual presentation format via Skype or Zoom. Reporting any updates on their research agenda was an important part of collaborative research and writing. Since the first day of Ken's doctoral program in Science and Technology Studies, the academic advisor had asked Ken to lead at least two or three research papers from the collaborative research participation. In Ken's interview, his research participation of this large collaboration team had been a landmark in his graduate program and actually been centered around various academic trainings in his graduate program. The collaborative writing activities in the group equipped Ken with comprehensive disciplinary knowledge on research work and further provided a cornerstone for shaping disciplinary collaborative writing practices during the graduate

studies. Ken's collaborative writing practice is very common disciplinary writing practices in Science and Technology Studies beyond graduate studies.

In his first year, the major tasks were doing literature reviews to synthesize the key arguments and categorize research trends regarding resilience and water management. First, he had to find relevant sources and upload them on the shared folders. Another part of research was conducting interviews with practitioners in a water and energy industry. Writing interview questions and initiating interview meetings were led by Ken. Around these major tasks in the first year, there were recurring tasks over the research period. Those are attending research meetings and discussing research plans, and dividing tasks between members, reporting research progress and incorporating feedback from researchers.

Ken was assigned as a lead author of his research paper that was going to be developed as a co-authored paper. Ken's supervisor asked Ken to lead the research project in his group and research papers from the assigned research topic. Ken had very overwhelming feelings about his tasks. To his knowledge, the leading author should know most of relevant research with resilience work and figure out what arguments and what contribution he should make before writing. In his case, he was just assigned to be the first author in the paper. The rest of co-authors were not specified at that point. The assignments were collecting articles, reviewing the relevant studies, interviewing with practitioners, and writing an abstract for a research paper. The major goals in the first year was for conceptualizing resilience work from literature review and data collection for a case study. Considering the major tasks by Ken, his supervisor assigned Ken to be a lead author for their paper.

He reflected on his first year. He did not think that he could be the first author specially when he was working with renowned scholars and experienced research fellows in the project. As a first-year doctoral student, doing all of assigned tasks was very overwhelming. He was not sure that he was able to lead the research that he had never worked. In most CoP, challenging tasks or leading roles are typically assigned to senior researchers, old-timers. However, in this case, Ken, a newcomer took a leading role in the team. It was a decision made by the supervisor considering his assignments in the team. It seems quite different than the typical CoP in a team. Because a novice does not play a central role at the beginning of the apprenticeship but here, Ken was assigned to a leading author in a paper.

In the interview, Ken reflected that Ken was the only graduate research fellow from the social-science background. Other research fellows were mostly from engineering department. His advisor's expertise was in Electric Engineering and social studies of Science and Technology. The research team needed a research paper focusing on resilience work in social science perspective. In the first year, besides literature review and data collection, Ken drafted an abstract for a research paper. He wrote the first draft and revised it based on research team's feedback.

It was my first time writing an abstract for a paper in English. I have written an abstract for a conference presentation but I haven't written abstracts for research paper. My academic supervisor asked me to communicate with one of the senior research fellow for my writing. It was my first year and I had no experience working in a large research group. I had so much pressure and I wanted to do anything suggested to do my best.

(P1, Interview, March 2015)

In his first year, his collaborator, a postdoctoral researcher worked closely with his abstract. He wrote the abstract draft and a postdoctoral researcher provided comments on his draft. Writing an abstract was a very challenging task without knowing exactly what he was trying to say in the paper. Ken indicated that his research was not fully ready to pull the core argument from the literature but at that time, but he just wrote what seemed to be important from the literature.

I wondered whether writing an abstract would work well at that point. I was not sure how the main arguments would go. But she thought writing an abstract was the first step to prepare for writing a manuscript. I had different thoughts about this process but I was the first year student and wanted to do anything that was asked to do.

(P1, Interview, August 2015)

From the interview, he did not think that writing an abstract first was the first step but he didn't negotiate his opinions clearly. In the first year, he positioned himself as a novice researcher and writer, he did not initiate much discussion or express what he thought to the research members. He often tried to follow and assimilate what was expected from the team. To write an abstract, the senior researcher asked him to write an outline. They worked on drafting an outline for more than two months and moved on writing an abstract. Based on the feedback that he received from the postdoctoral researcher, he revised the abstract many times and circulated his draft to his research team.

The Second and Third Year: Initial Drafting and Revising for Refining Arguments

The first and the second years were mostly spent for getting familiar with core disciplinary knowledge through doctoral course work that were designed for supporting the interdisciplinary research, planning data collection and research designs, and literature reviews. The multilingual writer's assigned research was on elaborating the

perspectives of how water and energy nexus was perceived by the social sciences and how the arguments have been advanced. The researchers in the collaborative project met at least twice a month for a laboratory meeting and exchanged research outlines and constantly negotiated the research directions and focuses. During this process, Ken realized the importance of sharing each member's research progress. Especially for Ken, looking into how modelling of resilience from engineers' perspective was very crucial for him to get a deeper understanding of how engineering or technical side of experts view resilience. Ken said,

Looking others' research work is very helpful. Without understanding what other experts were doing in the project, conceptualizing the infrastructure of water and energy system seems limited. It may not fully represent how the resilience of infrastructure system was interpreted in various fields. It is hard to come up with integrated view of resilience that can work effectively.

(P1, Interview, March 2016)

In this sense, the collaboration in this situated context does not simply mean getting together and exchanging views. It provides an opportunity for getting into the deeper understanding of each other's work and especially when it comes to a long-term based collaboration, it becomes much more crucial in research development. In the second year, Ken had more specific ideas on his collaboration project. His articulation in the paper was a lot clearer than that in the first year.

During the second year, Ken had a better understanding of what perspectives he was taking. In Ken's writing example below, he wrote a piece of research writing.

Writing Sample A

My research paper integrates theoretical approaches from a variety of adjacent disciplines including social studies of science and technology, institutional

analysis, and resilience studies. My paper entails the intersection of: the application of *sociotechnical systems theory* to the study of infrastructure structure and function; the governance of natural resources and infrastructural management using *common-pool resource theory*; infrastructure sustainability, adaptation, and transformation using insights from the *management of resilience*; conceptual integration and differentiation between notions of *risk* and *resilience*; institutional adaptation and organizational learning from *organizational theory*; and infrastructures as complex, interdependent *socio-eco-technical systems*.

In his writing, the difficult part was how to interpret what engineers do with their notions of resilience. He tried to combine the two views that seem quite distant to him but when he wrote the generalized views, he got some conflicting comments from the engineering team. Due to fundamental gaps in viewing how resilience is conceptualized, Ken's argument did not seem to be persuasive enough to the researchers in engineering department. In finding the middle ground of the both sides, Ken got much feedback from the researchers. The feedback from the research team was part of his disciplinary learning process. Finding how to mitigate the two sides of views or integrate the two was important tasks in the interdisciplinary research project.

Pairing with a peer researcher for revision. Ken's main task in the second and third year was drafting a research paper. Without deciding the specific journal for submission, the first manuscript was written entirely by the first author, Ken. After the very first draft, Ken spent a year for incorporating feedback from the research collaborators and revising the initial draft. In the multiple drafting stage, he had multiple versions of drafts with slightly different organizations and contents. Then, he shared the most completed version to the research members and tentative co-authors. One of the co-authors asked Ken to

work in pairs to work on his English expression. The peer research collaborator, another graduate student research fellow, was a native speaker of English and he provided his comments on Ken's paper.

I was curious about how my native speaker of English collaborator understood my writing or descriptions. I actually visited the writing center on campus so many times whenever I made revisions or added a new paragraph. Whenever I explain what I have found or identified, I do not feel confident with my writing and wanted to test or check whether or not my writing delivered clear message to native speakers of English. So it was a great opportunity for me to see how my writing works or makes sense to my peer researcher.

(P1, Interview, November 2017)

They had three Skype meetings to go over the whole paper. They spent about five hours to read the manuscript line by line. Due to limited time for scheduling, they could read and make some revisions together for one third of the paper. The salient features during their revision activity was the fellow researcher's asking clarification questions on the key meaning or delivery of the written sentences or paragraphs. For example, his fellow researcher asked, "Do you mean this in this paragraph? My understanding of this paragraph is like this... Would you explain more about this part?" Then Ken provided what he meant in the paragraph. Based on Ken's explanations, his peer researcher provided some comments on the sentences or directly revised some vocabulary or expressions to increase the clarity of the sentences. Ken felt that there were multiple reasons of his peer's clarification questions. Some parts were about his English expressions that did not directly articulate the key arguments. Others were due to his peer's limited understanding of the core argument in the paper. They were in the same research group but it seemed quite limited to have the same or similar level of

understanding on this research paper led by Ken. Because the initial draft was entirely written by Ken based on his research data, there was some discrepancy in understanding the text. Consequently, the partial revision work done with his native-English-speaking peer did not seem to be satisfactory to Ken.

Understanding the final direction of the paper and the argument structure in the paper seemed to be crucial prior to work collaboratively with a peer for effective revision. Ken indicated that the pairing support from the native speaking peer was helpful in terms of the opportunity of discussing specific issues with his peer research fellow who was familiar with Ken's research work. His peer focused on accuracy of grammar in sentences and marked unnatural or ambiguous parts in the paper while he read through the paper. Interestingly, Ken added that the ambiguous sentences or paragraphs brought up by his peer could result from the combination of several causes such as different understanding of the arguments and Ken's writing style. Ken felt that effective revision could be possible after having enough discussions over the contents and the arguments between writers. His peer's revision support can be effective in some of grammar issues but there are still remaining issues in how to accurately rephrase some sentences or paragraphs without changing the original ideas.

Another strategy that his peer used during the revision activity was providing some examples and suggesting Ken to follow the way his peer did. His peer directly made some changes on the draft about four pages and asked Ken to simulate the style. Ken did not feel that it would work. While working together, Ken felt that his peer's narrative style was completely different style with Ken's. It seemed impossible to just follow his peer's style of writing after looking at the direct changes made on his draft. So

the paper in a complete version did not seem to have consistent style of writing to Ken. One third of the paper from the beginning seemed like someone's writing and the rest was from Ken's. Ken's impression on his peer's writing was 'story telling' style, which Ken did not think as a good writing for a research paper.

I thought the style did not fit well with my writing style. I expect that my peer is good at English and he can adjust his writing to my writing style well but it did not work that way. My peer just wrote the way he used to write. He is good at narrating stories like a novel. But what I imagined for my research paper to look like is the typical journal writing style with concise contents with clear sections. Maybe my writing sounds quite dry.

(P1, Interview, November 2017)

In the interview, he told me that he tried to receive as much as feedback from native speakers or more advanced writers of English to see their responses or their reactions to his writing. To do this, he visited writing centers to check his grammar in the paper abstract and for the initial draft. He felt that the writing center was very helpful on his initial drafting. Then, after going through several times, he felt that his paper stayed the same. In fact, he attempted to seek help for better writing results with sophisticated expressions and concise ways of presenting his ideas but just trying the writing center consultation did not seem to dramatically change his writing into the direction that he wanted to have in his paper. At this point, it was quite frustrating that there was not enough resources for him to learn more advanced academic writing effectively. In the interview, Ken reflected that with his initial draft with multiple times of revision and rewriting, he could not see much changes in his text although he attempted to do more revisions. His two collaborators asked him to articulate the core argument more

effectively and the contributions to the field of Science and Technology Studies. Those contents were included in Ken's initial drafts but the arguments and contributions were not effectively connected or sharpened enough to attract readers. If readers think that there was not enough novelty in the paper, readers may not feel attracted to the article. He thought that repetitive focus on only grammar or language did not seem to be effective in developing his writing to more advanced level after certain period of time. He wanted to learn more about sophisticated expressions or native-like phrases from the feedback from the writing center. He was frustrated that the writing center's expectation was a lot lower than Ken's expectation on his paper. After the revision with his peer, he submitted the manuscript to an interdisciplinary journal of environmental science. It was the end of the third year. He was not fully happy with his manuscript but he could not do much work on revision. So, he just worked on what he could do for revision for the rest of the paper. Ken was not satisfied with the inconsistency of the flow in the contents. However, he did not know how to deal with the situation. His peer was not available after their meeting for further revision.

The Fourth & Fifth Year: Collaborative Writing for a Manuscript and Journal

Submission

Since the first submission to a journal, it almost took a year to have three reviewers' comments and decisions. The rejection result came after one year of the manuscript submission. After receiving the result from the journal editors, he discussed the results with other collaborators. The main reasons of the rejection were about the research method. The editors asked research hypothesis and ways to prove the hypothesis in the research. Those questions from the editors were very unexpected to Ken because

the manuscript employed a qualitative research method. The reactions from the editors did not seem to consider a qualitative research as a rigorous research method. It was very challenging moment to Ken. As a lead author, he was the corresponding author and felt so much burden on the result.

After discussing the result with research members, he decided to reorganize the structure of the manuscript and work on refining the core arguments by updating the data and relevant studies. Then he also selected collaborators who are highly relevant to the arguments in the manuscript and changed the major part of the arguments and the contents by refining the concept of resilience for interdisciplinary work. He wanted to strengthen the part of water and energy nexus so he asked to work with Faculty B with expertise in water and environmental history as a collaborator. He thought that his expertise in water and energy in Arizona was crucial in verifying the accuracy of the contents.

Developing a Manuscript for Publication through Collaborative Writing. The manuscript writing for publication in a collaborative writing setting started after Ken's two-year-long intensive research writing was met the expectations of research group members. The writing process appeared in a recursive process rather than in a linear process. There were critical progress moments that indicated the noticeable improvements in his writing. In his first years, his writing was mainly about research reports for the interdisciplinary research. The second and third year were spent on sharpening the argument and developing contents and organization in the manuscript. In fourth year, Ken's work gained more recognition with a research area, 'socio-technical approach to water and energy systems and resilience infrastructure' among his research

members. The area of research topic is heavily informed from the social science perspective to the Science and Technology Studies. What I interpreted in this transition point is that it was the critical moment to Ken because the most of research group members were from the field of engineering and their acceptance of Ken's research topic meant much more than the mere inclusion. That means the experts in the engineering side saw the necessity of the input from the resilience perspectives drawn from the social science perspective and they were persuaded by the argument. It may sound quite simple to just accept the viewpoint taken from the social science but the actual collaboration for writing papers may not be that simple due to the relation to the larger arguments behind the arguments.

The research paper was written without having a target journal at first. Up to that point, most of feedback was given by his senior researchers who were interested in the study. The feedback was not particularly focused on refining the arguments. Rather, those comments were based on overall flow or narrative, claims, and supporting evidence. To some extent, those organizational issues and rhetorical concerns in the paper assisted Ken's process of argument refinement to the key contribution to the field of Science and Technology.

More intensive collaborative writing was done after Ken restructured the paper and sharpened the arguments. Based on the previous result on the first journal submission, Ken showed more active initiation for the paper. He selected his collaborators this time. The second co-author participated more actively in the second revision process. The third co-author was invited by Ken in the last year of the collaborative research. Third co-author knew Ken's work since the first year of the

research but was not invited to the first manuscript. After accepting Ken's invitation for co-authoring, he actively participated in the writing collaboration. There were two co-authors in the revised manuscript.

During their intensive collaboration, one collaborator preferred more concise and persuasive narration styles with numbering to the main argument. On the other hand, the other collaborator liked a long and detailed narrative style with intensive analysis from the historical facts. The two co-authors' disciplines are related under the topic that Ken was working on, which was necessary due to the interrelatedness of the current interdisciplinary research theme, water and energy system management for extreme weather in urban settings. But their academic backgrounds or disciplines are very distant, which led to some conflicts on their preferences in writing. Often, Ken's writing was considered very information intensive but not so persuasive to co-authors. All agreed that the initial draft was good with sources and synthesis of the sources. However, the co-authors provided similar opinions on narrative. The logical flow was fine but the collaborators wanted more compelling aspects in the manuscript. They told Ken about their experience in learning to write. One of the co-authors was curious about Ken's writing style and asked some questions about previous writing. The first co-author made sense of his own interpretation on Ken's writing style. Due to the training of L1 writing in legal writing, the writing style in L2 seemed similar to his L1 writing. It can be assumed that another factor of causing some conflicts is Ken's preference shaped from previous academic trainings in Law and politics.

I got quite intensive and extensive training of writing while majoring in Law, which influenced my writing significantly especially both in my L1 (Korean) and

L2 (English) academic writing. My training in preparing for lawful documents heavily focused on logical connections based on massive previous information. The main focus is how to organize the contexts in a logical way, causes and effects. In my case, when I write my research paper in a graduate program or research paper in a group, I do massive amount of research and I tried to synthesize those data as much as possible. Then I align causes and effects to the issue. I think describing is the main task. Then, synthesizing the results to come up with the solutions to readers.

(P1, Interview, May 2018)

In the interview, Ken's description on his writing style indicated his general principle of viewing good papers or writing. That is if he provides ample of amounts of sources that can support his claim and organizes the contents of the research paper logically, then readers can understand his point.

I think if I write clearly, then anyone can follow what I say. When I argue, I try to make my points well-supported by evidence from my research. Logical connection is my focus of research paper or journal article. I sometimes read articles that do not have enough data. It does not sound persuasive to me at all. To me it seems like a personal story rather than research in my field.

(P1, Interview, April 2018)

His previous trainings emphasized intensive literature review such as past cases in legal decision-making and focusing on what has happened to the case and how it was ended. He thought that providing personal thoughts was less effective than synthesizing relevant literature and data extensively. In his assumptions in good academic writing, strong literature review and theoretical conceptualization were placed in the first place. At the time that two other collaborators were determined by Ken, three writers had more focused collaborative writing sessions. Ken revised the draft based on the feedback two co-authors provided. The feedback was given mostly in a written form via email.

Summary of Chapter 4

In this chapter, I examine the goals for collaboration that highlighted the outcomes from the collaborative research, which is related to the goals of collaborative writing. Then I demonstrate how the collaborative writing task was situated in an interdisciplinary research project. The expectations for the collaborative writing in a research setting were drawn from the proposal's objectives written for obtaining the research funding. The practices of collaborative writing in a research setting evolved as a longitudinal research collaboration continued. The writing practices were not pre-determined or planned before the collaborative writing started. In each year, it turned out that there were major tasks that were related to collaborative writing. The first year was spent for identifying research questions, reviewing literature reviews, data collections, and outlining the research. In the second year, the first author did the initial drafting and shared the multiple versions of the drafts with research group members. The first author received oral and written feedback that focused on the overall research directions and research development from the research members. In the third year, after research members decided to submit the draft to a certain journal, the first author worked with one of the graduate research fellows for revisions. The revision task with a fellow researcher was mainly on organizing the overall structures and refining the English expressions to improve the clarity of the contents. In the fourth and fifth year, the first author working with two other co-authors revised the manuscript based on the comments from the journal editors. The intensive collaborative writing occurred after receiving the feedback. The practices of collaborative writing did not occur evenly throughout the entire writing processes.

CHAPTER 5

EFFECTS FROM COLLABORATIVE WRITING

In this section, I discuss what effects of collaborative writing in an interdisciplinary research setting were shown from Ken's experience. The effects were identified from the interviews. In the final interview, Ken expressed how much he learned from the collaborative writing in a team. Especially he learned how to work with other researchers under the shared goals and how to work for the actual outcomes in the project. The actual outcome from the collaborative writing is a published paper in a journal. In Ken's interview, "Collaborating with team members on these projects has also taught me to effectively communicate across disciplinary and institutional boundaries, including with practitioners and stakeholders in infrastructure governance institutions and policy agencies."

The collaboration research has many other goals but particularly publishing a journal article is the main outcome from the research funding. Throughout the research collaboration experience, Ken continued to work collaboratively in other projects. Most of projects in interdisciplinary studies are conducted in a team setting. Ken indicated the potential of collaboration and collaborative writing in an interdisciplinary study.

Perceiving Tasks and Goals for Collaboration

In terms of Ken's discipline-specific writing in social dimensions of Science and Technology Studies, the major tasks in Ken's five years of graduate study were consisted of writing research papers for publication in a context of collaborative writing and research in his research project members. Considering the interdisciplinary work in his research projects between engineers and experts from social dimensions of Science and

Technology Studies, collaborative writing and research is very common. The majority of his research papers was based on collaborative writing work in his research group.

My program is in an interdisciplinary field of study. For example, it is about social science of science and technology. They study the institutional and social dimensions of science and technology, not science and technology itself. In other words, they study sociology, politics, anthropology, economics, law, philosophy, and history of science and technology.

(P1, Journal notes, March 2016)

From Ken's explanations on his writing, extensive writing tasks were assigned beyond his graduate courses. Most of graduate courses that he took were part of his research projects that provided some level of foundational knowledge related to the assigned research projects. For instance, some of the graduate courses were specifically designed for research members in their ongoing projects in the School of Sustainability and Science and Technology Studies. In those courses, all of class assignments and curriculum were built as part of research agenda, which promoted collaborations between members by facilitating discussions beyond scheduled project meetings. Ken had a lot of opportunities for practicing collaborations for developing his research topics and refining his research directions while observing other researchers' research process for idea development and research questions that are interrelated to his research agenda. For instance, Ken's research agenda in the project was institutional management for resilience. Others' research topics were green infrastructure, resilience and equity, resilience of electric system, resilience of water system, climate change and flooding risk. Those topics were subtopics of the larger research project.

I, as a researcher and writing specialist, attempted to figure out the typical types of interdisciplinary field of study in Science and Technology Studies to have a better sense of describing genre styles. When I asked Ken the conventional genres of his

discipline, his answer reflected that the genre styles were quite fluid and flexible. He answered that based on his observation, the genres were very broad and diversified depending on the topics or issues. Rather than following fixed formats of organization in contents, the genre styles seemed to emerge guided by their research topics and questions.

The research questions and issues in the interdisciplinary field of study were a collection of several fields that have relevance to research project agenda. More specifically, the organization of the Ken's manuscript was the results of discussion with other collaborators. Their inquiry covered institutional management for resilience, green infrastructure, resilience and equity, resilience of electric system, resilience of water system, climate change, and flooding risk.

Ken was able to develop three more research papers for publication out of the research. The major collaborative research writing took about three years and then, the paper was further developed into a manuscript for journal publication with intensive collaborative writing. Ken had kept revising the paper until the research members decided whether the contents of the paper reached to the level of being publishable to certain journals.

My research will lead to four journal articles. The first, submitted to *Environmental Science and Policy*, focuses on how institutional dynamics contribute to infrastructure resilience in water and energy systems at different levels and scales. The second, submitted to *Sustainability*, describes the institutional interdependencies of water and energy systems and how institutional changes in water systems impact the institutional governance and physical operation and management of energy systems. The third article, which is still being finalized for my dissertation and will be submitted to *Forests* in 2019, uses

the concept of socio-eco-technical systems to examine the dynamics of climate change and forest management and their impact on coupled water-energy systems through multiple pathways.

(P1, Interview, January 2019)

In his interview, he had clear goals of manuscript publication out of the major research work in the team project. He was more aware of the possible matching of the papers with the target journals. He considered the areas of the journal categories, the fit with the manuscript contents and the major topics covered in the journals. The collaborative writing experience with his research team members and his co-authors was very challenging but it provided Ken with lots of resources for developing his disciplinary knowledge and working on subsequent manuscripts. He also added that he learned how to deal with conflicts and what to expect from the conflicts. Having some conflicts for the first time can be very hard but later he thought that the conflicts he experienced actually strengthened his paper's arguments. Particularly, that would be part of the characteristics of interdisciplinary work.

Transitioning from the Conflicted Feedback

Receiving feedback from two co-authors provided Ken with a lot of learning opportunities because the two authors' expectations on the contents and their writing styles were different. Their considerable amounts of feedback was critical elements for refining the main argument and making logical connections between paragraphs. Ken had very challenging moments when he got conflicting feedback from two co-authors. Regarding the different views, co-authors with different disciplinary focus had gaps in what they hoped to achieve in a collaborative paper. Ken reflected on his revision experience.

My co-authors' academic backgrounds are different. When I first received conflicting feedback from them, I was lost and I didn't know what to do with revising. Basically, I tried to revise what they suggested but some parts were so critical and I did not know which suggestion I should take.

(P1, Interview, March 2019)

The negotiations of how to narrow their gaps on the content development appeared on the multiple versions of revision work, the most critical part of collaboration in writing happened during this stage. The communications between two faculty members can be illustrated in the following. The figure 1 illustrates feedback givers' different disciplinary orientations. The conflicting feedback results from collaborators' disciplinary orientations and the less interactions between collaborator 1, 2, and research team members.

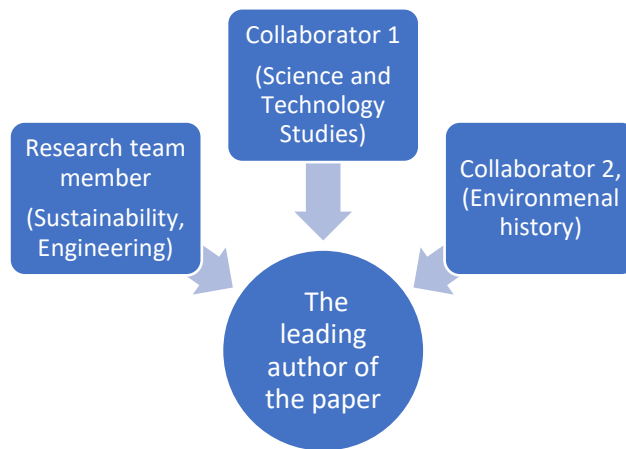


Figure 1. Feedback from the collaborators

For instance, one collaborator wanted to expand the contents in the theoretical analysis related to explaining what the paper was contributing to the field of Science and Technology Studies. The first co-author thought that the case study on water and energy management in Arizona was less important than the discussions of the theoretical

conceptualization on resilience and the contribution of resilience work to the field of Science and Technology studies. Based on his expertise in Science and Technology studies, he hoped to have more in-depth descriptions on how the notion of resilience would contribute to the field in the manuscript. The first collaborator emphasized that the goal of this paper was to show how institutions work and contribute to resilience. As shown in the above figure, the direct interactions between two co-authors seemed very limited. The two co-authors were mainly communicating with the first author separately in the revision stage. The additional interaction was found between the first author and the research member who was not directly related to the manuscript. The research member, a postdoctoral researcher participated in reading the manuscript and providing his comments. He was interested in providing any additional assistance. The co-authors welcomed his involvement for having the manuscript read by another research fellow. However, his comments did not seem to be considered as critical. Rather his comments were viewed as one of others' additional views on the manuscript. In the revision stage, some overlapping comments provided by the co-authors and the research fellow were mostly incorporated but other contradicting comments brought up by the research fellow were not included at the final revision stage.

Ken developed some strategies to prioritize various comments from the collaborative writing process. Ken actually asked what to do with conflicting comments provided by the postdoctoral researcher to his co-authors. One of his co-authors reviewed the comments and thought that those were minor issues from his perspective. So his co-author asked Ken to focus on the two co-authors comments and work on collaborative

revisions based on the points brought by co-authors. It seemed that there was power related aspect in prioritizing the comments and incorporating the feedback.

Regarding his feedback on Ken's draft, Ken went back to do more extensive research to illustrate various applications of resilience to synthesize its functions. The other collaborator said that the theoretical explanations were long enough to be in the section but the case study section needed more work for the in-depth analysis. The author 2 considered the case study section a mere sketch of the water system management in Arizona. He suggested Ken include more thorough analysis providing more paragraphs on how water system had been operated based on thick data analysis. That means he should expand his analysis with more paragraphs. The issue that the maximum word limit of the journal was 7000 words. Ken's draft had 9000 words. He had to limit the overall contents but the two areas in the theoretical section and case study section needed more contents.

I literally felt stuck in that revision part. Refining arguments and organizing the contents in a different sequence were relatively doable but this kind of disagreement, I did not know what to do. It was very challenging. I should cut out 2000 words but I still need to add more analysis in two sections. I tried to condense the contents to make it work. I got rid of some references and tried to come up with phrases that can capture my points in a concise way. That was the hardest part at that point. I struggled to resolve this conflicting view.

(P1, Interview, June 2019)

In this case, discussions between the two collaborators (faculty members) at one table could have been effective to mitigate their expectations but their schedule was too busy to sit down together to talk about the solutions. Ken kept communicating with two collaborators as he revised the paper. In his revision, Ken got rid of the chunk of

theoretical parts and rewrote the part more concisely. Ken indicated that his theoretical part was lengthy with lots of references. He cut down the part by sorting out less relevant references and refining the arguments with revised sources that supported his conceptualization on resilience in a socio-technological perspective. Another part that Ken struggled with was the case study. The two co-authors had different opinions on the case study section. Especially, the co-author 2 whose expertise was environmental history pointed out that the case study did not fully explain the how water and energy management in Arizona had been managed. He thought the case study was weak and needed deep analysis. Expanding more thorough analysis means his paper needs more technical information. As indicated above, Ken had very conflicting comments on the case study section from two co-authors. One thought it was good enough as it was and the other suggested to add more technical information to provide more accurate picture of the historical development of water and energy in Arizona.

Learning Narrative

Another point that the first co-author pointed out was the issue of narrative in the draft. Particularly the first co-author asked Ken to develop ‘narrative’ in his manuscript. From the beginning of their collaborative writing, developing narrative was one of the most frequent comments to Ken’s drafts. In multiple revising processes, he was advised to develop more effective and persuasive narrative, which was connected to the issue of audience awareness. Particularly, Ken reflected that it was very challenging to get to understand what narrative really meant in his collaborator/ supervisor and he really wanted to learn how he could make his draft with persuasive narrative. The first collaborator attempted to explain narrative.

Narrative is like a story in the manuscript. In another words, you are telling a story to your audience. If you make a compelling story, it will make this draft a lot easier to read to the audience. You should work on developing narrative.

(P2, Feedback notes, December 2018)

As indicated in the feedback notes, the description about the effective narrative seemed quite broad. It was very hard for Ken to understand what kind of narrative can fit in his manuscript and how he could learn persuasive narrative. He wondered what would be good narrative in academic writing.

Researcher: You had consistent comments on developing narrative from your co-authors. What was challenging?

Ken: I haven't had any change to learn about developing narrative in my previous English language courses in my country or graduate courses in US. And there is no such a class that teaches you how to develop narrative in graduate courses. I did not know how to narrative in my paper. To be honest, I didn't quite understand the purpose of narrative in a research paper. I think as far as the contents in a research paper can be organized in a logical way, the main points will eventually get across to readers.

Researcher: What do you mean by organizing contents logically?

Ken: I mean, I provide my research background, goals, purposes, research questions, and then the gaps I found. Then, it would be followed by discussions or interpretations from the case study.

(Excerpt 5, December 2018)

As indicated in Ken's excerpt, having a sense of how narrative would work in a research paper can be helpful for Ken's effective revising. The meaning of narrative seemed quite broad to Ken and consequently, Ken's effort to grasp the abstract meaning of effective narrative was quite challenging. Collaborators told him the importance of having compelling narrative and persuasive narrative. However, the specifics can only be

learned by trying out different styles of narrative through actual writing and getting feedback from the collaborators. Thus, regarding learning effective narratives in academic writing, it is worthwhile to practice comparing the different types of narrative and the effects and the functions of narrative in a research paper.

Clarity of Writing

Ken's collaborative writing process increased the clarity of the text. The clarity of text can be achieved when the text matches what the author wants to say with how the author expresses it. In Ken's collaborative writing, what he wrote for the initial research paper was revised about a year to represent what the other co-authors agreed to support in the argument. Refining the research analysis and sharpening the main argument based on the contents were the major tasks in revising process. The revising was based on the oral and written feedback to Ken's multiple drafts. One of his co-authors was a historian and his writing style preferred including rich historical information on water and energy history in Arizona. For instance, the faculty B (environmental history major) wanted to have thorough descriptions on the historical elements in Arizona's water management. Going through multiple drafting and revision stages with collaborators, Ken was better able to articulate his research focus more clearly.

My research integrates theoretical approaches from a variety of adjacent disciplines including social studies of science and technology, institutional analysis, and resilience studies. My study entails the intersection of: the application of *sociotechnical systems theory* to the study of infrastructure structure and function; the governance of natural resources and infrastructural management using *common-pool resource theory*; infrastructure sustainability, adaptation, and transformation using insights from the *management of resilience*; conceptual integration and differentiation between notions of *risk* and *resilience*;

institutional adaptation and organizational learning from *organizational theory*; and infrastructures as complex, interdependent *socio-eco-technical systems*.

(Writing Sample 4, September 2018)

As the revision work continued during collaborative writing with two co-authors, the significant improvements were shown in textual clarity.

Writing Sample B1

The lesson of Chapter 5 is that infrastructures are not just engineered systems but sociotechnical systems which requires political/ legal/ institutional work. To create a dam and allocate its resources, federal legal basis for political power before creating a dam and, after construction, regulatory arrangements for the allocation of water and electricity, and new organizational level practices (e.g., new operational practices of upgrading turbines) as well as engineering assessments are necessary. By building Hoover Dam as a water storage dam, a new source of water which need new social and institutional arrangements was created.

Given the institutional constitution of Hoover Dam, the resilience of Hoover Dam is the result of co-production of engineering and social components. In other words, a particular sociotechnical fashion of practices, regulations, cultures, imaginaries, and constitutional orders coupled with engineering efforts has co-produced the way how Hoover Dam has functioned as a *social* infrastructure over time. This chapter illustrates how the sociotechnical co-production and the social impacts of Hoover Dam (e.g., the sustainable supply of water and electricity) have been designed, sustained, and upgraded over time in the Southwest.

Writing Sample B2

The purpose of Chapter Five is to illustrate the core argument of Chapter Two: infrastructures are not just engineered systems but sociotechnical systems. Thus, the work of building and operating those infrastructures is not just engineering work but also social, political, legal, and institutional work. Chapter Five is particularly concerned with one of the central infrastructures of the Arizona water and energy systems, Hoover Dam, a water storage dam with hydroelectric generating capacity built in the 1930s and 1940s as the lynchpin of efforts to develop the water and energy resources of the Southwest region. The chapter shows that, in order to make it possible to build the dam, as a technological object, the US government first had to establish a legal or constitutional basis for its existence. This included both settling major political conflicts about water ownership, e.g., via the 1922 Colorado River Compact, and creating a legal basis for federal ownership and operation of electricity generation and sales, e.g., via

the 1929 Boulder Canyon Project Act. Put theoretically, Hoover Dam was co-produced with its institutional and legal constitution.

This system has not stayed static, however. Rather, institutional work has continued long after the construction of the dam in order to periodically update the regulatory arrangements for allocating water and electricity among diverse users. These adaptations have been necessary in order to adjust the operation of the dam in response to changes in both political values and social dynamics as well as the behavior of the physical systems involved. Several constitutional changes have occurred over the years, including the integration of Arizona into the legal agreements for water and power allocation, the reconfiguration of rights to water and power around the Southwest Native American communities, and the persistent drought in the Colorado River watershed since the 1990s. Chapter Five thus also illustrates the idea of constitutional resilience work, helping to maintain system functionality through transformational change in the supply of water and electricity over time in the Southwest.

The underlined sentences were added to summarize the purposes and functions of the previous discussions. Those underlined sentences showed the gist of the idea briefly and connected the previous ideas and the following ideas in a coherent manner. As shown in the Sample B1, the previous draft provided necessary information on the issues and research focus but the collaborators thought it needed more connections and narrative aspects in the contents. By strengthening the connections in the contents, the textual clarity was a lot more improved.

Writing for an Interdisciplinary Research

The major collaborative work with co-authors happened during the revising stage. Ken's a year-long revision process offered a great learning opportunity for developing academic writing skills in an interdisciplinary project and a manuscript for journal publication. Particularly at the revision stage while preparing for a journal publication, some critical feedback that he constantly received in the drafting stage became a lot more crucial before a paper submission to a journal. For instance, the narrative that connects

each section and description skills in the paragraph were brought up frequently by the collaborator 1. The first co-author's particular comments on how to make a strong narrative were getting rid of too technical information or data and writing the paper with a broader audience in mind. It was hard for Ken to know the boundary between a text with rich technical data and that with broader audience in mind and less technical data.

It was difficult to get the sense of where the boundaries exist between technical and less technical texts. My paper is a research paper and my paper will be read by certain groups of professionals. The conflicting part is that I need to write an easier text for a journal publication so that my paper can include a wide range of readers in other disciplines. This is one of the critical takeaways from my collaborative writing.

(P1, Interview, December 2018)

The fundamentally different views on the reasons of writing 'easier' texts offered by Ken's co-authors changed Ken's previous assumptions on the idea of writing for target audience in an academic writing. In most studies for writing for publication, for instance, Paltridge and Starfield (2016) point out, "There are substantial difference between writing for a broad, non-specialist audience, such as newspaper and magazine articles that are aimed at a lay audience, and writing for a specialist expert audience, as is the case with journal articles. Key for writing for different audience is developing a sense of who the audience is and what the appropriate level and style of language is for the particular communication. (p.10)" Another point brought up by Swales and Feak (2012) regarding the importance of audience is to consider target audience before writing texts so that those considerations would be incorporated in the writing. However, in Ken's case, before having a draft, he could not think about which journal he would target. It didn't seem that simple because deciding a journal would not be possible without

knowing the argument in a paper. In particular, Ken with a limited experience in writing journal articles and collaborative research felt the issue of target audience in a journal article very tricky.

My understanding of target audience for a journal article is writing for certain expert groups in mind. But my assumption on target audience in journals and the comments that I received from my graduate consults were completely different from what I have received from my collaborators.

(P1, Interview, February 2019)

Developing a sense of target audience involves various factors such as the audience's expectations and their level of prior knowledge but more importantly, choosing suitable journals for the paper is closely related to identifying target audience. During Ken's collaborative revision work, determining a journal for publication and figuring out target audience was gradually developed. As a novice researcher with no collaborative writing experience would feel difficulty in figuring out which journal the working paper would aim for and bringing up the issue of identifying target audience before writing for publication. It would be difficult to project what would be the major arguments in the paper and where the researcher would contribute to their research in advance. Experienced writers can identify those elements in early stages of writing such as invention or drafting stages. In the case of inexperienced multilingual writers, those tasks would seem a lot challenging. Not only pre-determined ideas on target audience but also practicing the determining process of identifying target audience can be beneficial to novice multilingual writers. Considering target audience and journal selection process in a collaborative writing can be closely related to what the research would focus on and how the research would contribute to the ongoing conversations in a particular study.

Looking at Ken's process of journal selection in a group, it became clear that the decisions for selecting a journal and audience can't be figured out from one or two meetings with research members. Rather, those issues were gradually resolved as the main argument was revised and refined in collaborative writing. In broad and general categories in journals, Ken's work had a wide range of journal choices. In his first journal submission, his senior research provided a list of possible journals and Ken's supervisor and his research team agreed upon one journal in the interdisciplinary studies of environmental sciences and policy. Ken pointed out that the trends in the interdisciplinary journals were their wide range of research topics and audience. Ken changed his previous assumptions on what target audience would mean. Previously he regarded target audience as certain groups of experts or professionals who shared similar knowledge backgrounds. He thought that the contents in a journal should be technical enough to meet the expectations from the audience. He did extensive research on how resilience was conceptualized historically in the environmental science studies. His advisor told him that his paper covered extensive amount of previous research and discussions on the theoretical gaps. However, what was lacking was narrative in presenting the research. Ken struggled to capture how he can improve his narrative. To his knowledge, narrative was considered as logical ways of discussing ideas. What his professors/collaborators referred to was dramatizing the descriptions or contents of the research. The reason behind this was that readers would be more persuaded by the claims in the paper and easily follow the contents. Reflecting the experienced writers' comments in the interdisciplinary field, the rhetorical strategies that Ken had in mind was quite different from the views from the experts. Expert writers preferred condensed writing style to

simple and easy writing style with clear arguments and persuasive narrative. This rhetorical awareness was very crucial in Ken's disciplinary writing and literacy development. He was not aware of those rhetorical strategies. Working on improving narrative was mostly focused on how to make nicer connections in sequencing arguments. Ken realized that improving narrative meant much more than just covering sufficient data and synthesis that would satisfy audience expectations in a research paper.

Gains from the Conflicting Views

Two co-authors brought up their concern of making the research paper more readable to the general audience, which means that Ken's writing was condensed with lots of information and synthesis but contents were not tightly connected in a form of story telling. It was a new concept to Ken. He wondered why his research paper should be dramatized. "I tried to understand what one of my co-author told me. Honestly, I still have difficulty in capturing what narrative really means in a research paper. My supervisor consistently pointed out my lacking narrative." From the feedback he received, Ken developed his own strategies in developing narrative.

It was a chaos. I did not know where to start revising for more persuasive narrative. So what I decided to do was just focusing on the clarity of my writing by asking myself about the research questions and making clear points to the research questions. Then I tried to develop the contents with focused attention to the main point in each section. I am not sure but I think at least this effort would be helpful in developing narrative.

(P1, Interview, March 2019)

As indicated in the interview above, Ken gradually moved from his struggling from different feedback to striking a balance between conflicting comments. His effort was made to improve clarity of the text. He thought that having a dramatic narrative was important but without having refined research questions and clear support, dramatizing stories would not work. Consequently, Ken seemed to gain more independence in prioritizing his goals in revising. To meet all co-authors' feedback would be ideal but would be hard to achieve. Ken was more aware of the practices of receiving different comments from collaborators. As a lead author for the paper, Ken took the responsible role in revising the drafts based on the feedback from co-authors and the gaps shown in collaborators' feedback became narrower compared to that of the earlier draft. It happened gradually as his research focus was more polished with the accumulated literature review practice and his claims were sharpened to clearly address his group's contribution to the field of Science and Technology Studies.

The gradual process of the multiple drafting for revision provided space for negotiation to reach a certain stage of having consensus in the paper. Ken actively involved in persuading the need of taking socio-technical perspective to resilience work in infrastructure to his co-authors through responding to their feedback and incorporating their input to his framework for critical conceptualization of resilience. Being able to reach this consensus phase was very enlightening to Ken. He expressed that he could see how the interdisciplinary research collaboration could work through collaboration in writing.

In the interview, Ken remembered the time that his co-authors asked questions such as Ken's research focus, the key conceptualization on resilience, the contribution,

and the suggested solutions to the current issues. The co-authors roles appeared in various ways of collaboration, such as challenging Ken's claim, verifying evidence in the paper, revising the draft based on journal editors' comments, and editing.

I wrote the initial draft first over two years based on my research data and incorporated my co-author's input and feedback into the revised paper over a year. While negotiating with them, my claim was contested by two authors and I needed to defend my research. It was kind of an opportunity to argue my claim first to my co-authors.

(P1, Interview, May 2019)

The gaps between the researchers were observed and all members thrived to find a balance in seeking innovative ways in solving problems occurred in the management of infrastructure in a preparation for Climate Change. For instance, it was noticeable that Ken got lots of comments where the two authors did not agree with. As their negotiation on Ken's ideas advanced, Ken received fewer comments on his draft. That indicated the mutual agreement from the collaborators. Especially, Ken thought that few comments on the draft did not mean that they all agreed upon the revised version. It can be assumed that all three members agreed to the core parts of the main points and the way the paper was presented.

Preferred writing styles. Another point that Ken learned from the collaborative writing was the preferred writing styles among scholars in the interdisciplinary studies. Those scholars preferred technical terminology to easy vocabulary with persuasive narrative. One of the co-author said that the reason to this tendency was to reach out broader audience groups in the interdisciplinary studies. It seemed quite contradictory to Ken. He imagined his research paper presenting to special groups with expertise and he didn't

want to lose his face by proposing shallow research outcome. He put so much time for synthesizing previous research on resilience. From the co-authors' interview, Ken did extensive literature review on resilience work. However, based on the accumulated knowledge from the literature, he needed to develop how to effectively present his research to target audience.

In Ken's reflection, Ken was concerned about his face value. He focused on demonstrating what he had been doing as a researcher in the paper by covering various views on resilience extensively. However, he realized that he should have focused more on refining the research questions, not just collecting data so that he could improve the clarity of his paper. To increase the overall clarity in the paper, he put more efforts for how to describe what he found in this paper for the readers of his paper.

I think that realizing what I missed in my writing was my aha moment. It seemed like the realization brought me to the next level of my writing. I should move forward toward this direction in my writing. I feel like my writing is now in the middle of my old writing style, focusing on showing my knowledge, and the desired writing style, emphasizing what my paper does to the field. I really hope to improve my writing toward this direction.

(P1, Interview, December 2018)

Ken developed his writing strategies from reflecting his takeaways while collaborating with his co-authors. Ken had kept writing notes for his own learning for writing since the first year of his doctoral study in US.

Awareness of the scope of feedback by the co-authors. Typically, in feedback or revision studies in L2 settings, the focus is on the changes based on a single draft and mostly the sources of feedback are either an instructor or peers. The differences in Ken's case are that the feedback was given on multiple drafts as far as the multiple versions of

revision were shared among the co-authors. Depending on collaborators, collaborators' feedback styles were very different. Sometimes, the feedback indicated the ultimate destination or the end point of the paper. In another words, the collaborator's comments will make more sense after Ken makes all the revisions. For instance, the collaborator 1 constantly brought up the issue of having weak narrative in a paper. He noticed this weak point as they had been working together. His comments seemed to project further learning based on the perceived writing patterns in Ken's drafts from the collaborative writing. Ken reflected on his comments and described his (Collaborator 1) feedback patterns.

In his feedback, I got to know his focus in my writing and his preferences of writing style. He usually focused on big things and very critical parts such as the structure of my arguments, the contributions of my study in a broad level of discussions in my discipline, and narrative in a paper. He never cared about my grammar. He thinks that any grammar issues can be resolved at the end. I always had concerns about my grammar mistakes whenever I share my drafts. But he does not care much about it. Rather he cared about how I conceptualized the notions of resilience in different disciplinary work.

(P1, Interview, March 2019)

Ken was well-aware of his collaborator's style from the repetitive feedback activities and started anticipating what his collaborator would have brought up in Ken's writing. The anticipation of the feedback varied depending on the feedback giver. In the first year of his doctoral study, he had consulted his writing with various people such as his cohort in the program. Then, Ken talked with the chief editor of their special issue and discussed what he could do. His senior researcher as a chief editor told Ken that his paper seemed to cover too many references and needed to cut down the number of references.

Although Ken thought all of references were representing different cases and aspects in resilience studies, he cut down the reference lists and the contents, and selected most relevant reference to meet the space limit in the journal manuscript. From this process, Ken realized how to select references more strategically, which made him reflect on the most important arguments in the theoretical discussion section. He had to reevaluate all the references by connecting the central argument. The selection of references was a lot more than just deleting some in the list. Relating to his interpretation of the previous literature and the significance of the arguments in the references, the deletion of references resulted in reconstructing his arguments with more clarity.

Summary of Chapter 5

The chapter illustrates the effects from the collaborative writing. Focusing on the focal participant's perspective, the findings reveal the impacts on the focal participant and his writing from various factors such as the feedback from the large research group members and comments from the co-authors. Regarding some of the major impacts from the collaboration in writing, the first author had some challenges on managing the gaps between the two co-authors individually. After working on multiple drafts, he had his own priorities in working on revision and developed strategies to manage different viewpoints and incorporate different views into revised text. The results also showed how the multilingual writer developed disciplinary knowledge from the collaborators' practices and interdisciplinary research processes through their collaborative writing. In terms of content and argument development, the feedback practices during the collaborative writing were based on typical one-to-one commenting style, which provided complicated situations to the multilingual writer. Due to the different expertise

in the co-authors, each collaborator had some preferences for the manuscript. As a result of several years' collaboration in writing, the argument and the contents in the manuscript were developed based on the mutual agreements between co-authors.

CHAPTER 6

FACTORS INFLUENCING COLLABORATIVE WRITING

In this section, I discuss what factors were involved in the collaborative writing in an interdisciplinary research setting. I organized the findings with several categories.

General Feedback at the Research Meetings

The feedback practices in Ken's collaborative writing seemed to be diverse considering the context of the feedback practices and the sources of feedback. First, the context of the feedback that Ken was involved in was at his research meetings and individual appointments with co-authors. The form of feedback at the meetings was mostly verbal feedback on his research focus and the key argument refinement. At the research meetings, Ken shared his research outline and provided explanations when research collaborators asked questions and needed clarifications. He also provided feedback to other members' research work.

While attending the regular research meetings, I felt that I learned so much from presenting my work and listening to others' research progress. This funded research provided ample opportunities for learning while interacting with other researchers on campus and other institutions.

(P1, Journal notes, December 2017)

At monthly research meetings, it was a series of scheduled virtual meetings with featured speakers all over the world in the field of Science and Technology Studies and research members from different states in US and Puerto Rico. The members presented their research topics and current research agendas. The meetings functioned as a learning site for building various research foundations relevant to Ken's research. The practices at the meetings and co-authored writing provided extended opportunities for presenting

research work in a long-term base and providing feedback on extended period of time for multiple versions of manuscripts. Especially at this meeting, the research topics were very diverse under the big topic of preparing for the extreme weather cases in climate change. This kind of research participation was very new to him and he learned so much from the research participation. He was able to catch up with current interests or agendas in other fields such as engineering or environmental science. He also got a chance to articulate his research focus to the research group. After the brief presentations, Q & A sessions were very helpful for his research idea development. Reflecting on his past research experience, he thought that the level of research diversity in his research group was very high and he learned so much from the meetings.

Diverse feedback was very overwhelming at the first time and I was quite skeptical about getting feedback from people from other disciplines. I was not sure the effectiveness of the feedback.

(P1, Interview, June 2015)

He was somewhat skeptical about the broad range of feedback with inconsistent feedback styles and its usage at the beginning of his research project, but he realized how much he learned from feedback given during the meeting. His gains from the verbal feedback at the research meetings were issues of how to get a better sense about broad audience and the use of their feedback to make his research more polished. At the interview, Ken expressed his mixed feelings about the expectations of those presentations. When he prepared for his presentation, he wanted to do his best to make it more focused to his target audience. Preparing for a presentation for a wide range of audience was very challenging to him. Incorporating feedback from people from diverse backgrounds took some time for him to learn how to use them effectively to his research.

The Use of Online Database

Among the collaborating researchers, they used a cloud computing system called, 'box' which provided services for collaborating, uploading research documents, and sharing files with its servers. This website was useful for data management and sharing documents among research members. The research members uploaded and shared their drafts in several folders for further development of their research contents and exchanging feedback from one another. The shared documents in box saved all of files in a shared folder chronologically. Ken posted any updated or revised contents and had other members' comments. In Ken's first year, most of members frequently used box and provided feedback to each other. Ken received written feedback on his manuscript. Before uploading his document with any changes, he made sure that there were any grammar mistakes on his manuscript. The system was convenient but there was one thing that he cared most.

Whenever I need to share my updated versions on BOX, I was concerned about my grammar mistakes and tried not to have basic grammar errors. Which made me to visit the writing center on campus frequently and had the writing consultants read my draft and spot tricky areas to read before I upload my document there.

(P1, Interview, December 2018)

Considering the Comprehensibility of Ken's Writing. Using BOX would not motivate constant grammar checking but Ken's case showed that he cared the accessibility to his research work to other collaborators. Consequently, Ken was concerned about his English accuracy. Another reason was that he was the only non-native speaker of English in his research team and that fact affected his attention to language usage. He thought that he

could lose his face value if he used incorrect English as a graduate student and researcher who was leading one strand of research subtopics. The virtual space that allowed members to upload any research reports and documents related to research made Ken revise any language related issues before posting. Ken's constant concern for correcting his grammar mistakes or errors was developed into sharpening his English expressions and idea description styles which sounded more professional and academic to him.

When explaining one concept to others, I tried to make new sentences with new sentence structures that I had never tried. Although I made sure that they were all grammatically correct, I read the sentences over and over again not to sound awkward to native speakers. I always wonder whether some of sentences and paragraphs that clearly delivered my complex ideas to native speakers. I try my best to sound clear to them by checking my fluency in my writing. I am confident with most of English sentences that I frequently used but I am curious about how some paragraphs were interpreted to native speakers.

(P1, Interview, June 2017)

As indicated in the interview, Ken was not fully confident with his style of presenting his ideas, not with his grammar. He wanted to check in with native or non-native speakers to test the readability of his sentences. He frequently used the writing center on campus or online to hear about how his text sounded to consultants at the writing center. Sometimes, Ken asked them to focus on only grammar or sentence flow. Definitely the use of BOX made Ken reflect his English in general and pay more attention to grammar mistakes. To avoid grammar mistakes or inaccurate expressions, Ken used the writing center for proofreading his paper and particularly for checking grammar accuracy.

Different Disciplinary Backgrounds

The difficulty that he encountered was how to make it clearer to research members who are coming from the engineering department. He realized that the fundamental viewpoints between social scientists and scientists from engineering sides were quite distant, which became the major concerns of his arguments in the paper. He needed to catch up conceptual foundations on resilience work. Over a year-long participation in the research project, his research focus and directions went through various feedback at lab meetings with research members and were gradually refined.

He said, “These experiences have equipped me to pursue independent research across a wide range of problems related to the energy industry.” Through research activities in a group such as research reports, discussions of relevant studies, observation of other relevant research topics, he refined his research outline. His research focuses on the institutional governance of energy and water.

I got the impression that the notion of resilience was independently developed under each disciplinary orientation but my work combines two disciplinary orientations and I need to think about how I develop or argue the notion of ‘resilience’ that reflect two disciplinary fields and can address issues in both fields. Being aware of these situated contexts took me about two years. My first year, I interviewed and worked on having core knowledge about ‘resilience’ and think about how those concepts can be applicable to the research project. Then after two years, I got to see more notions developed depending on their disciplinary origins and I looked at the both sides of the developed notions.

(P1, Interview, December 2016)

From his interview, he talked about not only the diversity of research topics among research members but also the diverse backgrounds of their research members,

which makes figuring out the audience difficult and complicated. The researchers have different research expertise and experience. They are graduate students, postdoctoral researchers, faculty members, practitioners in the engineering industry and environmental policy. He got to think about what all these people represented for and what diversity really meant for. When he presented his work at this meeting at first, it was very overwhelming because he was not sure who would be his audience both at the meeting and in the paper. Ken was unsure about his audience and wondered whether those who were from distant areas would get his ideas.

Feedback practices among the research members. In the four years of Ken's research participation experience, various kinds of feedback practices that influenced Ken's writing were observed depending on the contexts such as at the research group meetings and one-to-one meetings with co-authors. I will start describing collaboration and feedback practices at the regular research meetings and then illustrate the collaboration and feedback practices at the one-to-one meetings for collaborative writing. At the regular research meetings, the research group shared their ongoing research progress and presented their research ideas on a regular basis. In the interview and Ken's research meeting notes, researchers participated in discussing their research directions and key arguments and provided feedback to each other's work. Being a new research member, Ken needed some level of initiation for carrying out his research and to get involved with other researchers. Ken's supervisor/ academic advisor assigned a postdoctoral researcher (Postdoctoral researcher 1) to collaborate with Ken for discussing research focus, data collection, and drafting research report in earlier stages of research participation. The assigned postdoctoral researcher told him what to need to be done before interviews for

data collection and reviewed his research questions. She asked him to post his outline and drafts to document shared spaces, called Box, and gave feedback on Ken's work.

Specific writing tasks that Ken started in his first year was writing research questions, interview questions, literature reviews, and writing an abstract for a research paper. She provided mainly written feedback on Ken's drafts electronically. Her expertise in Sustainability and Climate Change were relevant to the project but not directly related to Ken's research. Ken's topic was also new to her but she showed a strong interest to Ken's research. Her involvement made Ken's initial engagement with other researchers and research activities a lot smoother. Based on the writing log appeared in Ken's journal, her initiation for research activities and her guidance for research was very helpful for him to communicate with other researchers and practitioners in the meeting. For examples, as a newcomer in the research group, he was not sure how to contact other researchers and carry out his interview assignment. Among his research assignments, collecting interview data for one of water and electric companies in Arizona was crucial because the topic was conceptualizing resilience in water and energy management in Arizona. However, the company was very notorious with their reluctance with allowing researchers to contact their representatives. The challenge of interviewing this company was obvious because they had tried to contact them but they never got a chance to get their interview. Ken knew about this issue but for his research topic he needed to get their interview on their institutional practices and decided to take this interview task. He took an important task that was crucial to research members.

Everyone thinks data from this company provides important pieces of information in their research but no one has gathered interview data from it. I didn't know

about the reluctance attitude from the company. I just thought their interview was critical and decided to do it. It is quite time consuming for data collection and most of researchers did not have enough time for it. I felt that I needed to try it because I thought it was something I could manage as a first-year doctoral student.

(P1, Interview, December 2015)

Ken's task for interview data collection made him more central role in their social sciences' side of their research. The key factor in Ken's socialization into the research group is taking a crucial task that was important to research members. Having the local company's infrastructure management can provide the focal evidence of their research for water and energy infrastructure.

After getting several rejecting emails for the interview, I understood the reasons of research members' reluctance for conducting interviews for this company. Everyone was saying that interviewing the company was so hard. So no one really did in-depth interviews from their representatives.

(P1, Interview, December 2014)

He asked help for the senior researcher's help for contacting one person that she had known and luckily, he had about an hour-long interview permission. After this first interview, he became more confident in introducing himself to the representative. He was less confident because he thought that people would not consider meeting a graduate student for research. They were practitioners and busy doing their business. However, interestingly he got several interview permissions. In the interview, he expressed that at first, it was very difficult to start. It was like a threshold. The first interviewer introduced his colleagues and upper-level directors. Companies can be reluctant to release some information if they do not understand the purposes and goals of the research. That can cause some consequences to the company's business to their public services.

In the research group, Ken's initiation for the interview task helped his engagement in the research group. The engineers' group in the research needed the interview data for their modeling outcomes for resilience data on institutional management. Ken got his recognition of carrying out the challenging interview data collection with this company. They looked forward to having his data and arranged any support for his interview task. As a newcomer, it is not easy to get into the research community but Ken's research tasks such as collecting interview data and taking a lead author role in a collaborative writing gave him ways to actively participate in the research activity. In observing Ken's role as a newcomer in the research group, his assigned roles were the combination of the peripheral and full-fledged roles in the team. Ken's socialization into the research community was quite mixed with multiple roles in research group. In most cases, the newcomers in a graduate school showed a gradual movement being peripheral to full-fledged participants. However, in this case, Ken's role as a research assistant in his graduate program and researcher in the research team was quite fluid than static. The role that his advisor and research supervisor took showed fluidity in performing various role in a particular context. He performed as an academic advisor in the classroom context but his performance was subtly transformed into a collaborator in a research setting. Understanding his fluid roles took time for Ken. Looking back for the last five years of his research participation in a team, his collaborative research experience was the most significant investment in his academic program because the research collaboration and co-authoring tasks broadened Ken's academic boundaries of working with experts in different disciplines for achieving goals in the interdisciplinary studies. More importantly, Ken's research participation became crucial elements in

evaluating his research capacity in various contexts. For instance, Ken realized that experience of collaborative research in a research group was highly valued in most job descriptions for postdoctoral and faculty positions, or researcher positions in the field of Science and Technology Studies. The long-term research tasks prepared him for undertaking various roles collaborating with experts and practitioners outside his discipline. The most significant gains from the extensive research and writing were how to synthesize expectations from other disciplines and seeking for balanced and nuanced voices by satisfying each side of discipline by incorporating the various kinds of feedback from the collaborators.

The Ambiguity in the Research

The stories from Ken's first and second year indicated that the ambiguity was the most challenging part in the interdisciplinary research. Due to the nature of the interdisciplinary research, it has broadly defined overarching themes and objectives for conducting collaborative research. In the interview, Ken talked about the challenge with ambiguity during the research activity. Especially with no prior experience in interdisciplinary research, the ambiguity seemed quite challenging.

In my first two years, I was not sure what direction I was aiming for in my research. I have never worked with engineering department. I didn't know who would be my audience and how I build up my academic identity in the interdisciplinary research. Especially this kind of a long-term based collaborative research, it is hard to anticipate the outcome and the path of the research collaboration. We are all invited to work together and do our part in the research team. The collaboration opportunities provide a lot more than I could expect. When I first started this kind of big collaboration research, I was not sure how we, researchers, from all different disciplines can satisfy the research objectives as

proposed in their proposal. We are always unclear about the development of the research process.

(P1, Interview, October 2016)

The purpose of Ken's research was to find ways to be better prepared for the extreme weather conditions in Climate Change in urban contexts. In his research team, upper-level researchers divided broad strands of research topic groups and what kinds of research they would conduct to solve the complex issues appeared in Climate Change. The subtopics and research directions were not specifically defined. Defining the research outcomes depended on how researchers specified and contextualized the research topics.

The objectives in collaborative writing. Collaborative writing beyond the classrooms in Ken's case was the results from the real collaboration research. Typically, collaborative tasks in L2 classroom contexts is incorporated for language learning or writing skill purposes. In collaborative writing under the research settings beyond classrooms, the pedagogical purposes for further language learning is not the priority. Language learning can be rather incidental and can't be purposefully designed in the research settings. Collaborative writing activity in the current study was part of disciplinary identity in Science and Technology studies. Collaborative writing in the interdisciplinary research contexts was located in the center of the research activity. Ken's collaborators took part in several collaborative writing tasks. During the interview, he said that he became aware of the importance of collaboration in the interdisciplinary studies. He had some doubts about the collaboration in his first year.

I remember what one of the faculty in my program said about collaboration. His words really awakened my view toward collaboration. My view was quite mixed to the collaborative work at first because I see the complex problems and collaboration for solutions seems to be less effective. Then, after I finished my collaborative writing and looking back all the processes of my research development, collaboration and collaborative writing helped seeking new ways of thinking and answering questions.

(P1, Journal notes, December 2018)

As Ken's reflection indicated, the collaboration experience totally changed his views on how to solve complex issues and rethink about the purpose of collaboration. He often had the question about the collaboration and the function of collaboration. Why does the interdisciplinary studies facilitate collaboration? The director in his program highlighted as follows.

People tend not to see the differences between innovation and invention. We strive for seeking innovative ways to answer or solve our current complex issues. Invention can happen under one person's solo contribution but innovation can achieve by a wide level of public participations for change. Science is embedded in the society. Science and technology does not belong to particular expert groups. It should be negotiated among people in our society. Collaboration research opportunities creates sites for finding innovative solutions in the interdisciplinary studies.

(P1, Journal notes, June 2018)

Collaboration and collaborative writing create opportunities for seeking innovative solutions for complex issues in the interdisciplinary research. Reflecting on the director of Ken's research team, Ken thought about the reason of our collaborative work. The topic focused on infrastructure systems and the centrality of institutional

analysis to the design and implementation of resilient infrastructures regarding water and energy in Arizona. While participating in the project, Ken has extensively examined the institutional structure and interdependence of water, energy, and ecological systems, with the goal of creating a model for incorporating institutional analysis into the broader understanding of resilience across the U.S., Latin America, and global communities. Ken took content-based courses that were related to the research projects to build the disciplinary knowledge in the Urban Resilience Extreme research projects. He articulated his research as follows.

My research demonstrates that, throughout these large projects, the resilience and sustainability of energy infrastructures are tightly coupled institutionally with other infrastructures and that these institutional interdependencies are at least as significant as physical and cyber interdependencies in terms of both creating vulnerabilities and/or promoting resilience for complex systems.

(P1, Interview, December 2018)

Based on the collaboration and negotiation through collaborative writing practice, Ken refined his core arguments by identifying the contextualized research goals in the project. Integrated and holistic understanding of the interdisciplinary research helped polish the central arguments, which help develop the quality of arguments and the quality of the whole paper.

Collaborative Writing Processes. In the first and second year of Ken's collaborative writing, most of writing tasks was drafting a research paper. Multiple drafts were written by Ken and the level of collaboration with members appeared in a quite broad level such as participating in idea development, providing feedback on drafts, or proofreading.

Incorporating senior research members' comments while deepening arguments in a paper can be viewed as part of collaborative writing. Their input on developing clear arguments and verifications on engineering research practices were crucial aspects in research developments. For instance, research collaborator who were in postdoctoral positions had more experience in writing research paper and o rather than focused. Ken was responsible to do the main writing tasks based on his research on conceptualizing resilience. Multiple drafts were written and revised based on the research members feedback. The majority of the contents was about synthesizing literature review for the definition of resilience and identifying issues in the application of resilience concept in various field of studies. Ken was responsible to the actual writing tasks because the conceptualization on resilience were in Ken's research topic and they were taken from his interview data.

The ownership of the research data belonged to Ken because the research topic on conceptualizing resilience work with socio-technical approach was initiated by Ken. Ken's data ownership was one of the crucial factors that made him as a leading author in a co-authored paper. In Ken's first year of research participation, his tasks were not clearly discussed and negotiated except the assigned topic areas. Ken reflected on his first year and said that he was not sure what his research was about and where his research aimed at.

I got my assigned topic that I needed to dig in but there were no details about research procedures. To some people, it can be interpreted as room for flexibility in research but it was very hard part for me to decide the directions of my research particularly in the interdisciplinary research. The hardest part was getting the sense of where my study and argument was going to be situated in the

collaborative research. I have been working in a group for about four years and things became clear gradually from my research practices.

(P1, Interview, March 2019)

As shown in the interview, Ken predicted what would be like in working in an interdisciplinary research. After the collaborative writing, the collaboration in research and writing became the central practices of Ken's disciplinary practices and facilitate to find scholarly identity in an interdisciplinary study.

The Functions of Collaborators' Feedback

Over the long-term period of collaborative writing, the major collaborative writing work with the co-authors happened at the last stage of the manuscript submission. The intensive collaborative writing on Ken's manuscript was done about six month before the submission of the journal submission. Prior to that stage, the revised versions of research paper incorporated with other researchers' feedback were the foundational accumulations of multiple views from interdisciplinary research members. Ken's multiple drafting and revising practices in a research group facilitated incorporating various views on resilience conceptualization on critical infrastructure management. In the interview, Ken felt that his academic writing skills improved significantly from negotiating with co-authors and journal editors. As illustrated in the processes of multiple drafting and patterns in the feedback practice, Ken's perceptions on feedback given by mentor/advanced researcher collaborator have gradually shifted from the rigid habitual practice to more flexible interaction. In the earlier stage of collaborators' feedback seemed to like a one sided feedback on Ken's draft rather than bidirectional interactive feedback patterns. As his collaborators were faculty members in one of his graduate courses, Ken

was used to accept their feedback unconditionally. Those feedback patterns were observed at the earlier revising stage.

Ken attempted to fully incorporate all the comments from the collaborators including the actual collaborators and team members to improve the quality of the draft. The attempt resulted in more conflicting understanding of which feedback should be incorporated more or less to make a balance between different comments. It was very tricky to do so with his earlier attitude towards feedback that he tried to include almost all of those feedback. Later in the feedback exchanges, Ken gradually learned how to anchor his position to make priorities from various feedback. He started to evaluate the priorities and importance of the feedback. The consideration of feedback givers' social status like experience of research and academic position definitely affected the Ken's feedback judgement. He indicated that he tended to incorporate two co-authors feedback first and then prioritized his research members' feedback. When he found some overlaps between feedback, that made him revise more. The examples below are the feedback focus from the postdoctoral researcher.

- You have good ingredients for your intro, just need to shorten and reorganize the presentation.

- Focus on connections between paragraphs and organization of the overall contents

- This smart system piece needs to be introduced and integrated. Presented as part of the challenge your research is investigating. How will the management of institutions under the smart system affect the need for better understanding the social learning aspects of the critical infrastructure of the future?

- It is not clear the purpose of this section.

-Sounds like it is fundamental to your argument to explain why this social-technological dimension has not been well recognized in the past, as part of explaining how it might be better recognized moving forward.

-An example of static system could help here.

-Great. Integrate this definition sooner, and can you tie it to other definitions of institution that might be lacking an understanding of the social dimensions?

-Lead with this sentence and remove some quotes from the paragraph, your synthesis is strong enough.

-Lead with this sentence and cut some quotations. You are building your own argument, not just citing what others have already established.

-The paper is quite strong up to this point, but Section 4 requires considerable reworking to help the reader understand what it is accomplished here; if it is simply illustrating the tight coupling of social-technological systems, focus on just one subject of the water and/or energy landscape, pointing perhaps to other citations where this work is done in more detail; but for the argument to stand that a new concept of social-technological understanding is needed to improve critical infrastructure management...

(Writing Sample 5, October 2018)

As the examples show, there was a general tendency of organizing feedback to Ken. The postdoctoral researcher was not a co-author but he wanted to participate in revision process. Usually he started providing compliments like 'excellent' or his overall evaluation first and then provide comments on what should be changed. He also indicated a little bit of uncertainty to his opinion on contents.

Compared to feedback focus found from the postdoctoral fellow, co-authors feedback provided more specific comments on shaping each argument by pointing out where he needed more revisions with specific reasons. Some of comments from the postdoctoral researcher seemed somewhat ambiguous and broad to Ken when sufficient reasons were not provided. Consequently, Ken was not so persuaded by them. When particular comments were overlapping with what co-authors suggested, there was a

tendency that Ken motivated to revise the areas that received similar or overlapping comment in the paper. It can be assumed that Ken evaluated the comments given between collaborators and decided which one he wanted to work on.

In terms of feedback provided to Ken, the co-author 1 was very focused on contents that were particularly related to his expertise. Key comments were made on the accuracy of contents related to water and energy history in Arizona. Based on his environmental history expertise, his style of preferred writing was providing sufficiency historical information. He was also specific about synthesizing particular arguments with water and energy history. The feedback was very interactive suggesting revision work with sufficient reasons and providing relevant knowledge base in relation to his expertise.

- Water and energy system in Arizona entails a complex institutional language.
- Those institutions are routinely doing resilience work of all three kinds....
- Only by understanding that work, we can understand how infrastructure resilience is evolving.

(Writing Sample 6, December 2018)

Above are some of feedback examples from the co-author 1. In addition to his direct change of grammar on Ken's draft, he sometimes gave his comments for further revision and wrote a one-page-long information on historical information on the margins of the paper. It provided more extensive learning opportunities for disciplinary knowledge practice through revision.

Incorporating Key Ideas into Visualizations

Two major figures and two tables were included in the paper. Starting from the initial drafts to the final draft, Ken included several visuals in order to show his

interpretations on the infrastructure in water and energy system in Arizona. Those visualizations are the summaries of various kinds of resilience application in relevant research areas and highlights of the key findings from the analysis of organizational communication networks in managing infrastructure. The figures attempted to illustrate how the aspects of resilience in managing infrastructure could be mapped out in a broader perspective with a lens of critical socio-technical approach.

I think my English is not sophisticated enough to explain the dynamic web of communication network in my paper. I need some alternatives. Showing this visualization would help understand my text more effectively. I also enjoy coming up with visuals and playing around with visuals in my mind whenever I am deeply involved with research ideas. Whenever those figures naturally came up to my mind, I feel like I got the way out or it is a sign of what I am getting at. That is my tool for understanding the key information from the literature and data.

(P1, Interview, November 2018)

It seemed that Ken had two purposes with this inclusion. First is to leverage his limited English writing ability in explaining the dynamic characteristics of its interconnectedness between organizations. He felt difficulty in reading what he expressed in the paragraph because his text did not seem to effectively capture the multi-directional aspects of communication networks. He thought that just providing the descriptions with text was not enough for the description of the complex network. He realized that coming up with effective visuals in order to increase better communication with readers was important aspect in an academic writing. This kind of audience awareness helped Ken consider more about what kinds of rhetorical elements were particularly impactful to his readers. Looking for effectively rhetorical tools is important part of learning in academic writing

skills. Especially in an interdisciplinary study, making an effective tool for better communication with readers can be crucial in attracting a wide range of audience.

Another reason of including visuals into text is Ken's personal preference toward having visual images that captures the highlights of the text content. This was related to his process of making meaning from what he read. He frequently associated some kinds of visual image with what he read and wrote. This was very natural process occurring to Ken. He also expressed that writing contents with text only with no visuals seemed boring. He indicated that having visuals increased readers' interest on his ideas and attracted their attention directly to the key points that Ken wanted to emphasize. Ken considered visuals as much more intuitive and strategic regarding processing messages. Further, it saves time for digesting the key points within a short period of time.

When I read others' papers, I look through quickly and stop where they have visuals in the content and focus on how those visuals talk about the contents. It is very interesting to me and I personally like to associate text with visual images. I write and draw my contents. In my collaborative research and writing process, I exchanged many visuals with my collaborators. At first, they asked me where I got those visuals and I needed to cite the sources of the visuals. I told them it was from me. They liked my visuals. After my collaborators knew that I often draw visuals, I became a 'diagram guy' in a research team. They often ask me to come up with visuals. This is funny but I like that.

(P1, Interview, December 2018)

As the above interview indicated, Ken strategically incorporated his visuals into the text to increase the readability of his text among readers. Drawing diagrams or tables for content gradually helped position Ken as an important research member in charge of creating visual representation. Interestingly, the research members' awareness of Ken's style with text and visuals, they wanted Ken to draw visuals for their work. They valued the effectiveness of visuals when visuals captured the essence of the text. It helped

increase the efficiency of the written text. Ken gained his confidence as a research member as he felt his research members' recognition of his work. He was a legitimate member in the research but Ken, himself did question about the weight of his position in the research team.

After their discussions on the visuals, his tables and communication networking map became a lot more developed and detailed in representing the findings. The changes made from the initial diagram and tables were the results from the constant discussions between his collaborators. For instance, his collaborator, faculty in Science and Technology provided comments on what subcategories might be useful. The other collaborator, faculty in environmental history, verified the descriptions in the diagrams showing the organizational communication network. Over many times of discussions and idea exchanges between collaborators, the diagram and table became a lot more improved.

Summary of Chapter 6

In this chapter, I identify the factors influencing the focal participant's writing development and the collaborative writing. The feedback from the research group members were relative broad and general compared to the feedback given by the co-authors. The general feedback on the initial drafting help developing research directions and content organization. More specific feedback given from the co-authors helped refining the key arguments in the manuscript. The feedback practices provided the multilingual writer with opportunities of learning disciplinary knowledge from the feedback givers and ways of negotiation for refining the central argument in the paper. The tools used for sharing data resources and multiple drafts indirectly helped the

multilingual writer work on issues with language and grammar accuracy. Other contributing factors were the communication styles between the co-authors during the collaborative writing and the process work in sharing research members' outlines and drafts regularly, and the journal editors' feedback. Especially after receiving the comments from the journal editors, the co-authors worked on interpreting the feedback and prioritizing the feedback for revisions. The process triggered more intensive level of collaborative writing among the co-authors.

CHAPTER 7

DISCUSSIONS, IMPLICATIONS, AND FUTURE STUDIES

Discussions

The aim of the study is to show the characteristics of collaborative writing occurring outside of classrooms. Considering the changing academic contexts that interdisciplinary research or interdisciplinary collaboration is encouraged in many academic institutions, we need to prepare L2 students not just for collaborative writing in classroom contexts for pedagogical purposes but also for collaborative writing in more situated disciplinary context with real outcome-based collaboration. Thus, it is important to extend our understanding of the nature of collaborative writing in more diverse settings such as in an interdisciplinary research outside of classrooms.

Collaborative writing is often employed as part of writing activities in L2 writing instruction. In many classroom practices, collaborative writing in L2 contexts is used for pedagogical purposes for promoting students' writing and language development through their verbal interactions with peers while writing in a pair or a group. The collaborative writing tasks have been used as a facilitative instructional tool for promoting peer interactions while L2 learners' writing texts together. The collaborative activity integrates oral and written productions in one task. To maximize the integral aspects of this activity for language use and language development, it emphasizes a particular kind of collaborative writing. That dominantly focuses on the act of a joint drafting with peers. Accordingly, collaborative writing tasks in L2 classrooms require writers' full participation, equal amount of efforts or contribution throughout the whole writing stages. The particular type of collaborative writing has the potential to be developed for

mastering certain writing skills or classroom-based pedagogical instructions. Such tendency would be useful for meeting particular needs in class activities. Yet, such collaboration task, seemingly, being unnatural in real collaborative situations, may provide a one-sided or unbalanced view on collaborative writing to L2 writers. In keeping with such tendency, collaborative writing is perceived only as a facilitative instructional tool for classroom instructions but limited as a goal for producing a better writing.

In the current study, I examined the processes of a multilingual graduate student's literacy development in an interdisciplinary research project in Science and Technology Studies. Throughout the extensive period of observation in collaborative writing, the development of Ken's writing skills was closely related to the development of his research skills in the assigned project. The capacity of his research skills helps identifying the key arguments in his research and finding critical gaps from the relevant studies. He worked on resilience work and trying to conceptualize how the notions of resilience has been applied in both engineers and social scientists. While searching for issues of the complexities in water and energy nexus, he reviewed many case studies to find the appropriate analysis perspectives regarding water and energy in extreme climate cases.

The qualitative case study identified what literate activities are involved around collaboration in writing and how the collaborative writing outside of classroom contributes to a multilingual graduate writer's disciplinary enculturation process in a situated learning. It also investigates the factors and effects that influenced the multilingual student's collaborative writing beyond classrooms and further examined how a multilingual writer incorporated feedback from the research collaborators and co-authors. Then, I discuss pedagogical implications for incorporating collaborative writing

into advanced level writers' writing instruction. Exploring collaborative writing that happened in the long-term period of time would shed light on what factors can be considered when it comes to designing curriculum for advanced level L2 writers, graduate level L2 writers, or writing in a discipline.

Providing certain kind of collaborative writing tasks to L2 learners would be beneficial to relatively low or intermediate levels of L2 proficiency students to have them practice their L2 language in writing and initiate peer scaffolding in a group context. In doing so, it is important for instructors to provide various forms of collaboration occurring in different writing tasks either in class or outside of class. The commonly used definition in L2 collaborative writing tasks can highlight the importance of mutual drafting when the collaborative drafting phase was identified by the collaborators as an crucial factor in the process of co-authoring context. Practicing collaboration in writing for beginner level students would offer opportunities for experiencing collaborative writing in a controlled situation by instructors. However, for training more advanced-level writers, incorporating collaborative writing tasks with authentic and real collaborative writing tasks can be crucial. For instance, Storch's notion of collaborative writing in L2 contexts presents a rigid model of collaborative writing. In her definition earlier, all members in a group should draft a text together. And her notion of collaboration seems to be limited to pair work and the face-to-face collaboration. Such type of collaborative writing may not be realistic if more than three or four people engage in the act of joint drafting at a time. However, it seems to require a laboratory-like condition where variables and factors are often controlled or managed by an instructor. Consequently, all members are asked to provide equal amount of contribution in text

production and participation for drafting throughout the process of collaborative writing. Consequently, that process is often regarded as the most crucial process to claim their ownership for the collaborative work. In typical collaborative writing in L2 writing instruction, students' participation and responsibility were assigned quite equally. That is collaborative writing that we have seen in L2 writing research. This provides the basic understanding of collaborative writing but it seems limited for students to prepare for the broader applications for other types of collaboration either in classroom, out-of-classroom, or professional collaborative writing settings.

Although the traditional type of collaborative writing is helpful but focusing on individual learning, we are not preparing for students for collaborative writing that requires various levels of collaboration and collaborative writing skills outside of the classroom context. The collaborative writing that happens outside of the classroom is much more flexible and complex in the collaboration process. Thus, it is important to note that collaborative writing research needs to explore various aspects of collaboration in more contextualized situations with the real task in a professional or academic context. In this light, as the findings beyond classroom provided, we need to seek ways to facilitate similar kinds of collaborative writing activities and incorporate those kinds of activities into L2 writing instructions particularly for advanced-level writers. L2 writing professionals should be exposed to various types of collaborative writing and promote possible directions to help students to prepared and learn various types of collaborative writing.

Another point is that the assumptions in most of L2 collaborative writing studies tends to be the homogeneous L2 writing classrooms. It assumes similar kinds of L2

proficiency levels and similar kinds of L2 writing skills. It assumes individual differences in L2 writing proficiency between peers but the gaps in their writing proficiency are not significantly large. Students are coming from various disciplinary orientations but the current studies in L2 collaborative writing tend not to consider the differences of students' disciplinary identities. Depending on what major they do, their ways of thinking and ways of solving problems would be different, which can make a huge difference in working collaborative writing tasks. In doing collaborative writing, typically instructors assigned expected roles for writers and students were asked to divide equal amount of writing tasks or responsibilities for tasks. For instance, drafting collaboratively with all assigned members is a crucial factor in L2 collaborative writing tasks. The procedures of collaborative writing are mostly focused on the drafting stage. The drafting collaboration was centered in the collaborative writing procedure. The students' relations are mostly assumed as peer writers with similar writing abilities. Other variables are not considered. However, in collaborative writing beyond classrooms, the processes are a lot more complex.

Collaborating with idea development and content development can be crucial part of collaborative writing. If one writer provided important ideas for content and argument development, authorship can be negotiable depending on the writers in collaborative writing. The typical assumptions in previous collaborative writing studies are that collaborative drafting equals co-authorship and collaboration in other writing stage considered to be less crucial and mostly considered as peer activities separately. What I found from this dissertation study is that collaboration patterns are much more flexible and the collaboration practices evolved in various stages depending on the importance of

the collaborative work and the kinds of issues. For instance, all members do not participate in drafting a text. The textual ownership is very fluid. Depending on the significance of involvement in the collaboration process, members negotiate the co-authorship rather than pre-determined from the beginning of the writing.

Implications

Collaborative writing activities in L2 contexts is often employed to facilitate L2 language practices and learning through working with peers' interactions during collaborative tasks. In general, the pedagogical focus is appropriate to low or intermediate levels of students' L2 proficiency. But for targeting advanced proficiency levels of L2 students or graduate level writers, the collaborative writing in L2 classrooms needs to provide broader and authentic types of collaborative writing tasks, which can be more relevant to their disciplinary writing tasks or applicable to real writing tasks in a professional context. Collaborative writing tasks in a disciplinary context or interdisciplinary research setting provide a wide range of real-life academic tasks. The work of Simpson and Matsuda (2008) argues the importance of having multilingual doctoral students exposed to various forms of real-life academic tasks to learn discourse language, disciplinary knowledge, conventions, and practices in the field. Collaborative writing tasks in a collaborative research project provide an opportunity for a multilingual doctoral student not only to learn how to write a collaborative research paper but also to engage others in the community and further develop a scholarly identity through co-authoring practices in the CoP. In this sense, it is important to extend our understanding of collaborative writing beyond classrooms by examining how writers in various

situations use collaboration for real tasks and how writing specialists and educators can prepare our students for various types of collaborations in writing.

The kind of writing prompts given in most L2 classes seem limited. The majority of prompts is relatively simple and general to any disciplinary field of study. The tasks are ranging from short grammar-oriented exercises targeting for lower or intermediate level writers to a short essay prompt. Those tasks are designed for short-term based collaborative activities to facilitate peer interactions and initiate collaborative drafting in a group. Such tasks can be helpful for students with low or intermediate level L2 proficiencies. A few prompts were either argumentative or descriptive, or grammar related completion tasks. Yet, the task prompts were not designed properly for the goals of collaborative writing. For the advanced level L2 writers, the tasks need to be constructed considering various factors such as writers' interests, disciplinary orientations, collaboration experience in a group.

Consideration of different levels of collaboration outside classrooms is useful in designing collaborative writing tasks. Student peers do not have particular social relations but in real collaboration contexts, writers have different social relations in a group. As seen in the hierarchical structure in the interdisciplinary research, there were graduate research fellows, postdoctoral fellows, and senior or faculty research fellows. Various social status in a collaborative group can affect how the group members collaborative and what kinds of collaboration can work with the consideration of various social relations between members.

With the common employed definition in L2 collaborative writing, the equal amount of responsibility or drafting efforts is expected to share mutual ownership of the

collaboration work. It assumes that ownership is directly obtained by participating in joint drafting. However, what happens beyond classroom collaborative writing is much more flexible in a group. The joint drafting may not be the most crucial factor for deciding the ownership of the text. Thus, there can be an issue with ownership and co-authorship. In a real context for collaboration, co-authors may or may not be involved in all processes of collaborative writing. Some may work more with drafting and others may involve more revising and editing. Co-authorship can be negotiated depending on the level of collaboration and consideration of various factors. Depending on how members decide the significance of their collaboration, the issue of co-authorship is somewhat different than what was assumed in classroom collaborative writing.

Members in a group can change over time and their involvement can be inconsistent from time to time. The collaboration between members varies depending on the issues arising from the collaborative writing tasks. Particularly in a long-term based collaborative writing, group members had been changed over five years due to their research assignments. This cannot be anticipated at the beginning of the research. There was uncertainty of collaborative work. Ken had to learn how to coordinate unexpected changes and adapt to modified research groups. Ken had several collaborators who worked together for idea development and drafting, some of them were not included because they decided not to be involved in the final stage due to their assignment change. At the drafting stage, there were a lot more frequent changes of collaborators. Then, more focused collaborative writing appeared when the goal of the research paper was set. So it can be noted that considering the flexible nature of collaborative writing allows various

types of collaboration patterns in a group and that consideration is related to the goals of collaboration.

Collaboration levels vary depending on the tasks during the collaborative writing. The participation levels among research members was varied depending researchers' roles. For instance, collaborators' feedback can be divided into focused group versus unfocused group. That is, the research team had several subgroups with different research agenda. The focused group means the group that were directly involved to collaborative writing tasks and providing their feedback. Another group, unfocused group is researcher members in a research project but they were not directly involved to collaborative writing. The unfocused group researchers also provided resources for idea development and useful feedback on Ken's group. The indirect involvement from those researchers was also influencing group's research directions and disciplinary knowledge in developing integrated ways of socio-technological approaches in a project.

Most tasks are designed with the assumption that L2 writers are quite homogeneous groups of learners with similar levels of L2 proficiency and subject matter knowledge, similar cultural backgrounds, and limited writing experiences. In contrast, L1 technical and business textbooks indicate individual differences and group dynamics while jointly producing a document. The importance of collaboration, various factors, and challenges including unexpected conflicts are discussed in technical or business writing textbooks (e.g., Bremner, 2010; Colen & Petelin, 2004). There exist much more complex relations with group members with different levels of L2 proficiency, writing proficiency, subject matter knowledge or disciplinary expertise, different age groups, or

social hierarchy. It seems important for L2 writers to have the sensitivity to identify varying levels of factors and develop their own strategies for collaboration.

L2 instructors and researchers do not need to cover everything that happens beyond classrooms but it is important to consider providing different types of collaborative writing in various contexts. Providing various kinds of collaboration pattern to L2 learners would benefit from preparing for future opportunities of collaborative writing tasks in their disciplinary studies or professional collaboration practices. Instructors need to provide alternative forms of collaboration in writing and identify strategies particularly used for collaborative tasks. The common definition employed in L2 collaborative writing may presents a rather controlled model of collaborative writing because it requires particular expectations and equally divided collaboration workload on collaborative writing such as peers' joint drafting. Such type of collaborative writing may not be realistic if ten people engage in the act of joint drafting at a time or a group of people are assigned to work flexibly online for their assigned writing tasks. It may end up requiring a laboratory-like situation where variables and factors are controlled ideally by teachers if all members provide equal amount of contribution and participation during drafting in collaborative writing. Therefore, there is a need to provide more broader perspectives on collaborative writing in more situated and naturalistic contexts. It can offer detailed information on what kinds of practices can lead to successful collaborative writing and how an individual writer in a group play a role in response to group members' socio-cultural relations and writing experience.

Ultimately, to advance the field of L2 writing and collaborative writing, it is important to redefine collaborative writing with the consideration to various writing

context so that we can extend our understanding of collaborative writing. Furthermore, we need to change the discourse of collaborative writing by differentiating the term, collaborative writing, which is typically used in the field of L2 writing. For instance, different terms can be used to indicate pedagogical collaborative writing and professional or outcome-based collaborative writing. Using the term, collaborative writing, with narrowly defined aspects of collaborative writing would be problematic in exploring broad ranges of collaboration in writing.

I would like to suggest some pedagogical suggestions based on the findings in the study by outlining implications with the bullet points below.

- Diversifying feedback practices in classroom-based collaborations
- Designing writing tasks that can reflect some authentic aspects of collaborative writing in a naturalistic setting.
- Considering L2 writers' interests and their individual differences not only collaboration preferences but also their disciplinary studies.
- Designing collaborative writing tasks that incorporate others' feedback and how students interpret those feedback
- Identifying or creating clear goals of collaboration and collaborative writing
- Considering ways for including teacher's intervention as resources rather than instructional purposes

Limitations

Selecting single case study design can be one of the limitations in this study considering generalizability (Yin, 2014). Although the generalizability of the research findings is not the primary aim of this study, it would be better to include multiple case

studies in investigating collaborative writing in an interdisciplinary research. That would reveal other aspects that I have not found in this one case study. There were several contextual limitations that I could not include multiple case studies for this research. First, conducting a research on one writing group was gone through quite complex process of collecting and analyzing data, which was very time-consuming. I could not have enough time for examining other groups' collaboration due to the time limitation of my research period. Second, I could not find a collaborative writing group with similar conditions around the time that I was doing the research. Conducting a study that happened beyond classrooms took a lot of time for scheduling interviews and data collection with participants who were working on different tasks in different times because the focus of my research was on the practices of collaborative writing in a research group over the total research period. So just focusing on one writing group was good enough for me to manage. It would be possible that a researcher can work on conducting other case studies at other times and then comparing all the results at the end if the research period is not considered. However, considering realistic study conditions, this research was my first time for doing a longitudinal case study and I tried to focus on one case analysis. Last, finding a different size of collaborative writing group would be necessary for examining how a different size of writing groups would affect the results of collaboration in writing. I could not find other writing groups that were in similar writing stages with my study at the time of my research period. The amount of time available during the research period would be a crucial factor in conducting a multiple case study method. Reflecting on my own limitations as a researcher, examining different writing

groups with similar conditions would yield more findings and reveal unforeseen aspects in studies of collaborative writing.

Being aware of my involvement in the study is crucial because my stance as a researcher is not completely outside observer. The informal relations with the participant may have some effects directly or indirectly on the research but mainly the personal relation helped conduct this research possible. I was aware of this possible influence on the study due to my presence. My position in the study is a participant observer rather than completely being an outside observer. I tried to keep a distance from the concerns that he brought and kept my involvement as minimal as possible. However, the personal relations made this research possible because looking into how research had been developed would be confidential to researchers before publishing a paper.

Before this study, I have known the multilingual graduate writer for years based on my personal relation as a friend. For instance, I and the multilingual writer talked about a variety of topics in general about English learning experience because the focal participant knew my expertise in English education and L2 writing studies. At the time of his entrance to the doctoral program in U.S., I was teaching composition courses and naturally he talked about how to improve his English skills to be successful in his research activity and graduate-level courses. As an international doctoral student, he had some level of accumulated content knowledge but the lacking experience particularly in English writing was concerned mostly to him. After assigned to the collaborative writing tasks, he wanted to talk about his tasks more and actually volunteered to be my participant. Due to the fact that he had never taken any English writing courses before, he

tried to get some resources or at least hear others' learning experience like me as a friend and graduate cohort.

Future Research

From reviewing the previous research on collaborative writing, I observed gaps from the literature in collaborative writing studies in academic settings; the context and process of the collaborative writing, the goals of collaborative tasks, participants in the collaborative writing group, the task prompts, and the task design.

We need to investigate various aspects of collaborative writing in a naturalistic context. Either in-class or out-of-class collaborative writing has its own purposes of collaboration. Particularly relating to writing collaboration, investigating the purposes of collaboration and objectives from the collaboration is necessary to consider contextual factors that influence the practices of collaborative writing. In a naturalistic setting of writing, it is likely to see more factors influencing collaborative writing. Those insights can shed light on advancing more effective way for L2 writing instruction and curriculum development which reflect real-world problem-oriented collaborative tasks. For instance, most studies in collaborative writing in L2 context do not consider much on editing or revising practices involved in collaborative writing tasks. It dominantly focused on drafting with peers for initial drafts. It seems unnatural to exclude the significance of extensive revising or editing stages that would actually require more intensive level of collaboration in writing process.

In most classroom activities, teachers play a crucial role in assigning groups, tasks, and responsibilities between writers. Such simplified classroom practices on collaborative tasks tend to provide only partial pictures of collaborative writing and have

them exposed to limited aspects of joint drafting to L2 writers. When applying Storch's notion of collaborative writing to a more authentic context, L2 writers with a lack of experience and limited knowledge on group collaboration may feel frustrated and may not be able to actively participate in various types of collaboration either in classrooms or outside of classroom contexts. The controlled collaborative writing tasks in classroom based L2 context would be useful for low or intermediate L2 proficiency level students to be exposed to collaborative writing tasks and get familiar with peer collaboration. For instructional purposes of using collaborative writing, employing a definition with relatively controlled notion can be useful in introducing one type of collaborative writing in class and then instructors can provide various patterns of collaboration with writing and discuss issues that would be related to ownership or co-authorship of the text in a group.

Most studies regarding the writing process are based on a single writing cycle rather than multiple drafting cycles. For future research directions, more in-depth investigation is needed to inform more realistic and situated collaborative writing tasks. In many studies, the textual analysis tended to focus mostly on the first draft and the second draft during the collaborative writing. More detailed examinations on multiple drafting and various revision work need to be done in the future studies. What are the factors that influence in various drafting and revising stages? It is necessary to investigate what kind of practices may be involved for extended revision or multiple revision cycles. Moreover, there is still a limited number of longitudinal research design in collaborative writing. Further research needs to examine writing groups with diverse disciplines across different homogeneous or mixed groups to help educators and researchers better

understand what constrains and processes may be associated with. It also helps writing specialists identify writers' needs and provide effective guidance and instructions for L2 students working with various writing tasks. Furthermore, more research is needed to investigate what strategies a learner or a group develops in various drafting stages in co-authoring tasks and how those strategies contribute to L2 learners' writing development.

In terms of working with peers in collaborative writing in L2 contexts, mostly co-authors are peers in their classrooms. In a professional collaborative writing context, peers can be their colleagues with varying experiences of writing and working. More studies with L2 writers collaborating with people from other fields or in various academic stages would reveal valuable insights for collaborative writing practices and writers' strategies. For instance, people tend to have their own interpretations and meanings in using certain terms such as editing and revising from my research. Writers often use editing and revising interchangeably to refer to revising. It would be important to have resources for the terminology conflicts in a group writing. So future studies would focus on investigating how each individual in a group has different interpretations or usage of terms and how writers in a group negotiate their gaps and develop the groups' writing strategies. Another line of future research would be how individual writers' writing processes work together with writing processes of group work. It would provide useful information on how each writer carries out their writing tasks in a collaboratively working context to achieve the mutual goals in the writing collaboration.

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APPENDIX A

INTERVIEW GUIDE FOR A GRADUATE STUDENT

Interview Guide for Graduate Student Participant

Interview Session I

1. What is your previous academic writing experience prior to this doctoral program?
2. What kinds of writing have you done in terms of writing a research paper either L1 and L2?
3. Would you explain your collaborative writing experience regarding both in-class and out-of-class collaborative research projects?
4. What are the goals of collaborative writing tasks that you perceived while working on out-of-class collaborative writing tasks?
5. What are your takeaways from in-class collaborative writing and outside-of-classroom collaborative writing tasks?

Interview Session II

6. Who are the collaborators in the out-of-class collaborative writing?
7. Would you explain the writing processes that you have gone through in writing for publication in collaborative writing?
8. Would you explain what kinds of writing tasks are involved in collaborative writing?
9. What were the practices of feedback and feedback types during drafting and editing stages?
10. Would you explain the major types of feedback that you have received and provided in your out-of-class collaborative writing project?

Interview Session III

11. How did you work with collaborators in developing the key arguments and the contents in the collaborative writing?
12. What issues have been brought up by your research collaborators in the process of collaboration?

13. As a lead author, what challenges have you encountered while working on collaborative writing and how did you overcome the perceived challenges?
14. Reflecting on your collaborative writing experience, what strategies have you developed and how did they work in developing your writing skills?
15. What kinds of language support and writing services have you used?
16. How would you describe the importance of collaborative writing in your field of study?

APPENDIX B
INTERVIEW GUIDE FOR FACULTY

1. What experiences have you had in collaborative writing projects?
2. Could you explain the aims of the current collaborative writing project?
3. What roles have you played in this collaborative writing project?
4. Could you explain the major writing tasks that you have participated in the collaborative writing?
5. If you are asked to explain the major writing processes in collaborative writing, how would you explain the characteristics of collaborative writing compared to individual writing?
6. What are your thoughts on collaborative writing projects in an out-of-class research context compared to in-class collaborative writing?
7. Regarding your current involvement in co-authoring a manuscript, what are the most important things when you provide feedback?
8. How would you describe the purpose of the co-authoring tasks in this field? Why does the collaboration matter?
9. How would you characterize your role in the co-authoring task?
10. What do you hope your students learn from the collaborative writing project?
11. What processes in collaborative writing do you think would be most challenging to multilingual students?
12. While working with a multilingual student in a co-authoring project, what are the most memorable things?
13. Would you explain your typical ways of providing feedback in collaborative writing?
14. Would you explain the focus of your feedback in drafting and editing stages?
15. What concerns have you had during your collaboration in this project?
16. What are the major decisions that the first author needs to make in co-authoring projects?
17. Reflecting on your past collaborative experience, what strategies have you developed and how did those strategies help developing your writing skills?
18. What are your expectations for L1 and multilingual students in collaborative writing tasks?

19. What are your concerns in developing a competitive paper?
20. How would you explain learning about the audience in a particular journal or the expectations of audience? How does the awareness of audience matter in writing for publication?
21. Would you explain how 'flow' and 'narrative' in the paper may affect the overall quality of a paper? What would be your advice to develop narrative in a research paper?
22. From your experience in mentoring graduate students' research and writing, what advice would you particularly offer for multilingual graduate students who want to improve their academic writing skills?
23. What are your thoughts on designing graduate-level writing support for multilingual students?

APPENDIX C
IRB PROTOCOL

EXEMPTION GRANTED

[Paul Matsuda](#)
[CLAS-H: English](#)
 480/965-6356
pmatsuda@asu.edu

Dear [Paul Matsuda](#):

On 9/11/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Examining an out-of-class collaborative writing in an interdisciplinary research project in Science and Technology Studies
Investigator:	Paul Matsuda
IRB ID:	STUDY00010412
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"> • Recruitment script_revised_Junghwa.pdf, Category: Recruitment Materials; • BACKGROUND INFORMATION QUESTIONNAIRE_Faculty.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • consent form for faculty.pdf, Category: Consent Form; • Consent form_Graduate student.pdf, Category: Consent Form; • Background questionnaire_Student.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Form-Social-Behavioral-Protocol_Junghwa Kim.docx, Category: IRB Protocol; • interview guide_student.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

	<ul style="list-style-type: none">• interview guide_faculty.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);
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The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 9/11/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator