

IRAQI GRADUATE STUDENTS' PERCEPTIONS OF ACADEMIC WRITING  
IN THE STEM FIELDS

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By  
MAHA KADUM KAREEM  
Dr. Amy Lannin, Dissertation Supervisor  
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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

IRAQI GRADUATE STUDENTS' PERCEPTIONS OF ACADEMIC WRITING  
IN THE STEM FIELDS

presented by Maha Kadum Kareem,

a candidate for the degree of Doctor of Philosophy

and hereby certify that, in their opinion, it is worthy of acceptance.

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Dr. Amy Lannin, Chair

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Dr. Roy Fox

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Dr. Mike Metz

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Dr. Christopher N. Okonkwo

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Dr. Christy Goldsmith

## **DEDICATION**

This research is dedicated to my family. Thanks to my beloved father Dr. Kathem Kareem Ridha, who supported me throughout this long journey and inspired me to become a better person and my mother who has been the emotional support that gave me strength through good and bad times. I couldn't have done it without them. I would also like to thank the love of my life, my husband, Mohammad Omar Alasfar, who encouraged and supported me whenever I felt down.

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## Abstract

The purpose of this study is to examine Iraqi multilingual graduate PhD STEM students' experiences and perceptions of their academic writing. In this study I explore the following areas: a) Experiences that shaped multilingual STEM students' thinking about academic writing; b) Strategies students use to help improve their writing skills; and c) Factors influencing multilingual STEM students' identity as writers.

Qualitative intrinsic case study is the methodology approach that guided this study. The study consists of multiple bounded cases of four participants studying in a doctoral program in the STEM fields at an R1 Midwest university during the 2019 fall and 2020 spring semesters. I used White & Marsh's (2006) procedures of qualitative content analysis to analyze the data from the four participants.

The findings show: a) students' past and present experiences with academic writing instruction impact their writing development; b) students' academic writing improves when positive and constructive feedback is provided; c) writing across disciplines leads to unique challenges; d) students created their own writing style through reading and using model papers; e) being multilingual helps students think in their native language and write in English; and f) writing within an academic discipline influences how students think about themselves as writers. The study shows some of the writing challenges the Iraqi students faced during their program. This includes challenges with writing across disciplines and challenges with some writing elements such as vocabulary and development of ideas.

The study also presents implications and recommendations for college advisors, graduate departments, and campus Intensive English programs, including creating a positive work atmosphere as crucial for students' learning success. In addition, providing graduate students with academic writing classes and writing workshops helps improve their writing skills.

## **Chapter One: Introduction**

The task, as we see it, is to develop an internationalist perspective capable of understanding the study and teaching of written English in relation to other languages and to the dynamics of globalization. At a point when many North Americans hold it self-evident that English is already or about to be the global lingua franca, we need to ask some serious questions about the underlying sense of inevitability in this belief--and about whose English and whose interests it serves. (Horner and Trimbur, 2002, p. 624)

### **Rationale**

Before I was accepted into my doctoral program, I was interviewed from Baghdad over the phone by Dr. Roy Fox, English Education Professor at the University of Missouri. One of the various questions he asked was why I wanted to enter this program. I recall talking about the current learning and teaching situation in my country and how it needed drastic improvement and change. I felt that our educational system was behind because of the constant wars and sanctions that the country faced for over a decade. Since I had been teaching Iraqi students for over 15 years, I know they have great potential, but they needed guidance. By guidance, I mean writing instruction that are geared towards professional writing, especially academic writing.

When I came to the United States in 2014 and started working at the College of Engineering, I felt the need to continue looking for ways to help Iraqi students. They

have been isolated from the world for over 15 years. Therefore, exploring the writing skills and competence of this demographic population that was removed and set apart from the globe is important to the research communities and education. This includes addressing the academic writing experiences and needs for a group of students who not only lacked resources but also came from an educational situation that can only be described as having “curriculum materials in all fields are in short supply, textbooks are outdated, administrative authority is overcentralized, new students are poorly prepared, and the teaching staff is inadequately trained” (Harb, 2008).

Throughout the five years working at the College of Engineering, I interacted with many graduate international students especially from Iraq. The common thing I heard from them was that they need to know how to write well, especially academic writing. It seemed clear to me that they possessed the knowledge, but they described feeling behind because they did not have the means to put that knowledge in English.

In his concluding chapter on “What is “Academic” Writing?” Lennie Irvin (2010) describes that “writing depends upon how well you understand what you are doing as you write, and then how you approach the writing task” (p. 16). Understanding what to do and how to do it can only come from practice and effective writing instruction. Therefore, knowing what kind of prior writing experiences and current writing situations students have had can help us understand their writing needs and what seems to make the difference.

Academic writing also reveals the person’s ability to think and analyze the information they work with in a way that makes sense to the reader. As Bean & Melzer

(2021) explain “quite simply, writing is a process of doing critical thinking and a product that communicates the results of critical thinking” (p.4). Thus, academic writing becomes important for knowledge production and having the ability to write in an academic style is an important learning skill.

The purpose of this study is to examine Iraqi multilingual PhD STEM students’ perceptions and experiences of their academic writing. Data for this study were collected from four Iraqi graduate international STEM students studying for their PhD. The study gathered data from interviews, writing samples, model papers, and writing reflections.

### **Definitions of Terms**

The following are brief definitions of some of the terms I used in this study:

**Multilingual:** Multilingual is a term used by poststructuralists to refer to second

language learners or non-native learners. Canagarajah (2013) makes a strong argument in favor of using the term multilingual, especially when it comes to writing. He explains that our understanding of the nature of language and written texts has changed, and many don’t think of language “as bounded and separate, but always in contact and mutually influencing each other” (p. 2).

When thinking about their reading and writing, such learners often have various resources that affect their writing process regardless of the language they use (Pomerantz & Kearney, 2012).

**STEM:** STEM is the acronym for Science, Technology, Engineering, and Math.

Academic writing: Academic writing is a formal type of writing that is usually taught and used in high school and college contexts. Academic writing also differs from one language to another in terms style, format, genre. It can also demonstrate the writer's ability to present his disciplinary knowledge and proficiency through his thinking, interpreting, and presenting (Irvin, 2010).

### **Research Questions**

The research questions emerged from my interaction with graduate and undergraduate engineering students while working for the College of Engineering and through working with these students at writing workshops. In this study, I will address the following questions:

1. What experiences shaped multilingual STEM student's thinking about academic writing?
2. How do students use strategies to help improve their writing skills?
3. What influences multilingual STEM students' identity as writers?

### **Theoretical Framework**

My study builds on the theoretical frame of social constructivism which views language development as a social process where the learner constructs knowledge through social interaction (Creswell, 2013).

The substantial theoretical framework of my study that supports my thinking about the concept of academic writing within communities of multilingual graduate

STEM students include the following areas: Second Language Writing (SLW), Social Cognitive theory, and literacy theories that include disciplinary literacies, and academic literacies. Chapter two presents a detailed literature review of these areas.

## **Methodology**

A qualitative intrinsic case study is the methodology approach that guided this research. According to Merriam (1998),

A case study design is employed to gain an in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation. (p. 19)

Creswell (2007) recommends case study as a methodology if the study focuses on "developing an in-depth understanding of a 'case' or bounded system" (p. 496) with the intent to understand "an event, activity, process, or one or more individuals" (p. 496). This study is a bounded case that consists of a group of four Iraqi graduate Ph.D. students studying in the STEM fields at a Midwestern RI University. I have purposefully selected multiple cases to show various perspectives of the study (Creswell, 2013). The participants were selected through a convenient method (Creswell, 2013) where data is collected from members who are conveniently available to participate in the study.

## **Limitations**

Due to the nature of my study, certain limitations emerged. First, this study is an intrinsic case study where I aim to look at a certain group of students' artifacts and explore their experiences with academic writing in a specific context which makes my findings ungeneralizable to other groups. Second, the narrow focus is on engineering students rather than other science fields (Lincoln & Guba, 1985), even though the participants came from different engineering departments. Third, my case study was constrained by time. Even though I conducted four rounds of interviews, I felt I needed to spend more time with the participants as they had so much to say. Additionally, I was not able to obtain enough follow up questions since the data collection and analysis took place at the beginning of the COVID-19 pandemic which made it harder for me to contact the participants. Finally, the issues of subjectivity cannot be neglected here since I, the researcher, worked with a group of people and engaged in data collection and analysis that allow me to look at the participants' experiences to better communicate it to others (Hatch, 2002).

## **Organization of the Study**

This study consists of five chapters. Chapter One gives a brief introduction to the study, including the rationale, the theoretical framework, the methodology and the limitations. Chapter Two begins with a background review of English learning as a foreign language across the Iraqi educational system. Then it reviews theories and studies related to my research, including Second Language Writing (SLW) theories,



Social Cognitive theory, and literacy theories that include disciplinary literacies, and academic literacies.

Chapter Three presents a detailed description of the methodological procedure, the participants, and the data collection process. Chapter Four outlines the findings of my study based on the data analysis. Chapter Five provides a summary of the study and the results with the implications.

## **Conclusion**

Multilingualism is becoming more and more prevalent around the globe. It helps make connections and bridge gaps between various cultures. English is at the core of this connection. It is not only important for many international students in terms of opening up job employment, but it also helps them advance their career through publication, conferencing, and studying. Therefore, U.S institutions especially in the higher education level need to work with multilingual students to provide them with the opportunity to improve their English writing skills, especially academic writing.

This begins with educators showing appreciation for the work of students who study from other languages because “foreign-born students, scientists, and entrepreneurs bring fresh perspectives, diverse experiences, expertise, new ideas, and creativity” (American Physical Society Report, 2020, p.2) to the U.S. Thus, they enrich and support research at U.S institutions. It also starts by understanding the background knowledge of these students and their prior writing experiences. Furthermore, supporting multilingual students begins with what Horner and Trimbur (2002) explained

in their quote in the opening chapter, to have an international perspective on how writing is being taught and an open mind about “whose English and whose interests it serves” (p.624).

## Chapter Two: Literature Review

This chapter synthesizes the literature and research that outlined the foundation of this study and informs my thinking about the concept of academic writing within communities of multilingual Iraqi writers with focus on STEM fields. The foundation of this research is based on Second Language Writing (SLW), Social Cognitive Theory, Disciplinary Literacies, and Academic Literacies. The chapter will start with a background review of English learning as a foreign language across the Iraqi educational system. I will then look at the social constructivist context of academic writing, including the notion of discourse communities and the nature and purpose of academic writing and its context. Then I will review the theoretical influences and research that shaped Second Language Writing (SLW) and its current views that assert the importance of shifting away from comparing multilingual learners with native English writers. Then I will look at the social cognitive theory and how modeling can influence students' attitude towards writing.

Finally, the chapter will look at literacy theory that includes disciplinary literacies and academic literacies. I will review the basic concepts of disciplinary literacies and how that is transferred to the way multilingual students in the STEM fields write. I will look at academic writing from the perspective of academic literacies. This approach considers writing as a repertoire of linguistic practices which are based on complex set of discourses, identities, and values (Lea & Street, 1998; 1999) and not as a monolingual perspective.

## **The Position of English in Iraqi Schools and Higher Education**

In this study I will be exploring academic English writing using the case of Iraqi STEM students in the U.S. Exploring the literacies of such a population, after years of isolation is important to the research communities and to education that includes multilingual academic writing for this population.

In this section, I will review the teaching of English as a foreign language in public and private schools, and in the higher education system in Iraq.

### ***Public and Private Schools***

Iraqis have always placed a high value on education. The country has been considered the cradle of civilization where the first ever known system of writing was created by Mesopotamians in 3100 BC (Silberman, Bauer, Holtorf, García, & Waterton, 2012). Learning and teaching languages has always been one of the priorities of the country. Though English was first taught in 1873 in a few private schools through missionaries, it was widely introduced into the Iraqi education system during the British colonization in the First World War (Altufaili, 2016; M. Amin, 2017). Al-Chalabi (1976) notes that during the early years of introducing English, it was first taught as a second language but then it became as a foreign language (as cited in Altufaili, 2016, p. 10).

Teaching English as a foreign language, which adopted the British English as the official form of teaching and learning, started as early as kindergarten for private schools and at fifth grade in public schools and continues until high school. Students start with simple language skills such as learning the alphabet, vocabulary, and easy

forms of sentences. During middle and high schools, however, they learn more complex language skills such as reading short stories and novels and formulating complex grammatical structures (Altufaili, 2016).

Most private school teachers at that time were either nuns or Christian females and few male teachers with college degrees (Dodge, 1972; Mohammed-Marzouk, 2012). They used textbooks that were based on the grammar translation method which focused mostly on developing students' reading and writing skills through memorizing and translating words and phrases with no particular attention to speaking and listening (Altufaili, 2016). Both the public and private school sectors at the time provided the Iraqi universities with highly qualified students that possessed good English language background.

After the war in 2003, the language policies in Iraq changed according to the new occupier. Since that time, Iraqi students have been introduced to the American English language and culture. American English became the dominant form of English though K-12 and university level. Even the K-12 textbooks that were adopted from 2008-2014 used American English (Altufaili, 2016) that used the communicative approach to teaching English. In this approach the focus is on all four learning skills (reading, writing, speaking, and listening) with a classroom that is more student oriented. Additionally, English is now being taught from first grade instead of fifth grade.

### ***Higher Education in Iraq***

During the 1960s and 1970s, Iraq became the leading country in the region for arts and sciences and the center of research in language, history, and literature (Harb, 2008). Most of the faculty at the Iraqi higher education level graduated from western universities most notably Britain, France, Germany, and the U.S. These instructors sought to transfer the knowledge and educational experiences they obtained to their students.

After being admitted to the university, Iraqi students continue learning English but for different purposes and on different levels. For instance, universities and colleges that focus on STEM education use textbooks that are all written in English, while those institutions that focus on social science and humanities, except English majors, use textbook that are all written in Arabic (Altufaili, 2016). Also, choosing which university a student can attend depends solely on the student's Bacculaureate score. The Bacculaureate is a national standardized exam which scores out of 100 and all students in their final high school year must take to be admitted to a university in the country. The higher the score, the better chance the students get to attend a STEM field. This means that most science majors have had higher scores on the Bacculaureate exam, between 80% -100%. If the student took the science path which usually starts in the fourth year of high school, then they are only tested in science subjects at the final high school year (chemistry, physics, biology) in addition to math, English, Arabic, and religious education (Al-Shaikhly & Cui, 2017).

During the ruling of Saddam Hussein (1979-2003), however, the education system in general was used as a tool for political agendas. It was used to promote the Ba'ath party beliefs that called for Arab nationalism and freedom from non-Arab control and interference, especially from the West. Learning languages, especially English, was used as a tool to understand western cultures. The English curriculum was focused on listening, speaking, reading, and writing, with writing mainly focused on grammar and drilling exercises.

From 1990 until 2003, the quality of the Iraqi educational system witnessed a sharp decline due to the economic sanctions imposed on the country. Additionally, the numerous wars the country faced managed to isolate its scholars in the academic and professional fields from the research community. Such an isolation led to a decline in the quality of education, teaching, and learning environment (Ranjan & Jain, 2009). This isolation also restricted and minimized research within various academic fields including education (Halliday, 1999). In 2010, the government sent thousands of graduate and undergraduate students to US universities to study in various science, technology, engineering, and mathematics fields (STEM) as a step to improve its higher education system. According to the Institute of International Education report, the number of Iraqi students increased by 16% in 2010, which is the largest increase of Iraqi students in the U.S. since the late 1950s (Institute of International Education, 2015). Exploring the literacies of such a population after years of isolation is important to the research communities and education including addressing the academic writing beliefs and needs for this population.

## **Academic Writing**

This section provides the social constructivist context of academic writing, including the notion of discourse communities, and a review of research on the nature and purpose of academic writing in higher education. Academic writing is a nonfiction form of writing that researchers use to define their discipline with clear, concise, and structured language. It is presented through formal tone, content, style, and unique organization that vary across discipline (Nesi & Gardner, 2012) with the goal of establishing arguments based on evidence.

### ***Discourse Communities***

The notion of discourse communities was first introduced by Martine Nystrand (1982) then later developed by John Swales (1987) where he defined the term as "groups that have goals or purposes and use communication to achieve these goals" (p. 2). Such groups are categorized into three types: local, focal, and flocal discourse communities (Swales, 2016).

The local discourse community is a narrow community that includes residential, vocational, and occupational (Swales, 2016, p.12). The occupational is the discourse that is more related to a university context. Such groups work together and share a set of goals and language understanding. For example, every STEM department shares a common set of words or abbreviations that are only understood within their narrow group. For instance, SSAP, SCOP, BLAST terms used in software and database names, or IGM (inheritable genetic modification) used in biomedical research. Furthermore, such



defined groups share a set of valued systems “that determine what is seen as good and less good work” (Swales, 2016, p. 12). For example, graduate students in the STEM field become part of a local community within their department. So, they either work individually or with a team of other graduate students or both on a research project and being part of this community includes high expectations that surrounds professional conduct in research and teamwork.

The focal discourse community includes a wider range of groups that expand to national and international communities in the form of professional and recreational associations (Swales, 2016, p. 13). Such communities share a set of standard written ideas that every member should follow such as the Institute of Electrical and Electronics Engineers (IEEE), an association that develops, defines, and reviews engineering and computer science standards. For example, IEEE has different standards for every discipline. N42.32a-2022 - American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security Amendment 1, N42.43-2021 - IEEE Standard for Mobile Radiation Monitors Used for Homeland Security (IEEE standards, 2022). NCTE and LRA are examples of focal discourse communities for literacy and English language arts scholars and educators, and so on.

The folocal discourse community combines the local and focal discourse communities which means the members of such communities have dual commitments that can sometimes cause challenging demands and conflicts. For example, at the university level graduate students are required to work late hours in their labs and follow the rules and guidelines of their departments in addition to following certain

discourse norms such as using codes and symbols as ways of communicating or incorporating scientific jargon when describing certain concepts (Pogner, 2003), while also devoting time to attend conferences and publish their work in a national or international publication.

This current study fits well within the local discourse community. First, because the study falls within the occupational category which means that it includes a group of people that work together in one defined space such as a lab or a department at a university. Second, the study includes participants who are part of a community that require their members to publish several of their works in an international or national association's journal before they can submit their dissertation and graduate. Furthermore, the challenging demands come from the fact that their study programs fall within the interdisciplinary STEM program which means their writing expectations and conventions vary according to their multiple audiences.

### ***Nature and Purpose***

Understanding the nature and purpose of academic writing is critical for undergraduate college students and students who are pursuing their graduate degrees as it plays an important role in their professional and academic life. Studies show (Irvin, 2010; Cheng, 2009) that students' academic writing success highly depends on how they conceptualize or interpret their writing task: "The writers' mental model for picturing their [writing] task [makes] a huge difference" (Irvin, 2010, p.3), but sometimes their

misconceptions about writing can get in their way of producing good writing. Irvin (2010) calls these misconceptions myths of writing that he summarizes in seven points:

1. The “Paint by Numbers.” This comes from the traditional idea that writing is linear and not recursive which makes the writer believe that writing constitutes steps that a writer should follow to achieve writing success.
2. “Writers only start writing when they have everything figured out.”  
Writers wait to the last moment or start writing when they feel they have everything ready. The author explains that the reality of writing is that it could start at any point, and most frequently the writer figures everything as they begin to write.
3. “Perfect first drafts.” When writers put unrealistic expectations for their first draft, they often lose control of their ideas which most often leads to a dead end.
4. “Some got it; I don’t—the genius fallacy.” When writers put limits on their writing abilities, this will affect their state of mind which will prevent them from developing their writing abilities.
5. “Good grammar is good writing.” Some students, especially international, link writing to good grammar. Good writing, the author explains, is more related to the writer’s unique style that can affect the targeted audience.
6. “The Five Paragraph Essay.” Some writers are fixated with the idea that good writing can only be achieved with the five-paragraph essay which can ultimately limit creativity.

7. First person reference. Writers often arrive at the higher education level with the notion that writing is purely objective and informal which can sometimes lead to what the author calls “artificial, puffed-up prose” (p.6).

In addition to these myths, academic writing has always had a history of dispute on who has the responsibility of teaching writing, especially in the content areas. This resulted in ongoing conflict within writing in the academic discipline which then led to marginalizing writing instructors. Russell (2002) outlines four of these conflicts and according to him, the first two are related to the nature of writing and its acquisition, while the third and fourth are more tied to the structure of mass education and language:

1. Many in academia assumed that writing is acquired naturally; therefore, they looked at writing as a reflection of speech, versus writing as a complex rhetorical skill that differs from one academic community to another.
2. The idea deficit or bad writing is a temporary problem that can be fixed or remedied by writing “experts” through systematic writing instruction, versus writing as a development that is gradually attained intellectually and socially through practice.
3. The idea that academia is an individual discourse community versus the idea that it constitutes a set of communities, each with its own written discourse.

4. The fourth and final conflict is related to what the author calls valuing the “disciplinary excellence versus social equity as the goal of writing instruction” (Russell, 2002, p.10).

When looking closely at the nature of academic writing, we see that it constitutes a set of complex writing conditions that the writer needs to be conscious of before writing. Such conditions include thinking about the target audience, the context, and the purpose. Carroll (2002) calls such writings considerations as “literacy tasks” because,

They require much more than the ability to construct correct sentences or compose neatly organized paragraphs with topic sentences. ... Projects calling for high levels of critical literacy in college typically require knowledge of research skills, ability to read complex texts, understanding of key disciplinary concepts, and strategies for synthesizing, analyzing, and responding critically to new information, usually within a limited time frame. (pp. 3-4)

These “literacy tasks” include possessing research skills, having the ability to read and interpret complex texts, recognizing main ideas within the discipline, and creating ways to analyze and synthesize what they (students) read (Carroll, 2002; Irvin, 2010).

When undergraduate freshmen students start their program, the majority take the same general composition classes. However, they eventually end up learning writing that is more geared towards their major disciplines (Carroll, 2002).

For graduate students, writing goes beyond essays and short papers. It includes publications and writing a dissertation that requires critical thinking and deep analysis. This by itself requires the student to reach a higher level of writing. And, in order to be recognized in the scientific world, they must prove their work through publication and as most of the world's renowned scientific journals are published in English, this means that most must write their research in English. This poses a challenge for both language learners and L1 speakers of English. Such challenges come from the idea that disciplinary academic writing requires certain sets of skills and competence to produce a well-refined text that is both accepted by the academic communities and understood by the readers. Writing in the STEM fields, in particular, is both complex and has different requirements as it tends to present facts (Bazerman, 1988; Jenkins, 2006) and "serves to establish and maintain the authority of science, largely through exclusion and intimidation" (Bazerman, 1988, p. 294).

For research reports and dissertations, students generally follow a certain format in accordance with their department. However, the process and the outline is usually the same (Fox, 1994). Students usually start by gathering and analyzing their data, and finally drawing conclusions. The dissertation or research usually contains the following sections:

**Abstract.** Although the abstract is the first section, it is often written at the end because it usually contains the summary of the whole research. It is also where the writer helps the reader understand the purpose of the study.

**Introduction.** This section is also a summary of what the researcher learned from the research. It should contain a definition of the problem, background information, and the purpose of the study (Fox, 1994).

**Literature Review.** During the process of collecting and analyzing data, the researcher also reads different sources that can support their topic. In this section, the researcher tries to layout previous research and connect it to the current research topic. This section could appear separately following the introduction or it could become part of the introduction.

**Materials and Methods.** This section is the heart of the research where the researcher shows the reader what was done and how.

**Results.** This section usually answers the major questions that were proposed in the study. It is also where the researcher starts to compare the results with those of other researchers (Fox, 1994).

**Conclusion/ Discussion.** The purpose of this section is to interpret the results and explain their meanings. This section is one of the most challenging parts because “It requires analytical thinking” (Fox, 1994).

Academic writing is also important for graduate students as it pushes them to be part of a larger community of research and scholarly dialogue. Academic writing plays a critical role in socializing graduate students into the discourse of their discipline (Hyland, 2009). Such students are usually expected to have a mastery of their writing discipline when they step into the world of research. This requires a lot of practice and specialized

skills that are not always taught through graduate courses. Embracing academic discourse is a challenge to many graduate students because of “the nature and functions of discourse, audience, and rhetorical appeals often differ across cultural, national, linguistic, and educational contexts” (CCCC, 2014).

Research highlights that graduate students in the science, technology, engineering, and mathematics (STEM) fields are sometimes not equipped with such abilities even though such students are known to possess a lot of knowledge about the discourse and content of their own disciplines (CCCC, 2014). Colwel, Whittington, & Jenks (2011) explain that one of the underlying factors of why engineering students have inadequate writing skills is because of the type of writing instruction they received at the undergraduate level as the focus is more on writing lab reports and short essays than actual analysis and synthesis.

Russell (2002), however, explains that students who have a strong background in their discipline are able to overcome some of their academic writing challenges:

In the absence of conscious, discipline-specific writing instruction, students whose writing language backgrounds allowed them to learn the discourse of a discipline without such instruction were more likely to enter successfully the professions associated with it; those students whose backgrounds made conscious, discipline-specific language instruction necessary were much less likely to succeed. And because the function of language in this sorting was thought to be generalized, transparent—a matter of prior instruction aptitude,



intelligence, or dedication rather than of conscious, discipline-specific teaching—faculty rarely felt responsible for addressing the issue of language and access to professional roles. (Russell, 2002, p. 28)

In this quote, Russell clearly distinguishes between students who do not have “discipline-specific writing instruction” and those who did. It is clear to him that even though the latter do not have writing instruction, they are more likely to have success in the discipline they choose to enter because their language background immersed them to the discourse of that discipline. Meaning that it is not always about specific writing instruction but rather the knowledge and language background the students possess.

Academic writing communities, especially at the higher level, have different expectations when it comes to their specific discourse. Students within these communities are expected to be well equipped to reach the level of these expectations. Thus, different factors affect how well these students are prepared. The most important factors include students’ various experiences and practices with writing, the type of instruction they received, and having the necessary background knowledge of the writing needs of their discipline.

### ***Context***

Writing context can be anything bridging the gap between the writer and the reader, whether it is for academic or non-academic purposes. It is usually the first thing a writer considers because it will dramatically shape their text. It can even shape the way sentences are written. For example, writing an argument in a social science context

is not the same as writing an argument in a science context. Therefore, when considering the academic writing context, writers need to think about the specific constraints that can affect a written context or setting which include time, place, and community.

Understanding the context of academic writing is linked to understanding the basics of composition studies or what is also known as the new rhetoric (Burke, 1969; Perelman and Olbrechts-Tyteca, 1969). The new rhetoric is characterized by identification (Burke, 1969) and argumentation (Perelman & Olbrechts-Tyteca, 1969). Identification occurs through persuasion, which is the traditional perception of rhetoric, while argumentation aims at securing the audience adherence (Burke, 1969). From this perspective, research studies on the new rhetoric paid more attention to the relationship between written texts and its contexts, and the purpose or social function they fulfill within a specific context (Bazerman, 1988; Hyon, 1996).

In *A Rhetoric for Writing Teachers*, Lindemann (2001) defines rhetoric as "a form of reasoning about probabilities, based on assumptions people share as members of a community" (p.30). She gives another interesting definition of rhetoric that it is "a humanistic discipline which enables us to understand those choices and the process whereby we make them" (p. 34). Choices include how we react to certain types of communication whether through reading, writing, or listening. Context in this sense becomes the writer's base for creating a subject matter or a topic (Lindemann, 2001).

This leads to the topic of academic writing context which varies from one discipline to another as studies (Hynninen & Kuteeva, 2017; Kaufhold, 2015) found that the discipline was a factor in how graduate students perceived academic writing and what elements are considered crucial to their discipline. For instance, Hynninen & Kuteeva (2017) found students from the history department gave importance to grammar and idiomatic correctness when referring to Standard English. They also characterized their writing as being “beautiful” and “elegantly written.” Students from computer science, on the other hand, associated their academic writing with clarity and correctness as requirements for “good” writing within their discipline. This shows that there is a deep connection between students’ discipline and the criteria of their academic writing. Thus, it is important for graduate students to understand their disciplinary genres for them to master or develop proficiencies in their writing because without this understanding they may not be able to gain control of their writing (Bazerman, 1988). Genre knowledge helps the writer identify and target specific readers within their discipline. Not knowing the targeted audience can cause issues, for example, when publishing in a specific journal.

### ***Audience***

In addition to purpose and context, audience awareness is key to developing rhetorical knowledge (Council of Writing Program Administrators, et al., 2011). Research show that knowing the needs of your audience helps writers to make decision on what information should be included and how to present it their texts (Chesky, 1987; (Midgette et al.,2008; Campbell, 1997).

As context and purpose of writing changes according to the discipline so does the audience. This means students should have the ability to adapt according to their targeted audience. Reid et al. (1994 – 2013) explains that there are three types of audiences, the “lay” audience, the “managerial” audience, and the “experts.” The “lay” are audience who are not experts in a specific subject and don’t have specific knowledge, so they need more detailed information with definitions and detailed descriptions. The “managerial” audience are more knowledgeable than the lay audience, but they still need some background information to determine their stance. The final types of audiences are clearly “experts,” and they are mostly professional academics who are demanding in terms of the information and require evidence and accuracy, and usually follow a certain format of writing. To have the ability to adapt to certain writing situations and according to the needs of the audience means the writer has rhetorical knowledge, which is a requirement for any higher education level students.

### **Theory and Research on Second Language Writing (SLW)**

To get a deeper understanding of how academic writing plays a role in language writing theories, it is important to look at the history of Second Language Writing (SLW) and how it was affected by first language theories of writing.

Throughout its relatively short history, second language writing (SLW) did not have a specific theory of its own but rather took much from the first language learning and writing theories. So, in order to understand the current paradigm shift in SLW, it is

important to investigate the various stages that it went through and how it evolved into its current status.

### ***Behaviorist Orientation***

Influenced by one of its pioneers, Skinner (1957), second language learning and writing theories first drew most of its ideas from the behaviorist school which focused on characteristics that were structural in nature, i.e., phonological, morphological, and syntactic. The two most prominent figures in this field were Brooks (1960) and Lado (1964). This perspective emphasized habit formation through mimicry and memorization of sentence patterns that would produce small sentences and then gradually evolve into larger paragraphs. Errors were a sign of non-learning behavior and, therefore, should be avoided or corrected. Additionally, the mental process was disregarded which made teachers emphasize “drilling” exercises as a process of correcting errors and modifying difficulties that students had. Such errors and difficulties were mostly centered on sentence structure in writing and pronunciation in reading. The two most prominent approaches that were adopted from the behaviorist orientation in SLW are controlled composition or sometimes called product approach and contrastive rhetoric.

**Controlled Composition/ Product Approach.** Several approaches and studies on second language writing took structural characteristics from the behaviorist theory. For example, the product approach (Staats & Staats, 1963; Staddon, 2014), or what some call it controlled composition approach (Silva, 1990), looks at writing as a product. This

approach focuses on writing as an imitation, copying, and transformation of already existing models (Budiman, 2017; Nunan, 1999).

Such an approach shares two main beliefs: (1) language is mainly speech and (2) learning is habit formation. The former idea came from structural linguistics while the latter from behaviorism. This puts writing, for this approach, at a level of minor concern since structural linguistics scholars did not concern themselves with writing because they believed that it was a mere reinforcement for oral habits (Silva, 1990; Silva & Leki, 2004).

**Contrastive rhetoric.** A more influential study on second language writing, that took its characteristic from behaviorism, is contrastive rhetoric which was first introduced by Kaplan in (1966). Contrastive rhetoric studies look at the influence of the learner's first language and its culture on the writing process of the second language. Kaplan (1966) claims that various languages and cultures have different writing patterns which can affect the writing process of language learners when they write in another language. So, what may seem to be a norm or a standard of writing in one language may not be in another. Such differences may cause some challenges to the learner.

Contrastive rhetoric had, for a long time, a strong influence on second language writing research. It went through several phases, the first phase focused on the problem of negative transfer of first language with L2 writing. This type of study assumes that the writing pattern of one language can affect the writing pattern of the other. According to Bai & Qin (2018), the reason for this is related to the learner's pattern of thinking,

aesthetic perception and religion. Research on this idea has been further built on by some studies of Asian students. For example, Cailing (2017) found that difference between English and Chinese thought pattern influenced the way students write which can affect the organizational structure of their texts.

Mohan and Lo (1985), on the other hand, indicated in their study on academic writing that language transfer does not negatively affect their writing process. The study focused on the effect of language transfer and developmental factors on organizational problems in academic writing. It concluded that language transfer does not interfere in organizing essays but rather helps in the process.

The second phase of contrastive rhetoric had more influence on SLW as it became the dominant approach in teaching ESL composition (Silva, 1990). Silva (1990) calls it the “Current- traditional rhetoric,” while Matsuda (1997) calls it “the Static theory of L2 writing.” The study incorporates the principles of contrastive rhetoric with the current-traditional paradigm from L1 composition instruction that includes linguistic, cultural, and educational factors. The theory investigates five distinctive elements that formulate SLW: the L2 writer, L1 reader, L2 text, L2 context, and the setting in which these elements interact (Silva, 1990).

Research on current traditional rhetoric focused on comparing and analyzing L2 written texts with that of L1 writers. This perspective, however, has been criticized by many scholars (Leki, 1991; Matsuda, 1997) because of its imposing nature and view that assumes the learner’s L1 writing background influences the way learners write in L2.

### ***Mentalist Orientation***

In the 1950s the behaviorist account on language learning and writing was severely criticized by Noam Chomsky who introduced the mentalist movement into the world of education. He based his argument that languages are not learned through mimicry, and the behaviorist theory did not take into consideration the logical problem of language acquisition, i.e., “the question of how adult speakers come to know the complex structure of their first language on the basis of limited samples of language to which they are exposed” (Lightbow & Spada, 2013, p. 22). Through introducing universal grammar (UG), Chomsky suggests that all human languages are based on some innate universal principles. L. White and White (2003) explain,

The strongest case for the operation of principles of UG in interlanguage grammars can be made if the learners demonstrate knowledge of subtle and abstract linguistic properties which can neither have been learned from L2 input alone nor derived from the grammar of the mother tongue. In other words, there should be underdetermination not only with respect to L2 input but also with respect to L1 grammar. (p. 22)

The innatist perspective also hypothesizes that there is a critical period for language acquisition called the Critical Period Hypothesis (CPH) in which human beings can acquire certain language knowledge and skills at a certain early period. Lightbow & Spada (2013) claim that this, in part, explains “the logical problem of language acquisition” (p.21). Beyond this Critical Period Hypothesis (CPH), however, it is not easy



to acquire those language skills which makes it difficult for adult learners to acquire such skills and knowledge. The downside of the Critical Period Hypothesis (CPH) is that it does not explain how some adult learners are able to learn a new language and able develop some native like language skills such as reading, listening, speaking, and even writing.

This theory accounts mostly for how children acquire language. Researchers interested in second language acquisition were more focused on how adult learners acquire competence of complex grammar (Lightbow and Spada, 2013). Research on second language acquisition (H. Dulay et al., 1981; H. C. Dulay & Burt, 1974; Krashen, 1981) argue that the acquisition of language in adult L2 learners is somewhat similar to the L1 acquisition of a child. They also argue that the learner's L1 background does not affect in any way the process of acquiring another language. Additionally, they claim that errors made by both L1 and L2 are similar, which are mainly developmental factors and not language transfer errors, thus, downplaying the behaviorist idea that language transfer affects language learning.

**Krashen's Monitor Model.** The best-known model for second language writing that was influenced by Chomsky's theory is Stephen Krashen's (1981) Monitor Model. This theory presents five hypotheses to language acquisition: acquisition/ learning hypothesis, monitor hypothesis, natural hypothesis, comprehensible input hypothesis, and affective filter hypothesis.

In the acquisition/ learning hypothesis Krashen makes a clear distinction between the process of acquiring and learning a language and hypothesizes that

language is mostly acquired not learned and unlike learning, acquisition is an unconscious process. He suggests that adult learners “acquire” language the same way children acquire their first language without paying attention to the form of that language. This is best done through direct immersion to the target language. The implication of this idea leads to the understanding that good writing does not come from exposure to form and rules but from exposure to texts.

The monitor hypothesis suggests that learners draw from their experiences with language when they engage in spontaneous communication. Learning in this respect becomes a tool for editing or monitoring written text. That is, learners can use some grammatical rules they have learned for the purpose of editing and polishing their texts only. This means that learning grammar through error correction does not develop the learner’s written language form (Krashen, 1981).

The natural order hypothesis is based on first language theory that states children’s acquisition of correct forms is a ‘predictable sequence.’ That is, language learners from different backgrounds show the same natural sequence when they learn the English morphemes. So, the language rules that are easiest do not necessarily mean they are the fastest or first to be acquired (Krashen, 1981).

In the comprehensible input hypothesis, Krashen suggests that acquisition happens according to an input that combines  $(i+1)$ . Where ‘ $i$ ’ is the existing knowledge that the learner has already acquired, and ‘ $i+1$ ’ is the developed knowledge that is beyond the learner’s current knowledge which is learned through a combination of meaning and

form. The implications for this idea lead to the understanding that reading promotes written language, and learning grammatical rules is only useful for editing a written text not creating one (Krashen, 1981).

The final hypothesis is the affective filter hypothesis which proposes that there are certain internal barriers that can prevent the learner from developing his or her language such as anxiety, attitude, and motivation (Lightbown & Spada, 2013). This means that regardless of the quantity of comprehensible input, language acquisition cannot take place if the learner possesses negative learning experiences.

### ***The Cognitive Orientation***

The 1970s brought substantial changes concerning beliefs about language learning. Such changes included the belief that writing is a cognitive process, the importance of student diversity in language and culture, the distinction between home and school language, and finally giving more attention to writing in the discipline (Silva & Leki, 2004). It was not until the 1990's that theories and research from cognitive psychology began to influence theories and research on L2 writing. From this perspective, first and second language learning draws from the processes of "perception, memory, categorization, and generalization" (Lightbown & Spada, 2013, 108). It emphasizes the importance of human experiences in learning a language through processing and learning information (Lightbown & Spada, 2013). Several approaches to second language writing appeared to be influenced by the cognitive theory, process approach and English for academic purpose (EAP).

**Process Approach.** Influenced by first language scholars (Emig, 1977; Flower & Hayes, 1981; Sommers, 1980) who were more interested in how writers write, second language scholars used this paradigm in their research to understand and study the writing strategies of language learners (Raimes, 1985; Silva, 1993; Zamel, 1983). Also, in their attempt to address writing problems, more attention turned towards comparing language learners to L1. Such a paradigm revealed that the writing process used by L1 and language learners are more similar in nature (Arndt, 1987; Matsumoto, 1995; Raimes, 1985; Zamel, 1983). For instance, in a case study of the composing processes of six advanced ESL freshmen students, Zamel (1983) found that her skilled writers did not have concerns at the sentence level until their ideas had been delineated, which is something L1 writers often do. Her less skilled students, on the other hand, were more concerned with correctness and did not see composing as the creation of a whole discourse. A similar outcome was found when Matsumoto (1995) interviewed four Japanese professional writers on their writing process in an EFL context. The results found that these writers used writing strategies similar to the ones used by native English speakers.

Silva (1993), however, had a different perspective. In his goal to understand the distinct nature of second language writing, he examined several reports that compare L1 and L2 writing. The participants involved were predominately undergraduate and graduate students from different cultural and language backgrounds, with Arabic, Chinese, Japanese, and Spanish students being the dominant participants. The research revealed salient differences exist between L1 and language learners' writing in terms of

planning, transcribing, and reviewing: the language learners did less planning and had more difficulties in defining their goals of writing and generating and organizing their materials. Their transcribing was “laborious, less fluent, and less productive” (Silva, p. 668) which, according to the author, was due to lack of lexical resources. The study also found that these students also reviewed their texts less and revised more but with some difficulties.

**English for Academic Purposes (EAP).** This approach to language learning originated from two major language studies: composition studies and applied linguistics (Silva & Leki, 2004). EAP came as a response to problems related to academic settings. Silva and Leki (2004) explain that English for Academic Purposes shifted their research focus in second language writing from the writer to the reader because they believed it is much more oriented towards the academic and discourse community needs. It aims at helping international students and students whose first language is not English to adapt to the academic needs of higher education institutions especially universities and writing for research journals.

### ***Social Orientation***

The social orientation criticized both the cognitive and the current traditional rhetoric approach, especially scholars in the fields of linguistics and psychology. The criticism focused on the idea that the cognitive perspective gave much attention to the individual writer and his internal world without considering the writer’s social context (Gee, 1986; Swales, 1990). They also criticized research on current traditional rhetoric

approach for its imposing nature of comparing and analyzing second language written texts with native writers.

Two main aspects of this orientation align with the purpose of this study. These include the social linguistic approach to language and the genre-based approach.

**Social Linguistic Approach.** Scholars from this approach (Canagarajah, 2002; Gee, 2008; Holliday, 2005; Scollon, 1999) stressed that it is important to not look at language and cultural differences as an error or a deficit as this will impede the writer's ability to develop their academic writing in English. In *Social Linguistics and Literacies*, Gee (2008) argues that the basis of making meaning comes from what he calls "the cultural models" which he compares to movies or videotapes that are linked to our minds. He defines cultural models as "pictures of simplified worlds in which prototypical events unfold...They are also variable, differing across different cultural groups including different cultural groups in a society in the same language" (p. 104). These different cultural groups often share various assumptions about language use which he calls "master myths" of the social group or society. Gee (2008) explains that such cultural models have great implications on education especially for those who are language learners or those who come from a non-mainstream culture and wish to learn the "standard or dominant" mainstream language and culture. For such groups, acculturation is important, but it needs time, and it has its consequences. Acculturation can conflict in terms of "content, in how they are used, and in the values and perspectives they carry" (113). For adult language learners, Gee (2008) explains, they do not have the amount of time that a child has learning their first language. Therefore, it is

important that these learners receive appropriate instruction and ongoing practice.

Additionally, it is not a matter of learning the language by itself but also the culture, as

Gee explains:

All cultural models tend ultimately to limit our perception of differences and of new possibilities. They allow us to function in the world with ease, but at the price of stereotypes and routinized thought and perception. It is the job of the teacher to allow students to grow beyond both the cultural models of their home cultures and those of mainstream and school culture. (114)

**Genre-Based Approach.** This approach shifted away from studying students' errors and more towards understanding what students bring to the academic writing communities that come from their cultural and academic writing experiences. Such an approach also focuses on how their cultural and academic experiences can affect the way they write and the challenges that confront them as they shift into writing for academic and professional purposes (Hyland, 2003).

One of the distinctive features of this approach which bears relevance to this study is the focus on the use of model texts to help students analyze the different structures and purposes of texts within each discipline and try to replicate those features in their own writing (Peloghitis & Ferreira, 2018). Therefore, this structure is made of three phases: a) modeling, b) the teacher and the learner negotiate the text, c) the learner constructs the text independently (Hammond et al., 1992). Modeling helps the learner read and examine the structure, purpose, and the overall linguistic features

of the text. The teacher learner negotiation of the text helps the teacher to scaffold the learners writing. The final stage allows the learner to independently construct the text based on the modeling and the Co-negotiation with the teacher through choosing the topic and writing multiple drafts.

Additionally, the use of English as a global communication language in western and non-western societies has lead scholars of language to shift their view of English from a monolingual perspective to a more pluralistic perspective. That is, the monolingual view that academic English writing requires students to maintain its rules and standard conventions is no longer the only view within language research. Scholars who research on language learning are calling for the pluralization approach to the use of English, referred to as World Englishes (Canagarajah, 2006; Jenkins, 2006; Matsuda & Matsuda, 2010). This approach helps language learners to investigate their sociolinguist reality “rather than that of a usually distant native speaker” (Jenkins, 2006, p. 173). The approach considers the learners’ perceptions on their writing without looking at it as errors that need to be corrected. It also looks at writing as a process of negotiating language and co-constructing meanings through conversation as means of exploring possibilities of writing (Canagarajah, 2006; Canagarajah, 2009; Gee, 2008).

### **Social Cognitive Theory**

Given the purpose of this study, this section focuses on the social orientation from the social cognitive theory that informed my thinking for this study especially the aspect of how a person’s social and academic environment influences their thinking on



the meaning of a writer and writing. The theory also informed my thinking in terms of the aspect of self-efficacy and how modeling influences the way students write and their attitude towards writing especially negative and positive modeling and how it impacts graduate international STEM students' writing.

In his description of the Social Cognitive theory Bandura (1986) explains that "Of the many cues that influence behavior, at any point in time, none is more common than the actions of others" (p. 206). The Social Cognitive Theory (SCT) is a learning theory that was influenced by the behaviorists but differs in terms of how behavior is learned and how cognitive factors influence the learning process (i.e., it makes a distinction between learning and behavior and assumes that learning can happen without any change of behavior until something motivating happens). In this sense, SCT proposes the idea that learning is acquiring new knowledge, behavior, cognitive skills, abstract rules and other cognitive constructs (Harare, 2016).

Initially, the theory was named social learning theory by Bandura (1977) and then later changed into social cognitive theory (Bandura, 1986). The main concepts of this theory are reciprocal interaction, self-efficacy, self-regulation, and modeling. Reciprocal interactions are a series of connected human functions that include personal influences such as beliefs and thoughts, the behavior, and the environment in which the behavior takes place (Schunk & Zimmerman, 2007). For example, a person's belief about writing can affect the way they write especially when their social or academic environment influences their decisions.

The theory also proposes that self-efficacy and self-regulation are key components of students' learning achievements. Self-efficacy means possessing confidence in one's ability to produce and perform a certain set of skills (Bandura, 1997). Self-regulation, on the other hand, means the ability to generate ideas and actions that affects the process of learning new skills (Zimmerman, 2001). Modeling is the ability to pattern one's thoughts and beliefs according to what they observe which is a key element in gaining literacy skills (Schunk, 1987; Rosenthal & Zimmerman, 1978). Thus, modeling helps the learner's self-efficacy and self-regulation which are critical for reading and writing development (Schunk & Zimmerman, 2007). Teachers and peers are effective models for students.

According to this theory, knowledge is acquired through observation of the social interaction of people which Bandura calls models. Based on the reaction of the model towards the learner or observer, the learner may have a positive or negative impact towards the learning process (McLeod, 2016) that can influence the learner's self-efficacy.

Additionally, Bandura believes that a mediating process occurs between stimuli and responses which can determine whether a new behavior is acquired or not. These mediational processes are cognitive factors that can influence the learning process. Thus, proposing four steps of mediational processes:

- 1- Attention: This is the first step of the mediational process which is related to being exposed or noticing an action that grabs the attention. For example, a

teacher giving a student a useful and informative feedback versus a paper filled with red marks.

- 2- Retention: The second step is related to the memory and how much the learner stores the behavior observed.
- 3- Reproduction: The third step is related to how well the learner performs after being exposed to a certain action or reaction performed by the model. However, if exposure to the behavior and positive reinforcement is not occurring, reproduction becomes unlikely.
- 4- Motivation is the final stage of this process. It is related to the person's will to imitate and go beyond to perform the behavior. Motivation can happen if the learner sees the action or behavior as important especially if it is followed by a reward not punishment (McLeod, 2016).

As mentioned earlier, teachers and peers serve as a good example of a model and receiving feedback from such models is an important part of the learning process that helps the learner to evaluate their learning behavior. Modeling and feedback are especially important to language learners whose language and cultural background differ from the language they are writing in. Viewing research on feedback as a social process is embedded within the social cognitive theory. The feedback students receive from their teachers or instructors has a great impact on how such students perceive their writing, thus affecting their ability to write.

Studies report that academic writing challenges come from the mismatch between graduate students and their supervisors (Adrian-Taylor, Noels, & Tischler,

2007; Angelova & Riazantseva, 1998; Bitchener & Basturkmen, 2006; Casanave, 2018; Santos, 1988). The study conducted by Adrian-Taylor, Noels, & Tischler (2007), looks at the factors that help postgraduate students develop their academic writing. One major theme that emerge from this study is that effective feedback from the supervisor has a significant role in the student's academic writing growth. It helped them build up their writing strategies and boost their growth towards being more independent and autonomous writers.

The relationship between graduate students and their supervisor is also an important factor in the success of any graduate student, and it is even more important to international students as they move into a new academic environment. Research found that the source of the mismatch includes lack of feedback, or the type of feedback received from supervisors (Azman, Nor, Nor, & Aghwela, 2014; Odena & Burgess, 2017), and the type of academic support they receive during their doctoral program.

In an ethnographic examination of students' academic writing, Angelova & Riazantseva (1998) conducted a case study on four graduate international students from different linguistic and cultural backgrounds studying at a U.S. university. The study found that students who bring different writing experiences to U.S. classrooms, need assistance to adjust to the requirements of the new academic environment. This assistance, however, "depends on international students and U.S. faculty alike learning to address explicitly how academic writing conventions differ across cultures" (p. 491). Nevertheless, U.S. professors mix international students' failure to meet expectations

with poor language skills or lack of cognitive ability (Zamel, 1995). Even those who adopt a more flexible attitude say that improving students' academic writing proficiency neither is and nor should be a faculty responsibility (Trice, 2003)—putting a burden for overcoming writing challenges on international multilingual students alone.

### **Literacy Theories and Multilingual Writing**

This section will look at two major literacy theories: academic literacies and disciplinary literacy. These two paradigms have relevant connections to the current study; therefore, I will be taking up the two literacy theories as a lens for this research.

#### ***Academic Literacies***

The notion of academic literacies first started in the UK. It emerged as the number of international, as well as local students, started to grow in higher education. This growth led to the need for accommodating communities that were linguistically, socially, and culturally diverse which fits within the focus of this study (Lea & Street, 1998).

This section will look at writing at the higher education level from an academic literacies approach. Lea & Street (2006) define academic literacies as the field that is concerned with “meaning making, identity, power, and authority, and foregrounds the institutional nature of what counts as knowledge in any particular academic context” (p. 369). The approach addresses writing from a “social practice perspective” that changes within each context, culture, and genre (Lea & Street, 2006) rather than focusing on

writing skills and abilities. The pluralization of “literacies” in this sense conveys various meanings (Lea & Street, 1998, 2006; Lillis & Scott, 2015; Lillis & Tuck, 2016):

- The diversity of academic writing and its users who come from various disciplinary contexts.
- Writing is ideologically shaped by institutions, reflecting power relations.

The situation in which these social practices take place are called “literacy events,” a phrase first introduced by Heath (1982) “as occasions in which written language is integral to the nature of participants' interactions and their interpretive processes and strategies” (p. 50). This means that students’ interaction within their text includes their practices and experiences with writing and the situation in which it took place, in addition to their interpretation of their own writing which is usually related to their specific culture (Street, 2003). For STEM students, the literacy events include the various spaces in which the writing process takes place such as the university space or their residential space. Their writing within such spaces is their literacy practices which is “the general cultural way of utilizing written language which people draw upon in their lives” (Barton and Hamilton, 2000, p. 8). Their experiences can come from various past and present sources such as their home country or their current academic situation. Their interpretation also depends on their cultural, social and academic background practices. Thus, literacies in this sense become “ideological practices, implicated in power relations and embedded in specific cultural meanings and practices” (Street, 1995).

### ***Disciplinary Literacy***

Disciplinary literacy came as a result of the reading, writing, and thinking assessments that were analyzed by Professors Timothy Shanahan and Cynthia Shanahan. These assessments showed that middle and high school students were not well prepared for certain university disciplines, especially those in the STEM areas (Shanahan & Shanahan, 2012). Furthermore, students who were from socioeconomically, ethnically, and linguistically diverse backgrounds had even less progress in literacy outcomes than their peers (Greenleaf et al., 2001). However, when such students were put in an academic literacy course, they showed great progress in learning reading strategies and became more knowledgeable and confident readers.

Every discipline differs in terms of purposes, their use of genres, ways of communication, assessment of quality and precision, and use of language. When it comes to language use, each discipline possesses unique discourse structure, vocabulary, and grammatical choices (Shanahan & Shanahan, 2012). Such language components are relatively new to middle and high school students. Therefore, the need for advanced literacy instruction become important to teach to middle and high school students the knowledge and “nuanced differences in producing knowledge via written language across multiple disciplines” (Moje, 2007, p. 9).

Disciplinary literacy then, in this sense, refers to the common ways of reading, writing, thinking, and reasoning within various academic fields (Moje, 2007; Shanahan & Shanahan, 2008). The approach assumes that the basic literacy skills that students learn

at some point become less relevant in their academic field. Once these students become part of their discipline profession, the needs shift to more specific literacy abilities within each discipline. For example, kids at a young age begin to learn basic vocabularies such as book, water, chair, and such common nouns. But as their literacy advances, such words become automatic and part of their daily usage. However, vocabularies such *paradigm*, *rhombus*, *esoteric*, and *reluctant* (terms used in more complex texts in certain disciplines) become more important as students enter higher education. For this reason, it is important for middle and high school students to become familiar with such vocabularies for them to advance in their academic and professional disciplines (Shanahan & Shanahan, 2008).



Figure 2. 1

Shanahan & Shanahan's Literacy Model.

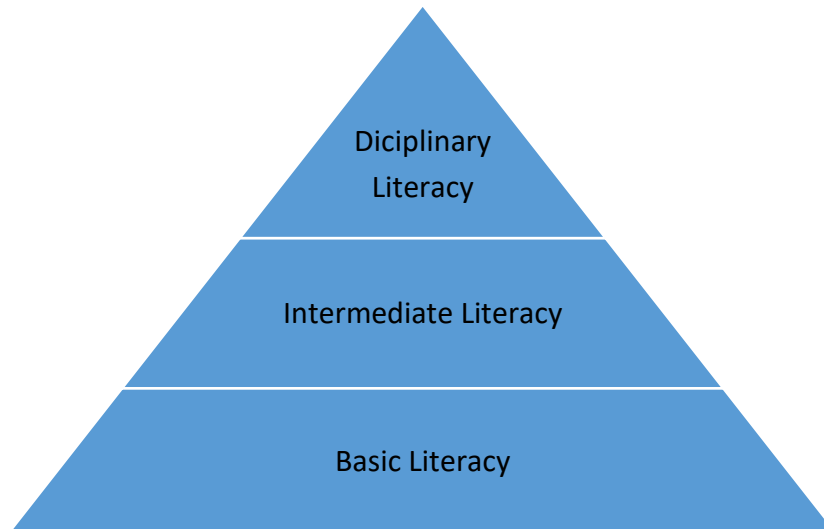


Figure 1 is a model that illustrates Shanahan & Shanahan's (2008) idea of literacy progress. The model suggests a three-layer framework in a shape of a pyramid: basic literacy, intermediate literacy, and disciplinary literacy. The base of the pyramid represents basic literacy skills such as recognizing words and their meanings in its context, recognizing high frequency words, and basic fluency routines such as more common punctuation marks, accuracy and speed. Such skills are usually obtained as early as elementary level. The middle layer is intermediate literacy where the basic literacy skills become a little more sophisticated. For example, having the ability to recognize and use more complicated words that are less frequently used in oral communications and texts, increasing their basic fluency, and become familiar in using less common punctuation marks such as colons and split quotes (Shanahan & Shanahan, 2008).

The intermediate literacy skills go beyond word recognition and fluency. These skills include reading comprehension, text organization, and critical response to complex texts that are not discipline specific. Though these skills are usually mastered by the end of middle school, Shanahan & Shanahan (2008) explain that it is not uncommon to find high school students struggle to maintain such skills.

In disciplinary literacy, the focus becomes less generalized and more centered towards a specific discipline. So, the literacy task becomes narrower at this stage as the learner becomes more acquainted with the studied discipline. However, Shanahan & Shanahan (2008) explain that students face challenges in being proficient at this level even though they have already learned the two previous levels.

The hallmark of this approach is the focus on the uniqueness of each discipline and how that plays out in the reading, writing, and language use within disciplines:

Each discipline has unique ways of asking questions and solving problems.

Similarly, each discipline has unique expectations for the types of claims that are made and the way those claims are supported. These differences play out in the ways that texts are written and in the demands those texts place on the readers.

For these reasons, we can say that each discipline has its own discourse community, a shared way of using language and constructing knowledge.

(Shanahan & Shanahan, 2008, p.73)

Disciplinary literacy puts emphasis “on the knowledge and abilities possessed by those who create, communicate, and use knowledge within the disciplines” (Shanahan

& Shanahan, 2012, p.7). Thus, it focuses on the tools that students use in a discipline to communicate or make sense of their work within that discipline. This definition has significant implications for students in the STEM fields in general and for multilingual students specifically. For instance, these students are knowledgeable in their discipline but may lack some basic and intermediate literacy skills that could help them in their academic writing skills.

Disciplinary literacy also emphasizes how language is used in different disciplines in terms of vocabulary, language patterns, and reader awareness (Shanahan & Shanahan, 2012). In terms of vocabulary, disciplinary literacy focuses on the importance of learning discipline vocabulary by understanding how and why these terminologies are used in phrases and sentences. For language patterns, disciplinary literacy looks at the linguistic difference between each discipline, such as the way point of views are displayed, the use of passive and active voice, and other linguistic difference. For example, research found that science texts tend to use nominalization in their texts whereas this is less likely to occur in social science texts (Schleppegrell et al., 2008). Finally, reader awareness focuses on how different disciplines look at the author's point of view and see whether the author is given importance during the reading process and how that is translated through writing. For example, science texts such as chemistry tend to focus more on the work itself and give little attention to the author when considering the interpretation of the text they are reading while social sciences such as history tend to focus a lot on the author when interpreting a text such as thinking about

the biases the author may bring into the text (Shanahan et al., 2011, Shanahan & Shanahan, 2012).

### ***Research on Disciplinary Literacy***

Research within disciplinary literacy shows that there is a difference in how each discipline looks at reading (Shanahan et al., 2011; Shanahan & Shanahan, 2008, 2012) in terms of the author and the content. In the social science fields, readers give importance to the authorial source in order to understand the context. In the science fields, however, the reader tends to focus more on the quality of context itself disregarding sometimes the authorial source. Additionally, and as stated in the previous section, research found that scientists pay attention to new information that was not available or that contradicts their expectations (Bazerman, 1988).

C. Shanahan et al. (2011) also revealed in their research that every discipline has its own unique written form that differs in terms of purpose, genre, artifacts, communication, evaluation of quality and precision, and use of language. For example, Shanahan & Shanahan (2012) explain that in contrast to social science texts, science texts tend to present their ideas in a form that represents a mixture of equations, graphics, and prose. Therefore, it is important that writers present their ideas in an explicit manner as they aim towards creating a text that can be built on for the future by other writers. Finally, Shanahan & Shanahan (2012) believe that if explicit instruction were to be provided for students, they would progress better in both reading and writing within each specific discipline.

In sum, both academic literacies, originated in the United Kingdom, and disciplinary literacy, originated in the United States, given that it emphasizes on changing disciplinary practices, are closely aligned with the current nature of this research. Disciplinary literacy provides a lens that looks at disciplinary discourse while academic literacies echo the latter by focusing on academic discourse, ideology, and power struggle.

### **Conclusion**

From this literature review, it is clear to me studying international graduate STEM student's perception of their academic writing is important since there are not enough studies that focus on a group that has been marginalized for many years. Such marginalization was not just because of the political and educational situation they experienced in their country but also because of the lack of resources available to researchers in reaching out to these groups.

Most of the studies that focus on groups that are similar in language background to this case study either focus on the errors and mistakes such students make in an EFL context or compare their L2 writing with that of their L1 writers. What we need to understand, and study, are the students' experiences and self-perceptions before and during their study program in addition to their writing beliefs that affects their writing without comparing or looking at their writing as mistakes or errors. It is also important to understand the discourse community-(ies) such graduate students come from as it helps us to understand the decisions they make when writing. International students

bring with them a lot of experiences as they think and write in multiple languages and understanding such experiences is an important study.

### **Chapter Three: Methodology**

The purpose of this study is to examine multilingual graduate PhD STEM students' perceptions of their academic writing. In this chapter I discuss the research questions, the methodology that guided this study, the context of the study, the data collection, data analysis, and the trustworthiness and positionality of the study and limitations.

#### **Research Questions**

The research questions arose from two main sources: my writing workshops with graduate engineering and other STEM field students, and my work with various graduate engineering students at my workplace. Through the workshop and my interaction with those students, I wanted to understand the experiences of multilingual graduate student writers. Did the workshop help in any way? What could instructors and writing program administrators do to support these students?

To answer these questions, I conducted a qualitative intrinsic case study to help guide me in answering the main research questions of the study:

1. What experiences shaped multilingual STEM student's thinking about academic writing?
2. How do students use strategies to help improve their writing skills?
3. What influences multilingual STEM students' identity as writers?

## Research Method

### *Paradigm*

Filstead (as cited in Ponterotto, 2005) defines paradigm as a “set of interrelated assumptions about the social world which provides a philosophical and conceptual framework for the organized study of that world” (p. 127). The chosen paradigm helps the researcher understand the philosophical assumptions of his or her research. It also helps the researcher choose the tools, instruments, participants, and methods used in the study (Denzin & Lincoln, 2011). My paradigm for this research is social constructivism, and the data collected is to provide qualitative case study.

Creswell (2013) explains that in qualitative study, it is important that the researcher lays out the ontological, epistemological and any other assumptions of his or her study. Since in social constructivism (Creswell, 2013; Denzin & Lincoln, 2011), the ontological beliefs are constructed through multiple lenses, my research anchors such beliefs through the participants’ various experiences and interactions with others within their disciplinary communities. While epistemologically, reality is co-constructed between the researcher and the case or issue being studied and also shaped by personal experiences.

This study seeks to explore students’ perceptions of their writing to understand their academic writing experiences. A social constructivist informed paradigm fosters the value of students’ knowledge of academic writing. Therefore, as a researcher the knowledge I am constructing comes from how students perceive their academic writing



and the type of writing processes they use within their discipline. Creswell (2007) stated that in social constructivism:

Individuals develop subjective meanings of their experiences —meanings directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrow the meanings into a few categories or ideas. The goal of the research is to rely as much as possible on the participants' views of the situation. (p. 20)

As a researcher, I seek to explore the participants' complex views of writing through their varied experiences within their academic and social communities.

### ***Approach***

A qualitative intrinsic case study is the methodology approach that guided this research. According to Creswell (2007), case study research is a qualitative approach in which:

The investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observation, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes. (p. 73)

My study consists of multiple bounded cases of participants studying in a doctoral program in the STEM fields at an R1 Midwest university during the 2019 fall

semester. The study also includes in-depth data collection from multiple sources, i.e., interviews, observation memos, audiovisual material, and written documents.

The context of this study also fits well within Merriam's (1998) definition of case study as "an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" (p. 21). The study is "bounded" in the sense that it focuses on international Iraqi students studying in a PhD program in the STEM fields. The study describes how these participants perceive and approach their academic writing, recognizing that their perspectives come from their ideologies and beliefs about language (Gee, 2008; Weber & Horner, 2018).

Understanding such ideologies means understanding their "beliefs about what language is (and what multilingualism is), how language works and how it is used" (Weber & Horner, 2018, p. 3). Therefore, the study focuses on the students' beliefs about writing which are based on their cultural and language experiences and their practices within their past and current context.

### ***Researcher Role***

As a language learner myself, I can sometimes understand some of the challenges these participants may have faced as we share similar language background and culture. Additionally, I have helped some of these students revise their papers and have given them feedback in the engineering writing workshop that was held during the summer of 2018. This gave me a sense of what some of these students struggle with when writing a research paper. On the personal level, I knew one of the participants as

we worked together before coming to the United States and knew how devoted he was to his research.

My role in this case study was also as an outsider because the students come from a different field of study, i.e., STEM fields. Their experiences with writing are much different from mine. Thus, my role in this case study was a constructivist and interpreter, who co-constructed meaning and knowledge from the participants' past and present experiences with writing.

### ***Research Context***

Qualitative research considers the importance of context as it provides a real understanding of the study. In the following section, I will describe the context of this study that includes the site, the setting and the participants.

The case being studied is a bounded system composed of four Iraqi participants studying for their doctorate degree in the STEM fields. The research took place at a Midwestern public research university with an average enrolment of 29,866 of which 1,108 are international non-resident graduate students (2018-2019). Permission for the study was obtained from the university's Institutional Review Board (IRB) November 15<sup>th</sup>, 2019. The interviews started late November 2019 and ended late February 2020.

### ***The Setting***

The setting of this study was at a Midwest university. The interviews took place in a quiet study room located at the far end of the College of Engineering library. The College has six different departments that also have sub departments. For example, in

the Electrical Engineering and Computer Science department, students would study electrical engineering or computer science or both. The four participants came from three different departments that included Biomedical, Biological and Chemical Engineering, Engineering and Information Technology, and Mechanical & Aerospace Engineering. The College also has ten undergraduate programs, nine master's programs, and seven doctoral programs. Students at the graduate doctoral level are expected to do lab work, present their research at conferences, and publish their work in high impact factor journals before graduating. Before entering their graduate programs, the international students are expected to obtain GRE and TOEFL scores set by each department. Some international students would already have their GRE and TOEFL ready before coming to the United States and other students were given a conditional admission were they had to enter the Intensive English Language Program (IEP) at the university for one or two semesters to be able to obtain the TOEFL and the GRE scores.

### ***The Participants***

This case study consists of a group of four international Iraqi graduate Ph.D. students in the STEM fields studying at a Midwestern RI University. To show different perspectives of the issue being studied, I have purposefully selected multiple cases (Creswell, 2013). The participants were selected through a convenient method (Creswell, 2013). Convenience sampling is the method that depends on data collection from population members who are conveniently available to participate in the study.

Students received a recruitment email that included information about the study (Appendix A). The letter explained the purpose of the study and what is expected from the participants, which included the location and the lengths of the interviews. Students were asked to bring one writing sample and one mentor or model paper.

After consent was received, the selected participants took a short survey to gather background information. The survey focused on their educational and language background in addition to their current status as a graduate student (Appendix B). Thus, the selected graduate students should be in the process of writing their dissertation, publishing an article or both. This means that they are not within their first year of their doctorate program. Two out of the six participants who took the initial survey were not included in the study because they were in their first year of the program.

Initially, I had six students. The number went down to four, three male and one female. The other two did not fit the criteria of the study, i.e., they were in their first year of their program. The characteristics of the participants are that they have finished their undergraduate degree in Iraq, and English is not their first language.

I have known some of these students personally, which gave me the ability to provide a thick description. Other students, I was able to gather as much information as I possibly could through the interviews and through their description of their writing. The participants seemed to be relaxed throughout the interviews except for one who seemed a little nervous.

Two of the male participants were married and had children and their families knew each other. The participants came to the United States through a sponsored government scholarship program from Iraq and met in Columbia as an Iraqi community. So, since then they have known each other both academically and personally. Additionally, two of the participants share the same supervisor.

The female participant is single and knew the male participants since she was accepted through the same scholarship program. However, her relationship is not as close since she works with the chemical engineering department and, therefore, mostly works at a different facility.

In terms of scheduling a meeting with the participants for the interviews, it was hard sometimes because they were extremely busy. They were working on several research projects from early morning until midnight in their labs. However, since they were sponsored students, they did not have the opportunity to have any type of assistantship that allows them to teach or communicate with their fellow American colleagues. Sometimes during the interviews, they would get carried away talking about their research, which showed their devotion to what they do.

For the purpose of protecting the privacy of the participants in this study, their names have been presented as pseudonyms. Following is the introduction of each participant.

**Zee.** Zee is 38-year-old single female from a middle-class family. Her father died when she was five years old, therefore she was raised at her grandparents' home with her mother. She has two younger siblings, one sister and one brother.

She finished her undergraduate degree in computer science in Baghdad and her master's degree in the United States in computer engineering. She then received an assistantship to pursue her PhD at a U.S. university. For her doctorate program, she is studying informatics and data science which is interdisciplinary, crossing paths with medical, engineering, and pharmaceutical fields.

I have known Zee since she was studying for her master's degree in computer science. She was able to obtain an assistantship and complete her PhD program at the same institution. In all the interviews, Zee was wearing the hijab, the traditional Islamic headcover. She was always smiling and optimistic about the interviews and the study itself. She characterizes herself as "researcher" who has been writing scientific writing since her undergraduate studies.

**Ray.** Ray is a single male who came from a middle-class family. He comes from an Iraqi Christian family from the city of Mosul, the capital of Nineveh governorate (province) located in the northern part of Iraq. He is currently in his sixth year of the program studying computer engineering. He finished his undergraduate and master's degree in computer engineering in Iraq. He has two female siblings, one who is also studying engineering at the same institution. His mother and father are both elementary school teachers.

I have known Ray since he first came to the United States six years ago. He was one of the graduate students who participated in a weeklong intensive summer writing workshop I facilitated. When I asked him about his Christian background, whether he is Assyrian or Chaldean, he replied he is Assyrian. Immediately I assumed he spoke the language as most Iraqi Christians did, Assyrian or Chaldean. Surprisingly, he said he never learned the language because he lived in an area where it was predominantly Arabs and therefore, he only spoke Arabic. He described his English as being “horrible” when he first came to the United States. Ray sees himself as a researcher of science.

**Ameen.** He came from the city of Baquba in the province of Diala, east of Baghdad. He is married with two kids who have also accompanied him in his doctoral journey. Ameen comes from a big family. He has two brothers, one-a soldier who died in a battle against ISIS-and three sisters all educated and with bachelor’s degrees. Both his father and mother are deceased and had no formal educational background. When I asked him about his city, he was laughing as he explained that he came from a small city in Iraq and ended up in a small city in the U.S.

Ameen enjoys long conversations and feels proud about his writing accomplishments yet still finds specific things he needs to work on. He characterizes himself as a “researcher” and gives himself a seven on a scale from 1-10 because he believes he “still have kind of issue with writing.”

**Hassan.** Hassan is a 37-year-old male married with three children. He completed his undergraduate and graduate master’s degree in Baghdad in computer engineering.



He has been in the doctorate program in computer engineering for six years. He comes from a well-educated family all living in Baghdad. He has five siblings, one brother and four sisters. I know Hassan and his wife from Baghdad as we all worked together in the same department in my previous job.

Hassan was the only participant who felt a little nervous talking about his writing. He echoed this feeling when I asked him how he would characterize himself as a writer. His response was "I don't write." He went further when asked if he does any type of writing even as a hobby, his response was, "Nope, I don't like writing in general and not even in Arabic" -- a statement that will be uncovered in the next chapter.

### **Data Collection Sources and Data Collection Procedures**

Data was collected through multiple sources in order "to capture the case under study in its complexity and entirety" (Yazan, 2015) and to strengthen and give reliability to the case study ( Merriam, 1998; Stake, 2010; Yin, 2009). Data was collected through interviews, sample of participants' writing, their reflection on their mentor or model paper that they shared during one of the interviews and follow up interview.

### ***Interviews***

The interviews included structured, semi-structured and text-based protocols spread out over four interviews. For accuracy, I used a digital camera that recorded the interview while I was asking the questions. Using the camera helped me focus on the participants to capture the deeper meaning of their answers and reaction to the questions. I also wrote down some notes about the interview and about some of the

answers the participants gave me in addition to some of their reactions to the questions immediately after the interview. In addition to the camera, I used a digital recorder and transcribed the interviews. Before the start of each interview, I allowed the participants to look at the interview questions so that they were aware of the context of the questions.

Each participant had four separate rounds of questions that lasted from 30-50 minutes. Each round focused on a specific topic that helped me understand their writing experiences. The questions were designed to cover aspects of participants' writing that includes their approaches, processes, experiences, attitudes, and general beliefs about writing. For example, in round one I focused on two main topics, writing history and writing experiences. Table 3:1 shows the breakdown of each round with their follow up round and some sample questions.

*Table 3. 1*

Interview breakdown with sample questions

Rounds	Interview focus	Sample questions
Round 1	Writing history	1. Have you ever been taught how to write academic paper in English? If so, can you explain?
	Writing experiences	2. Have you ever taken any writing classes? If so, what, where, and when?
Round 2	Writing strategies	<ul style="list-style-type: none"> <li>Describe your writing routines: how do you begin a piece of writing? what do you do between beginning and submitting? How does this vary based on the type of writing?</li> </ul>

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	Fluency	<ul style="list-style-type: none"> <li>• How easily can you put your ideas into words?</li> </ul>
Round 3	Interview on model paper Reflection on model paper	<ul style="list-style-type: none"> <li>• Why this text?</li> <li>• Which part of the text impresses you the most and why?</li> </ul>
Round 4	Interview on sample writing paper Reflection on sample writing paper	<ul style="list-style-type: none"> <li>• What would you consider as the strength of this paper? And why?</li> <li>• Do you feel there is a particular section that you get stuck with and why?</li> </ul>

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Every interview started with a normal conversation about topics that are not related to the study so that I could ease the possible tension or anxiety that might occur before the start of the interview.

Interviews in qualitative studies can help to understand what is going on in an individuals' mind (Patton, 2002). Hatch (2002) introduces three types of interviews: formal, informal, and standardized. Choosing what type of interviews to utilize depends on "the assumptions of the researcher paradigm" (p. 92). As the assumption of social constructivism is to try to co-construct meanings between the researcher and the participant within the context, the informal interview fits effectively within this paradigm.

The informal interview, which was the first part of round 1, included asking questions about the student's background such as the place of birth, family, and education. These questions were open-ended, helping to establish some common ground so the conversation developed naturally. The questions would sometimes differ

from one participant to another based on what they shared and how the conversation followed. For example, I asked questions like:

- Where do/did you live in Iraq?
- Talk to me about your family, how many brothers and sisters do you have and what is their educational background?

I conducted a formal interview which Hatch (2002) breaks into “structured,” “semi-structured,” or “in-depth.” The interviews were a mixture of structured and semi-structured for the first and second round while the third and fourth round were mainly structured interview questions that focused on the model paper and their sample writing paper, they brought with them. The structured interview involved questions predetermined by the researcher, and the semi-structured interviews were in the form of open-ended questions that can help the researcher dig deeper into the participants’ perspectives and personal experience with writing (Creswell, 2013; Merriam, 1998). The participants were also able to look at the questions ahead of the interview to familiarize themselves with the questions and think about their answers (Appendix C).

The interviews were conducted within four rounds with the first part of round 1 being dedicated to getting to know the participants. The interviews lasted between 30-50 minutes. The interviews were also recorded for accuracy and so I was able to focus on the participants and note down some of their reactions to capture the deeper meaning of their answers. The participants were able to see each interview transcription for accuracy.

Throughout the interview process, I listened carefully to the participants, transcribed their interviews, asked the participants to cross check the transcripts, read and reread each transcript, and coded them carefully. The follow-up interview took place after I had transcribed, read, and reread the interviews. For example, in round 1, I asked Ameen the following question, “what are your writing weaknesses?” Ameen answered “Uh, as I said, the vocabulary. Um, I need to develop myself by adding more vocabularies in the future.” For the follow-up questions, I asked him “Why do you think that? Why do you think you need more vocabulary?”

### ***Writing Sample and Model Article***

In addition to the interview questions, for rounds 3 and 4, I asked the participants to bring an academic paper they were currently writing and an article they use as a model for their writing. I asked them a series of questions regarding the model paper (Appendix D) and the paper they were working on (Appendix E). Then I had them write a reflection on both the model paper and the paper they were writing using the same questions I asked as a guide for their reflection.

For the sample paper, the participants were asked to bring a draft writing sample with its final version to compare between the versions. Additionally, I asked them to send me the feedback version they received from their supervisor and the writing center if they have any available. For the model paper, I asked them to bring one paper they use as a model within their discipline when writing their research.

## Data Analysis

### *Interviews*

Data analysis is primarily inductive and comparative that answers the researcher's main research questions (Merriam, 1998). In this study I used White and Marsh's (2006) procedures of qualitative content analysis. Krippendorff (2004) defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (p. 18).

In content analysis, the researcher creates analytical constructs from the text to answer the research questions. The text and the context in this sense are independent. Therefore, the researcher should draw conclusions, independently, from the texts and the context (White & Marsh, 2006). Below I explain step-by-step how I used content analysis to analyze my data:

1. Before Coding. Before the coding process begins, I started to look for emerging patterns immediately while reviewing the data to give the document a "big picture." The "foreshadowing" questions of the research are the initial guide to data analysis. For example, in this study the "foreshadowing" questions focused on the effect of culture and language on the student's writing beliefs, and their experiences and attitude towards academic writing.
2. Coding Documents. During the coding process, emerging codes were identified through sub-components of the "foreshadowing" questions. The emerging codes were culture, language, writing approach, experiences,

attitudes, writing beliefs, and writing process. I gave each code a corresponding color to make it easier for me to differentiate between each code. Then, I re-read the texts to see the bigger picture of the data and highlighted the “tag phrases and text segments that correspond to those questions” (White and Marsh, 2006, p. 37). Additionally, I paid attention to unexpected text segments that might appear during the initial coding process, and I gave such segments a different color and coded it as “other.”

3. Refining Categories/Themes. At this point, I started to categorize all the codes into main themes and sub themes. Table 3.2 shows content analysis step-by-step process with examples from the study.

*Table 3. 2*

Content Analysis step-by-step process

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Steps	Process	Example
Before coding	<ul style="list-style-type: none"> <li>• Making initial constructs from the research questions. In the research questions, the initial constructs are underlined.</li> </ul>	<ol style="list-style-type: none"> <li>1. What <u>experiences</u> shaped international STEM students’ <u>thinking about academic writing</u>?</li> <li>2. How do students <u>use strategies</u> to help <u>improve their writing</u>?</li> </ol>

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3. What influences multilingual STEM students' identity as writers?

- |        |   |  |
|--------|---|--|
| Coding | <ul style="list-style-type: none"> <li>• Identifying sub-components or categories through aggregating the text then tag and highlight phrases related to the sub-components. The sub-components are:           <ul style="list-style-type: none"> <li>- students improve writing</li> <li>-writing process</li> <li>-student experiences</li> <li>-strategies students use</li> <li>-influence on identity</li> </ul> </li> <li>• Note down unexpected phrases that are not related to the sub-components.</li> <li>• Look for similarities and differences within the tagged noted phrases and lump them into labeled categories.</li> </ul> | <ul style="list-style-type: none"> <li>• This is where I start to identify sub-components from the interviews and highlight and tag phrases that are related to these sub-components. For example, I color coded the following sentence in red and tagged it as writing process, “usually I start with, yeah, I start with the main topic. I go like, since I will, Oh, I will have to do like some literature review. I'll start there.”</li> <li>• Additionally, I also tagged unexpected phrases that are not related to the sub-components. For example, time management was an unexpected phrase that went under the “other.”</li> <li>• Next, I categorized similar phrases together and gave them a label.</li> </ul> |
|--------|---|--|
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Refining Categories/Themes	<ul style="list-style-type: none"> <li>• Identify the labeled categories into main and sub themes. Main being the stronger themes and sub-themes being the weaker.</li> <li>• After identifying the themes, ensure that “confirming” and “disconfirming” evidence have been considered as the researcher presents his or her interpretation. This process may suggest new questions that have not been considered during the analysis.</li> <li>• Cross-case analysis will be conducted to examine the emerging themes for possible</li> </ul>	<p>For example, for phrases that were related to words, meanings, I labeled them as vocab.</p> <ul style="list-style-type: none"> <li>• At this stage I started to identify and label the strong and weak categories into themes that should be able to give answers to the research questions.</li> <li>• Then made sure that “confirming” and “disconfirming” evidence have been considered. However, no new questions have been considered after this stage.</li> <li>• Cross case analysis has been made between each case to see the similar and different themes that emerged from this process. For</li> </ul>
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similarities and differences  
across cases.

example, I found similarities and  
differences in the types of  
feedback each participant  
received.

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### ***Writing Sample and Model Article Within Data Analysis***

For the writing sample the participants were working on, their reflections on these writings, and on the model article, I looked back at the interview transcripts and identified writing elements that emerged. I listed these elements in a rubric, see table 3.3, and analyzed these in their writing sample, model paper, and reflections.

The rubric, in this sense, becomes a lens that gives me the language and the terms that describe the writing. Then I looked at the writing to see the alignment. This step gives me consistency with each participant to see how they compare across their descriptions of writing. Table 3.3 shows how the rubric was categorized and analyzed according to the types of writing sample.

*Table 3. 3*

Analysis of writing sample and model article

Writing elements from interview	Type of writing sample	Notes
Organization	Writing sample	-Lacking thesis statement Include too many ideas to reach the main point. - Minimal use of transition words

Clarity		-Nonlinear writing
Vocabulary	-Writing sample	-Not using the correct vocabulary
	-Reflection on model paper	-Not using the accurate word for the sentence.
Grammar	Writing sample	-Nominative sentences.
Visual language	-Writing sample	-Using various images to describe the results, discussion, methods sections
	-Model paper	

Additionally, when comparing the model article with the sample writing, there seemed to be similarities in the idea, structure, and style of writing. For example, in the opening methods section of one of the model papers is the following paragraph:

The MAINMAST procedure. MAINMAST consists of five steps (Fig. 1): (1) identification of local dense points (LDPs) in EM density map by the mean shifting algorithm; (2) Connection of LDPs to a MST; (3) Generating many tree structures by at tabu search; and (4) for each of the trees, aligning and rectangle marks the first part of the fully automated approach evaluating the protein sequence in two directions by the threading score. (5) Finally, top scoring models by the threading score undergo refinement using. (Terashi & Kihara, 2018, p.8)

In the sample paper, the methods section starts with the following paragraph:

DeepCryoPicker consists of two components (Fig. 7): (1) Component 1: fully automated training particles selection based on unsupervised learning; (2) Component 2: fully automated single particle picking based on deep classification network. The orange rectangle marks the first part of the fully automated approach “fully training particles section and dataset generation” while the blue rectangle marks the second part “fully automated single particles picking”. The rest, green and gray rectangles marked the first and second stage of the processing step.

In this comparison, we notice that the participant based the structure and style of writing of his paper on the model article, which shows that this process is guiding the participant in developing his writing skills.

### **Trustworthiness**

Validating the findings is one of the most essential processes in any qualitative research and, according to Guba (1985), one of the key components of a qualitative case study is establishing data trustworthiness. This study sought to strengthen all elements of trustworthiness listed below.

### ***Credibility***

Lincoln and Guba (1985) define credibility as “an evaluation of whether or not the research findings represent a credible conceptual interpretation of the data drawn from the participants’ original data” (p. 296). Various qualitative scholars also indicate that there are several strategies that a researcher can follow to make sure their

research has credibility. Below are the strategies I have adopted and used to give credibility to this study:

**Prolonged Engagement.** In qualitative research, prolonged engagement (Guba, 1981; Lincoln & Guba, 1985; Merriam, 1998) is recommended between the researcher and the participants in order to first establish a relationship of trust, and second, to gain an adequate understanding of the case itself. Prolonged engagement was reached in part through interviews and follow-up meetings. The initial interview began with informal questions that focused on the participant's family and personal background. Then through the rest of the interviews, we usually began with a friendly conversation that focused mainly about their future and how they are coping through their doctoral program. Such conversations connect and create a sense of trust between the researcher and the participants.

**Triangulation.** It provides the researcher with multiple interpretation which can be achieved through the use of multiple data source and multiple methods of data collection (Denzin, 2009; Merriam, 1998; Stake, 2010). In this study the multiple methods of data include interviews, observations, and written sample documents. Multiple data source comes from comparing and cross-checking data that was collected from the multiple methods of data (Merriam, 1998).

**Peer Debriefing.** This involves people outside the study such as a study program colleague or a supervisor who is willing to investigate the study and ask questions and think outside the box. Such questions can be related to the methods used, the data

analysis, the emerging conclusions and findings and so on. This process helps the researcher maintain honesty in the research and point out issues that might need future investigation or explanation. I had various conversations with my supervisor and one of my colleagues about the interviews and data. My supervisor read nearly all the interviews and analyzed them. Then, I matched her analysis with mine. I also gave my colleague several samples of the participants' writing to analyze and look for writing elements, then I compared them with my analysis.

**Member Check.** Member check (Merriam, 1998) is where the participants validate the data and provide feedback after it has been transcribed. After each interview, I took the data and tentative interpretations back to the participants and checked with them to see if my findings and interpretations were reasonable and within their scope of meaning.

**Thick Description.** Trustworthiness was also achieved through thick description of the phenomena that is being studied (Merriam, 1998). Thick description usually helps the reader to understand the case and determine transferability (Lincoln and Guba, 1985; Merriam, 1988). I tried my best to describe each case thoroughly as a whole through showing their voices, feelings, and actions. For example, in my analysis I wrote,

Zee describes herself as being self-taught when it comes to writing in both Arabic and English. She explains:

I don't remember. No, I don't think anyone taught me how to write academic paper in my first language but I kind of try to learn by reading

papers or I try to like to find how they are, those people write. How they are writing and then I try to figure out the way to write about my own stuff in the same way. And, also, I read many books before in my first language. So, kind of taught myself actually. (laughing) Yeah. (Zee, Interview, December 23, 2019).

### ***Positionality***

Positionality is mostly related to the conflict between emic/etic perspectives in qualitative research. Merriam et.al (2001) define positionality as “determined by where one stands in relation to ‘the other’” (p. 411). For this study, “the other” are the participants. Therefore, I acknowledge my positionality and the ways in which it might influence my interpretation of the data.

The elements of positionality include, “education, gender, sexual orientation, class, race,” (Merriam et al., 2001, p. 412). As a researcher, I acknowledge that I am a female graduate student studying English Education. I come from an educated middle class Muslim family from the Middle East. My own experience as a language learner likely biased some of my interpretation of the data as I share the same cultural and language background as the participants. That said, this bias gave me an insight into the participants’ experiences with writing that helped render the data and the analyses that lend themselves to this qualitative approach.

Although I gained my bachelor’s degree in English language and literature and my master’s degree in English literature from Iraq, I struggled with some writing aspects

due to the nature of the educational system that did not give importance to writing. In addition to this, the period in which I received my degrees was during the economic sanctions that were imposed on Iraq from 1990 till 2003. During that period, I witnessed how the educational system declined until the war in 2003. Additionally, when I first started my graduate program in English Education in the United States, reading was not an issue for me, but I had difficulties synthesizing articles and difficulties in developing some of my ideas when writing a literature review.

As a researcher, I made sure to keep notes that point to the perspective of the participants in addition to the multiple data sources that were collected, member checks and debriefing with some of my colleagues to minimize my personal biased opinions that helped me make meaning of the data.

### **Limitations**

Like all qualitative studies, this study has certain limitations. First, the narrow focus on engineering students instead of other STEM fields (Lincoln & Guba, 1985). Throughout the four rounds of interviews conducted with the participants, the time spent with them may not have been enough. It takes time to understand a person's views and perceptions towards their writing especially when there are some contradictions or when you feel the participant is sometimes overreacting. Additionally, I was not able to obtain enough follow up questions since the analysis took place during the COVID pandemic which made it harder for me to contact the participants. It would



be an additional benefit to see how their writing process evolved throughout their program.

## **Chapter Four: Findings**

The purpose of this study is to examine multilingual graduate PhD students' perceptions of their academic writing in the STEM fields. During the study, four graduate students talked about their past and present academic writing experiences within their discipline. They also provided a sample of their written draft, a sample article from their discipline and wrote a reflection on both their draft and their sample article. In this chapter, based on the data collected, I will present the findings according to the main research questions:

1. What experiences shaped multilingual STEM student's thinking about academic writing?
2. How do students use strategies to help improve their writing skills?
3. What influences multilingual STEM students' identity as writers?

### **Overview of Methodology and Data Analysis Procedures**

To answer the above questions, I conducted a case study involving four Iraqi PhD students studying in various engineering fields. From late November 2019 to late February 2020, the students took part in the study. All four students completed four separate interviews about their writing. They submitted a sample draft and final version of their writing and a model article from their discipline. Additionally, they wrote about their sample writing and the model article. The primary source of data was from their interview about their past and present writing experiences.

## **Overview of Data Analysis Procedures**

I began analyzing data early in the study by reading students' interviews after transcribing them. I also wrote notes throughout the analysis and through observing the video interviews. I analyzed the data through looking for emerging patterns and then started coding these patterns looking for main and sub themes. Then I went back and looked at my literature review and started to categorize all the emerging codes into main themes and sub themes. I included codes based on White & Marsh's (2006) procedures of qualitative analysis. I also created a framework of writing elements that were mentioned in interviews. I used this framework as a rubric to analyze the writing samples, model article and the reflections. The rubric, thus, framed the language and the terms that were used in the participant's writing.

## **Overview of the Findings**

In the "Methodology" chapter, I introduced the four participants in this study: Zee, Ray, Ameen, and Hassan. In this chapter, I will start by contextualizing the data through providing information about the participants' situations. Then I will present my findings through answering the research questions by conducting a cross-case analysis to examine the emerging themes and sub themes for possible similarities and differences.

The results of the study are organized into the following categories: a) Experiences that shaped multilingual STEM student's thinking about academic writing; b) Strategies students use to help improve their writing skills; c) Factors influencing

multilingual STEM students' identity as writers. Then I present the findings from the participant's writing sample, model paper, and their reflections which have been cross analyzed with their interviews.

### ***Contextualizing the Data***

Before presenting the findings of this study, it is important to provide information about the respondents' situations. This is important because it adds a layer of background information about each participant. Information about who they are and where they stand in terms of their academic situation helps us to generate insights that are relevant to the data of this study.

**Zee.** Zee describes herself as being self-taught when it comes to writing in both Arabic and English. She explains:

I don't remember ... anyone teaching me how to write academic paper in my first language but I kind of try to learn by reading papers or I try to like to find how they are, those people write. How they are writing and then I try to figure out the way to write about my own stuff in the same way. And, also, I read many books in my first language. So, kind of taught myself actually. (Zee, Interview, December 23, 2019)

She defines her writing style as being simple and devoid of jargon. However, she admits that this could sometimes be a problem as she believes simplicity may not make her writing look professional. Therefore, she believes that her writing should sometimes include jargon. Then there is the lack of vocabulary that she feels makes her writing look

less professional and less interesting. She prefers to use simple words because she doesn't have confidence in using complex words and is not used to using them on a daily basis.

In describing her writing style, Zee talks about how her writing mostly starts from general to specific ideas which means she has the ability to develop her ideas smoothly though introducing a general statement, then adding details that becomes more specific. This process was noticeable in the writing samples she brought with her. In the Introduction of the sample article, Zee notes in the margins of her paper her writing progress as she moves from more general topics to more specific ideas and what each paragraph stands for. For example, the first paragraph represents a general explanation of the research topic while the second paragraph represents the work of others on the same topic. The third and fourth paragraphs link the earlier paragraphs to her own work.

Innovation is important in her field. Therefore, Zee tries to present her work in a way that "reflects the importance of my method and my finding," (Zee, Reflection, February 18, 2020). This is why she has issues when writing her results section. She explains that the issue is making sure she presents her results in a way "that makes my finding appreciated in the field and for the targeted readers" (Zee, Reflection, February 18, 2020).

Zee also considered her teaching experience as another factor that influenced her thinking about academic writing. Before coming to the United States, Zee taught at

an Iraqi college level institution for five years. This experience she explains taught her that writing clear and simple style is more effective than writing jargon. She explains that her students always understood clear and simple texts and that this experience made her think about her own writing style.

Zee feels comfortable writing in English when it comes to academic writing, and this is not surprising as she has been writing in her discipline since her undergraduate studies. Most of her writing, however, ranged from lab reports, exams, and graduation papers. Zee did not, however, receive any type of feedback on any of her writings in the past because they were written in English, a “second language” (Zee, Interview, December 23<sup>rd</sup>, 2019). That is to say, English is a second language, therefore, it was not given any importance or priority by her instructors in Iraq.

When it comes to non-academic writing, however, she feels more comfortable writing in her first language, Arabic. She explains that this is the language she learned and enjoyed reading and writing. She enjoyed reading books in social science like history, sociology, and parapsychology. She also used to enjoy writing poetry in Arabic when she was young, but she was too shy to allow anyone to read her poems and that is why she discontinued writing.

**Ray.** Ray generally has a shy and quiet personality but speaks with passion about his field of study which focuses on the use of artificial intelligence in the medical field. This is an interdisciplinary field that crosses paths with other medical and STEM disciplines.

Even though Ray never received any type of writing instruction in Arabic, he believes that his Arabic writing is good as “it comes out directly. I don’t know, I don’t think about it. So, it just like, I start like talking directly in Arabic, so I’ve never like. You know, like this is my language. So, just talk directly” (Ray, Interview, December 23, 2019). The idea that “it comes out directly” seems to show that he believes fluency comes naturally when born into the language.

Nevertheless, Ray has never written any full academic paper in Arabic but has written mostly in English and within his discipline. His writing during his undergraduate and master’s degrees was limited to some lab reports, a small project, and a capstone. The feedback he received was minimal and only focused on grammatical mistakes with no instruction on how and where to begin writing or even how to brainstorm and organize his writing.

Time management seems to be an issue for Ray as well. Since Ray spends most of his time doing lab research, when it comes to writing, it is always done at the last moment which doesn’t give him much room for feedback, revision and editing. As he explains:

My first paper that I wrote was for a conference and my writing wasn't good that much, but it was like I was like in a limited time. So, it's like I have to submit the paper as soon as possible because it was just like I had seven days. Maybe no, I had like about 20 days to write it, but then I didn't submit it to the last moment. So, my supervisor read it very quickly and then we submit it. (Ray, Interview, December 23, 2019)

For Ray it is easier to write about his work because “I worked on it. So, I know what I have to say about it” (Ray, interview, December 23, 2019), but the difficulty comes when writing something that is more related to other people's work or just writing in general. He talks about the difficulty of writing the introduction, abstract and conclusion which is where most of the feedback from his supervisor comes from. For example, the abstract section is difficult to start with, so he leaves it to the end because it's hard for him to summarize all his work in few sentences. He explains, “I have to be careful about it [introduction] and I have to write it in a good English, good grammar, and I have to put everything like in few sentences. The same thing for conclusion,” (Ray, Interview, December 23, 2019). We see that Ray is cautious and apprehensive regarding language and grammar issues especially when he is synthesizing information from others' work and not just presenting his own. This is why he has issues when writing the introduction, literature review and conclusion as these sections go beyond documenting one's research and collecting, sorting, and analyzing data to answer major questions (Fox, 1994). It involves reading sources, analyzing, synthesizing, summarizing, and then connecting (Fox, 1994). This was clear when I asked Ray how he felt about his writing skills. He explained that “for the introduction, I have to go through like general things. Then I have to like go smoothly, uh, to, to my, like precisely to my paper, to my research. I mean, what I would like to go through. So, it's like the production is very hard” (Ray, Interview, December 23, 2019). Again, this brings us back to the idea that it is easier for Ray to write about his own work, but he has difficulty connecting this to



other research. Some writing elements, such as development, appear to be the main cause of his writing struggles.

The method section, on the other hand, is the easiest part as it is easy for him “to explain the experimental results” (Ray, December 23, 2019) because it is his own work, and he knows the specific steps, so it is easy to write about. He also mentions that it is easy to write the method section because it includes a lot of charts and tables which means visual elements help him develop his ideas and simplify complicated textual descriptions.

Ray also talks about the challenge of using vocabulary. He feels he has limited vocabulary range and more specifically with words that he does not use on a daily basis and words that are not related to his discipline. To overcome this, he explains that he uses descriptive language to explain more. He gives me an example of a water bottle and explains it as “the thing that students usually have, and they put their water in it. I usually drink water from it” (Ray, Interview, December 23, 2019). When writing, he tries to find the equivalent word in Google or sometimes a dictionary but makes sure that he is using the correct meaning. Though this may seem to be a long process for understanding difficult vocabulary, Ray feels it is helping him to gradually develop his vocabulary skills.

**Ameen.** He has a bachelor’s degree in software engineering and two master’s degrees in software engineering and computer engineering from Iraq and another third master’s degree in ME Master of Engineering from the U.S. His PhD program is also in

software engineering. Ameen was in his final semester when I interviewed him. He graduated with a PhD in software engineering and was getting ready to graduate and apply for post doctorate positions.

Although Ameen never had any writing experience or received any writing instruction in Arabic or English, he still feels that he can articulate himself “fluently” in Arabic because he feels it’s a talent he possesses. He describes writing as:

A talent. You cannot learn how to make, how to draw a picture in work, like for example, I can write a piece of paper that can make you fly in a different world. This is not easy you know, when you read these things. I imagine myself in that specific picture that you put me in. So, I kind of, um. I want for a future. I want to educate myself to do the same thing with English, not just in Arabic. (Ameen, Interview, January 15, 2020)

His ability to write creatively with vivid imagination in Arabic and his perseverance and determination to do the same in English is probably one of the reasons why Ameen was successful in developing his academic writing skills in English.

Ameen created various reading and writing strategies to help him cope with the challenges of academic writing. Such strategies include keeping old copies of his earlier writing to track his progress, keeping notes of any feedback he receives from his supervisor and the university writing center, and any editorial feedback he receives from various reviewers.

Ameen feels that using charts and tables helps him to start his writing especially when he reaches to the point where he is unable to brainstorm his ideas. He outlines his paper by creating flow charts and tables for each section to help him organize his ideas.

Ameen also believes that writing is a skill that cannot be learned easily but needs time and effort. He explains that when he entered his doctorate program, he had to do a lot of writing which is something he did not do in the past. This time spent writing early in his program helped him to overcome some of the barriers of writing in academia.

When comparing how he felt about his writing when he first began his doctorate program with how he characterized himself after a couple of years of writing, we see great progress. He used to have difficulty in “being consistent,” and he said that he usually wanders off topic. Now, he believes his writing is clear and concise and his reader is able to understand his writing from the beginning.

His weakness, however, is his inability to generate a variety of vocabulary, which is something he pointed out several times throughout the interviews. When I asked him what type of vocabulary he needed more, he explained that he didn't want to repeat his ideas with the same set of vocabulary as this will derail his readers away from his writing. He wanted to have the ability to generate different vocabulary for the same set of words to make his writing more elegant and professional.

This awareness of word choices illustrates that Ameen is also interested in his audience. He explains that he always thinks about his reader and tries to put himself in

the mindset of the reader. This process helped him to make his writing clearer in addition to making his revision process much easier.

Ameen believed that writing to is a logical process where the writer sets forth his writing goals through organized steps. For Ameen, it is important to write down the steps you take towards writing a paper and follow them in a “logical” (Ameen, interview, February 6, 2020) way. For example, when he is writing a research paper, he always starts with the introduction then moves to the methods section, experimental results, conclusion and ends with the abstract. He also likes to start writing by describing his tables, flow charts, and equations as it helps him to get a good start and brainstorm his ideas.

**Hassan.** I have known Hassan and his family for over 10 years since we worked together in the same institution in Baghdad for about 4 years and then we travelled to the United States in the same year to pursue our doctorate program. Throughout those years I have known Hassan and his wife professionally when we worked together, and my relationship with them became more personal when we moved to the U.S. Hassan is always professional and attentive when given any task. He likes to go into detail and explain every step he takes. This is something I have noticed when he talks about his experience with writing. When I first started scheduling the interviews, Hassan was very hard to reach. Since his research focus is on the use of camera sensors in the medical field, he spent most of his time working at a university hospital lab. Sometimes he would be there until midnight. I even had to call his wife to get him to schedule a date for the interview.

Although Hassan does not consider himself to be a writer, I am going to call him the writer-researcher because of his passion for firsthand research. Despite this passion for research, he shared apprehension about writing. I wanted to understand where his fear and anxiety came from by digging deeper into his history with writing right up to the present.

From day one of the interview, I could sense Hassan felt nervous in talking about his writing. Every time a question about his writing experience came up, he would first smile then laugh and pause before answering my question, which was simply, "I don't write." He explains, he doesn't like writing and always leaves writing until the last moment because he is too nervous. When it came to talking about his research, he would go on nonstop explaining details in a way that made me understand what he was doing. He was good at that. So, to make Hassan more comfortable, we sat in the library for a couple of minutes and started catching up and talking about life, work, research, and his children. Once I felt he was more comfortable, I started recording our conversation.

Hassan does not see himself as a writer. He does not like writing in general whether it is in Arabic or English. Most of the time Hassan feels that he has to figure things out by himself when he is writing. This was clear when he was talking about his struggle when he was writing his master's thesis which shows that the focus was only on grammar:

I have to figure it out of myself. I have to write something and then send it to the advisor. At that time, for him it was just like the grammar thing. He will check the grammar more than anything else. He doesn't care about... just your sentence structure is right. It's not about like help to connect your idea, how you express it, or sometimes it doesn't make sense. You aren't saying or repeating stuff. Nobody cares. So just they will check it, make sure, and they point out the grammar thing only and punctuation also. So that's it but not about the ideas. (Hassan, interview, February 3, 2020)

Time management is an issue for Hassan. Since he spends most of his time doing research in the hospital lab, when it comes to writing, it is always done at the last minute. Since he relies more on the reviewers than his advisor for feedback, writing became the last step in his research.

There is no doubt that there is some growth in Hassan's writing as he recalls writing his first paper and comparing that to his current paper. He feels constant practice is helping him. He has used some online resources such as Grammarly and some on-campus services to help him overcome some of his writing issues. However, Hassan doesn't feel that such resources are enough to make him a better writer. He knows writing is much more than grammar and feels discontented about his current situation.

## **Research Questions Findings**

In this section of research findings, I will present the results of the inquiry which are organized into three categories to answer the research questions: a) Experiences that shaped multilingual STEM student's thinking about academic writing; b) Strategies students use to help improve their writing skills; c) Factors influencing multilingual STEM students' identity as writers. Then I present the findings from the participant's writing sample, model paper, and their reflections which have been cross analyzed with their interviews.

### ***Experiences that Shaped Multilingual STEM Students' Thinking about Academic Writing***

Analysis of the data brought out three types of experiences that shaped participant's understandings of academic writing: Students experience with academic writing instruction, the type of feedback students received from their advisors, and the challenge of writing across disciplines.

**Experience with Academic Writing Instruction.** Writing instruction was one of the major themes that emerged from this study. I found two sub themes that show what type of writing instruction students received during their academic career, a) prior writing instruction, and b) present writing instruction.

***Prior Writing Instruction.*** Participants previous language experiences were limited to understanding grammar rules, writing through imitation or mimicking, drilling sentences, and no formal reading or writing instruction. Although they did write in both

languages, they came from a classroom culture that embodied a traditional education system in terms of learning and teaching. This began as early as high school and continued to the college level.

This type of classroom culture has political and economic roots. Although Hassan, Ray, Ameen, and Zee came from a culture that prioritizes education, the political situation they lived in limited their exposure to student-centered teaching and learning. That is to say, the culture prioritizes the products of education like perfectly completed writing or the degree that comes from it, but not necessarily the processes the participants go through that makes them stronger writers in English, or in any language. All four students mentioned that they were never given any meaningful type of writing instruction in Arabic or English.

Since I wanted to know what type of writing experiences these students had within Iraq, my question focused on their writing in both Arabic and English. Hassan immediately pointed out that he doesn't like writing in both Arabic and English, and the reason for that was that he had never been taught or given proper instruction in either language. In the interview, I was trying to find out about writing in Arabic, but Hassan kept focusing on writing in English:

H: That's the problem maybe. No. I don't remember having any academic instruction on how to write. You have like guidance generally guidance. For example, in order to write, you have to use... to address like use passive voice.

M: This is in Arabic?



H: Oh Arabic! Uh, no. We usually need to write in English, I think even in college because I'm engineering so everything in English like back in undergrad. ... Usually, I don't do well at this. That's, I tried to memorize the thing.

M: This is in Arabic?

H: English. We are still talking about Arabic? I don't have any Arabic writing like even in academic writing. I don't remember that I had any. (Hassan, Interview February 3, 2020)

Hassan in this conversation keeps his focus on his writing in English even though my question was focused on his Arabic writing experience. He did not have much to say about his first language writing experience as he did not seem to have had such instruction.

The only writing instructions he received, which he calls "general guidance," were mostly geared towards sentence structure, and his only way of understanding this is through memorizing sentence patterns. He provided an example of what that looks like and explained:

They give you guidance. The guidance is different from content ... I know how to do some connected words but like no proper teaching or, I don't have like one-to-one thing. I write, and somebody will score my writing or give me feedback. So, I never had this. So, this is what the issue was before I came and still issue. (Hassan, Interview, February 3, 2020)

The meaning of guidance here is focusing on grammar and syntax rather than content, which he clearly distinguishes. Thus, writing for Hassan has become a product. So, rather than writing as part of the thinking and process of writing, he is more focused on the finished product (Silva, 1990, Staddon, 2014). This has been an issue for him in the past and present.

When it came to talk about his writing experience with English, Hassan had a lot more to say as English writing seemed to be more dominant than Arabic. He indicated that throughout his undergraduate program his writing was only in English, but “nobody expects you to write a paper for your undergrad” (Hassan, Interview, February 3, 2020). Therefore, he only wrote lab reports and a capstone for his master’s degree.

Ray’s writing experience is somewhat similar to Hassan’s. He never received any type of instruction in Arabic and English throughout high school, undergraduate, and graduate studies. When I asked him about his writing experience in Arabic, he went as far as his high school years where he explained:

Nobody like teach us how to write. We just like have a time to start trying to think about like a subject about a topic. But nobody like kind of teach us like this is like the introduction, this is the statement. Nobody taught us anything. (Ray, Interview, December 23<sup>rd</sup>, 2019)

He also makes a comparison between his writing experience in his home country with the experience of his American friends who start to learn how to write at an early stage in life. For Ray, this was not the case:

They [Americans] start doing presentations since they are in elementary school. I have a friend of mine who has like kids in elementary school. They do presentation in the elementary school. I have never done any presentation back in my country until I was in masters like when I was a graduate student. I started doing presentations from time to time but here they teach them how to do a presentation, how to like start writing essays in the right way but for us like it was like I never was taught how to do that. (Ray, Interview, December 23, 2019)

This quote shows that the previous education for participants in this study was based on content that was geared towards a more “traditional” product-focused instruction. Writing as a process and with scaffolded writing instruction over time was not part of their instruction. For Ray learning how to write only starts later in his master’s program but it is somewhat developed with practice in his PhD program.

Ameen was probably the most articulate on how the educational system was affected by the political atmosphere as he was growing up. Even though he considers himself to be a good writer in Arabic, he doesn’t remember anyone giving him any type of writing instruction in both Arabic and English. The reason for this is because of the controlling atmosphere he lived in during his high school and university years. He explained that before 2003 the Baath’s party, the controlling government party, controlled what students could and could not write:

Before 2003, we were guided to write about political stuff. We don’t have like open mind things, even though we are afraid maybe to write something. So, this

is also affecting our writing when we came here because one of these things that I said so we don't have a lot of detail thinking about it. Even though my son asked me about my memories I avoid answering him because you know we have a lot of bad memories. (Ameen, interview, January 15, 2020)

The environment and the culture that Ameen lived in didn't give him the space and opportunity to express his emotions and feelings through writing which is why he never cared to write anything beyond his discipline. Ameen also shares his disappointment in not having any writing experiences in the past. He goes further in comparing his past experience with writing with his son's experience who was attending school in the U.S while he was studying for his doctoral program. He explains:

So now when I'm comparing myself to my son. This is very tiny things that like for Christmas. My son described a lot of pages about these things, but when I came here, I thought, this is a pretty tiny thing. We don't need to even put it in our memories. So, writing um, it just not affects your writing skill affecting your thoughts too...You know, in our language though, it's very tiny thing, but here in English he writes how he discovered that while it's like about two or three seconds in the bus, but he wrote like two pages about it. (Ameen, interview, January 15, 2020)

In this conversation, Ameen is comparing his experience when he was a child to his son's experience. He explains because his son was encouraged to write early in his age, he was able to describe an action that lasted for two to three seconds in a bus and

turn it into a two-page narrative. He, on the other hand, did not have such abilities when he was at his son's age.

Zee also never remembers anyone teaching her how to write in Arabic or English. Even though she never received any type of instruction in both languages, she feels that she was a better writer in Arabic because she is used to reading a lot. She explains:

I kind of try to learn by reading papers so I can try to like to find how they are, those people writing, how they are writing and then I try to figure out the way to write about my own stuff in the same way. And I read many books before in my first language. So, kind of taught myself actually. (Zee, interview, December 23, 2019)

***Present Writing Instruction.*** When I asked Zee whether she took writing classes during her graduate programs in the U.S, she mentions that she never took writing classes as they were not available, and she explains that the reason is her department doesn't give any priority to writing:

The thing is, and this is one of the problem they have in computer science department, I'm not sure if other departments have but they don't pay attention to the writing because they care about like formula, this stuff like in the classes....Even class reports, I can customize whatever in the way that communicate the idea of like whatever, how I find these results, what I did. I know they don't care about like if it's scientific writing or the way I write is the

correct way to write or not. So, this is one of the problems...I don't think that there are classes that teach engineering students to write scientific writing about like how to write a research paper, like these kinds of things. (Zee, Interview, December 23rd, 2019)

Zee believes that her department thinks of writing as providing templates that students can use as a guide for their writing with no proper writing instruction. This is a problem for her because it does not provide her with the necessary practice and strategies to write a research paper. The only apparent writing class she took focused on grant writing. She explains that the instructor taught this class every other year, and it only focused on how to write a grant. Although the instructor gave them some feedback during the class, she still doesn't think that grant writing is similar to writing a research paper.

Ray echoes both Zee and Ameen's idea that his current institution does not provide him and his colleagues support through appropriate writing classes that focus on academic writing. Ray also mentions the IEP program he took before the beginning of his doctoral program. He believed that the IEP gave him some support as it helped him learn the basics of writing an essay but not enough to write an academic research paper.

In his description about his own writing skills, Hassan said, "I usually struggle with writing in English specifically, and in Arabic too. The two of them the same problem but like taking me a long time in order to write a piece... for example, if I want to write

one page maybe it takes me three, four days maybe a week might be two weeks... it's issue for me" (Hassan, Interview, February 3, 2020). In his own explanation, he believes that his negative attitude toward writing is because he was never taught or even given any proper classroom writing instruction on how to write an academic paper or even write a simple paper in English.

Ameen mentions that when he first came to the United States and before entering his doctorate program, he was placed into an IEP (Intensive English Program) at the university. He describes the experience as not being helpful towards improving his academic writing skills. He goes further in comparing between his experience in the IEP and the experience of his fellow Iraqi students at another university. He explains:

They told me that they got specific academic writing, and there are different levels. Level one, two, and three is very advanced. And to be honest that helped them a lot when they're writing a paper. But unfortunately, here...in the IEP intensive English program, we haven't had anything. So, when we went out of the IEP to the academic. I think, you know, one of the major things from the advisor to write a paper. So sometimes they ask you to write a sample of a research paper, or they just want to know how skilled you are in writing. And it was terrible, you know, so unfortunately no. (Ameen, January 15, 2020)

I asked him what type of writing they did at the IEP. He explains that it was not related to academic writing but more of a personal narrative where he describes it as being "very small level writing" (Ameen, Interview, January 15, 2020) which he believes

to be different from academic writing. Ameen doesn't believe narrative writing can develop his academic writing skills as he feels that the two are different and therefore not relevant to his profession. He also feels the need for his institution to provide academic writing instruction since it appeared to have helped his colleagues in other institutions.

When I asked Hassan about his writing experience throughout his doctorate program in the US, he mentioned taking a summer intensive writing workshop, which seemed to have given him some basic academic writing tips and motivation. When I asked him how the seminar helped him, he was very specific:

What we should write in each section first, and also give us more than guidance. Like before I have a guidance, now it gives us some kinds of techniques. For example, you have to start to lay down your draft and start writing about your results first and then you don't need like to struggle with introduction because always the introduction is hard to do. Like they give me some technique. It was good to give some confidence, always like take notes. At that time, I was like, okay, but now after. Now I'm back. (Hassan, Interview, February 3, 2020)

The workshop Hassan was talking about was an intensive writing workshop that I helped to set up during the summer of 2018 through the university's writing program, a WAC/WID program (Writing Across the Curriculum and Writing in the Disciplines). The College of Engineering had asked the university's Campus Writing Program to set up this workshop to help their international students with writing. With the support and



guidance of my advisor and her assistant, we were able to facilitate a two-week intensive workshop for international graduate engineering students. Even though the workshop was short, it appeared to have helped Hassan learn some writing strategies on how and where to start writing, in addition to receiving some feedback on his writing. This workshop was the closest thing to a writing class he took throughout his academic career.

Nevertheless, Hassan felt he still needed more writing instruction because he ended this conversation with “At that time. But now I’m back.” In my interview memos, I noted that he meant at the time of the workshop his knowledge of the basics of academic writing was improving, but since the workshop was only for a short time, it wasn’t enough to support him in developing and maintaining his writing skills. This need for instruction in academic writing aligns with Gee’s (2008) recommendations for providing language learners time, proper instruction, and ongoing practice to improve their language skills.

Academic writing involves a series of complex tasks that includes having the ability to analyze and synthesize data students work with in addition to having the ability to organize writing in a way that shows smooth flow of ideas. Such knowledge cannot come easily within a short period of time. If students arrive at the higher education level system with no proper guided academic writing instruction, this affects their future academic career.

In conclusion, writing instruction should start as early as high school years and it should be in both first language and second language. Lacking meaningful academic writing instruction in the first language or second language impacts students' knowledge production when they reach higher level education system. This was the case with the current participants in this study. They did not receive proper writing instruction in their previous educational context in both Arabic and English which in turn had an impact on their academic writing when they entered their doctorate program. To further complicate things, when they came to the U.S, they faced similar situation. Even though they received some basic writing instruction through the IEP program, it wasn't good enough in developing their academic writing skills.

**Experience with Feedback on Student Writing.** I found three sub themes that showed the type of feedback being provided and how this impacted recipients: a) constructive feedback, b) negative feedback, c) blended feedback.

**Constructive Feedback.** Two of the participants, Ameen and Ray, described receiving positive feedback on their writing. Ray's writing skills improved when he started his doctoral program. The improvement was slow but effective. He believes that if he compared his old writing with his current writing, he would see a big difference. This improvement is seen when he compares the first and second papers he wrote at the beginning of his doctoral program. He explains:

My first paper that I wrote, it was like two years ago, I think. Yeah, two years and a half. So, it was for a conference and my writing wasn't good ...The second

paper. Um, I had like, I had written it like better than the first paper. It was good. Uh, but it's still like, uh, I still had a lot of mistakes, especially my supervisor is very particular about language. Uh, he used to edit everything, talk about everything and like every single mistake. So, he would like to get like very good writing. He wants to add his name on a paper, which is not writing, which is like, has written like in a bad language, they say, or like very weak English. So, we have to like to put more efforts, like when write a paper here more than back in Iraq. (Ray, Interview, December 23, 2019)

Feedback seems to be a factor in Ray's improved writing, and his advisor made sure that he provided Ray with feedback. His advisor was also meticulous and detailed in his feedback which helped Ray understand his mistakes and improve his future writing. When asked what type of feedback he receives from his advisor, Ray mentions that his advisor at first gave him general writing instruction then after that he started focusing mainly on areas Ray originally had issues with. For example:

let's say, uh, in the introduction. Yeah. I mentioned like a sentence, and he said like, "be careful because you are going to submit this, like to this journal. If you like to submit it to this journal, you should've tried it that way because all of these, like people who is reading this like kind of reviewing this kind of papers will be focusing on this area and I'm kind of criticizing this area." So, he's advising me to not doing this. And sometimes I write some sentence and he said like, "clarify, this is not clear enough. You know it is because you did it, but the reader don't know what you mean! Do you mean like this or like that?" So sometimes I

say something, but I know what I mean. But I don't like, I feel like everybody knows it, but it's not. (Ray, Interview, December 23, 2019)

Development and sentence structure are the two main writing issues the advisor mostly focused on, and this was clear from the writing sample Ray brought with him which will be discussed in the next section. The quote above also shows that Ray needs to rethink his sentences so that it is clear to the reader what he is trying to convey. Ray seemed to have improved this skill gradually as he received more feedback.

Ameen also talked about issues of development in his writing and that he sometimes wanders off topic, but he gave credit to his advisor for pointing this out to him from the first time they met. He recalled that his advisor sat with him for eight hours giving him feedback on his writing and providing him with some writing tips. He explained that his advisor was from China, "But he is very skilled in writing," (Ameen, January 15, 2020). They sat for hours where Ameen wrote over 12 pages of notes. These notes were used as a guiding reference for Ameen for future writing.

In addition to the notes, we also see that Ameen specifies the nationality of his advisor which is a clear reference to a distinction being made between native and nonnative English writers and how that impacts the perception of the writer. In this case, it was positive, and the student was confident in the feedback he received. The type of feedback he received was both informative and constructive. Ameen explained this when asked what type of feedback he was receiving from his advisor:

When you start writing here, you have to start with these things. Move this [sentence] and try to make this a present tense, not very complicated tense. Start with the very simple vocabulary. We don't want to, because the introduction of your paper or the motivation of your paper is the most important thing that makes people more motivated to read through, go through the rest of your paper. (Ameen, interview, January 15, 2020)

The advisor instructed Ameen to write in a simple yet effective language. Ameen also kept all his advisor's feedback, notes, and writing tips for future reference. Thus, creating for himself good writing resources that he could use whenever needed. This shows that the main source of feedback was his current advisor, and the feedback was a source of motivation and growth for Ameen as he clearly expresses this when he says, "honestly speaking, my advisor helps me a lot to improve my English" (Ameen, interview, January 15, 2020), i.e., written English.

In addition to his advisor, Ameen also uses the university's writing center as an additional source for feedback. He explains that although he only used this center at the beginning of his doctoral program, the center helped him improve some of his mechanical issues. He also keeps notes and copies from feedback he received from the center which gives him an additional writing resource.

**Negative Feedback.** Hassan, on the other hand, had a very different experience with feedback on his writing. His previous negative experiences with writing seemed to make him struggle and dislike writing in general, and one of the main reasons Hassan

attributes this is the lack of feedback. Hassan believes in the importance of feedback to improve and develop his writing skills, which is something he did not experience throughout his academic career both in Iraq and in the U.S.

Hassan received feedback from his main advisor, and then his co-advisor, who is an international scholar and multilingual. The type of feedback Hassan received from them confused him rather than supported him as the feedback seemed contradictory.

He explains:

The only feedback I received from my supervisor...So, I received two different feedbacks. One feedback, he [co-advisor] said "Waw, did you write this by your own?" He says, yes, "that's very good writing". So, I was happy. I sent it to the other [main advisor] ... The other one said, "I couldn't, it's very painful to read it." Uh, so he said it was painful to read. He literally e-mails every one page. He corrects the grammar thing only. That's why I checked with the other guy [co-supervisor], I say okay, do you have issue with this? I usually don't catch some *the, a* [articles]. He said use Grammarly. (Hassan, interview, February 3, 2020)

From this interview conversation, it is clear Hassan feels confused and sometimes frustrated because of the conflicting feedback. This also appeared to have created within him a sense of doubt about the quality of the feedback based on the person giving him feedback. It created doubt in his co-supervisor because he is non-native English. He even doubted the reviewer's quality of feedback because, although the paper was accepted and he received good feedback from the reviewers, he still had

a sense of uncertainty about whether the paper was accepted because the reviewers were non-native writers. In his response to the reviewers' feedback he said, "I don't know if that, if the reviewers are international or American, if it makes a difference or not" (Hassan, Interview, February 3, 2020).

Feedback also plays an important role in Hassan's writing development in addition to his editing and revision process. Hassan feels that if he does not receive feedback, he finds himself stuck because he cannot "see it anymore" (Hassan, Interview, February 3, 2020). He feels that he is too close to his writing and unable to see the forest for the trees. Thus, he is unable to see his writing strengths and weakness.

Hassan is constantly either being given negative feedback or no feedback which makes him feel in a state of not knowing what to do as he clearly expresses this feeling when asked about his editing and revision process:

Then after that point, it will be hard to edit for me. I will do some editing, but the thing is when I read it, I will, I know what's coming. I know what to expect. I remember the words, so I don't really, even if there is major thing, I cannot see it anymore. But the thing is I can send it now, after I finish, I have to send it. I should also send it to the writing center at the university because when they pointed an error, you know, when I read it, I can read it in different way... I will read it, but it's very hard to point out the problems because I already did some editing. (Hassan, interview, February 11, 2020)

In this quote, Hassan talks about the difference between revising after being given feedback and revising after no feedback. He explains that when he reaches a point where it is difficult to write anything further, he feels the need to receive feedback from the writing center because at this point, he feels he cannot think outside of the box. However, when he is given feedback, he can see his writing from a different perspective. Furthermore, Hassan does not mention his advisor as the source of positive and useful feedback.

***Blended Feedback.*** Zee received a combination of constructive and negative feedback which I will call blended feedback. Zee realizes that her strength in describing things in detail can be her weakness when writing, and she explains, “This also could be a weakness because sometimes you write too much about the background of the things” (Zee, Interview, December 23<sup>rd</sup>, 2019). She admits that she can drift away sometimes and provide details that are not necessary. She explains that her advisor has pointed out this issue several times in his feedback. She recalls that in his feedback he wrote, “you are lecturing people here. It seems you don't respect their intelligence or their knowledge in the field” (Zee, writing sample, December 23, 2019). When Zee was explaining the way her advisor gave her feedback, it was clear from her reaction that this made her feel uncomfortable.

Such feedback had a negative effect on Zee as it caused her to feel confused and lacking confidence about her own writing, especially her view of academic writing. She explains that after receiving feedback, “I feel like I was better as a writer before” (Zee, Interview, December 23, 2019). When I asked her to explain what she meant by this, she



said that she was used to writing in a “storytelling” style which she defines as the ability “to go from the easiest things/point and get the reader step-by-step, to the things that I want to say” (Zee, Interview, December 23, 2019). Zee was writing in a narrative manner where she felt the need to explain herself more and provide details regardless of the reader. Her advisor, however, pointed out that when writing in this style she is not considering her audience and is insulting them and the way he presented it to her made her lose confidence in her writing and become less motivated.

The positive effect, on the other hand, made her rethink her writing, which can be seen as a form of self-awareness. Zee explains that she tried to overcome the negative feedback her advisor gave her and was trying to develop her writing by focusing more on cutting unnecessary details and increasing her vocabulary skills. She also talks about other types of feedback she received which came from her peers. She explains that her advisor assigned an international student to give her feedback before submitting it to her advisor. She points out that even though her peer was not American, he was a good writer and was able to assist her with her writing. However, the type of writing feedback he gave her was not content related as he was not familiar with her area of research. His feedback mainly focused on grammar and vocabulary which had some impact on her writing, but she did not feel it was effective enough.

No doubt feedback is important but what is more important is the type of feedback being given and how it was delivered. In some educational context, feedback only means focusing on mechanical issues and correcting errors and in other cases it means focusing on content, flow of ideas, organization, and mechanical issues.

Participants faced both types of feedback had better outcome than those who only experienced the former type. Additionally, the way that the feedback was delivered also impacted the participants. Participants who had constructive feedback in a positive way, were more motivated to improve their writing than those who received constructive feedback in a negative way.

**Writing Across Disciplines.** Students in STEM fields, such as many of the engineering areas, found that writing expectations included the need for moving between different disciplinary expectations. For example, Zee was studying informatics and data science which is an interdisciplinary field that crosses paths with medical, engineering, and pharmaceutical fields. Writing for interdisciplinary fields can be a challenge for Zee because she feels she doesn't have enough knowledge about the readers in the other disciplines. She explains that their writing expectations are very different from what she was used to. For example, she explains:

I'm studying biomedical informatics. So, it's biology, medicine and computer science. So, it is difficult to write. Like I need to decide which journal I'm going to submit, so I need to know to think about the reader. Okay, should I write more about computational complicated formulas and all this stuff? If it is more computational journal, like if I'm going to submit for more biology, so they will most probably, they will not read them as part. So, I don't even, if I have like say the novelty in the methods parts, I cannot submit to the journal that doesn't care about method because like biological journals won't care about results. (Zee, Interview, December 23<sup>rd</sup>, 2019)

Writing for interdisciplinary fields requires a deep understanding of the ways each discipline approaches research and knowing how to adapt your writing according to their needs. Zee seems to understand such needs, which is clear in how she explains the difference in the needs for journals focusing on computational methods versus journals focusing on biology or medicine. She is, however, challenged when it comes to adapting to those needs when writing especially when there is no prior knowledge or experience.

Ray's research study focused on the use of artificial intelligence in the medical field which makes his work more of an interdisciplinary field that crossed paths with the medical field. His writing differs according to the discipline he focuses on. The structure and focus changes according to the discipline as he explains:

If it's like biomedical area, I have to focus on that area. If it's like in machine learning, artificial intelligence, I have to focus on that area. And although the same result, the same paper, but I have to know where, like how, what the topic or what's the areas that I have to focus on and to start to write more about this area. For example, like last time this paper here [referencing his sample writing paper], I submitted to the biomedical conference...We usually in engineering, don't put some statistic about the data that we collected, like specific, certain statistics...The reviewer said like, where is the mean of this? Where is the variance of this data set? Where is the statistics of this data set? And then I told my supervisor, he said, yeah, this is because it was biomedical reviewers, so you'll have to focus on those things, and you have to include them. But if we are going to submit it to the artificial intelligence, they don't care about some

statistical or biomedical data. We have to care about, like we have to focus on the methodology itself more than biomedical. So, it depends. (Ray, Interview, January 1st, 2020)

From the interview it is clear that Ray was not prepared for this type of writing, and it took him a while to figure out and understand the needs for this new scope of writing. In addition to the difference in the writing needs for each discipline, Ray must adhere to the Institute of Electrical and Electronics Engineers (IEEE) standard structure which is the highest standard for engineering professionalism. Ray explains that quality and impact factors are of great importance in his field. Therefore, he tries to focus on quality and impact factor when choosing his sources as a reading and writing guide for his own research. This means his literature review includes sources that fit the impact factor criteria and he is reading articles that fit these criteria and using those as mentor texts for his own writing.

For Ameen, his biggest challenge is writing for different readers. Ameen explains that he sometimes writes for interdisciplinary fields, which means he needs to think about readers that are outside his area of study. For example, one of his challenges is writing for the National Science Foundation (NSF) because it targets a different audience and purpose from what he is used to. Since he is used to writing in one specific area and for one specific audience, changing the whole writing process is not easy. He explains it as being “a new skill, new experience” (Ameen, interview, January 15, 2020).

One of the challenges for writing in an interdisciplinary field is that he needs to adjust his language in a way that allows his reader to understand what he is writing. For example, Ameen talks about writing a paper that focuses on a protein called Cry E M protein. The paper talks about the prediction of the human protein structure that will help people in biochemistry and biology to enhance the drugs according to the molecular structure of the human body. For Ameen, the difficulty comes from adding biochemistry and biology knowledge into the paper, making it readable for all disciplines. It takes him a long time to understand some of the terms used by other disciplines and an even longer time to try to fit them into his research.

Hassan's academic research also falls within the interdisciplinary field of engineering and medical fields. He mentions that since he is used to writing for engineering journals, such as the IEEE, he faces some challenges when writing for a medical journal. Such challenges include thinking about the reader and the difference in structure. For example, when asked about the different types of writing he does, he replied:

I am doing something that is a little bit different from my previous work, it has more validation of a sensor. It has more different structure... that's still tricky for me...Usually we have standard structure for us in general, like based on the journal. If you have like IEEE paper, we have a general guidance, the template, it has clearly defined, you know, categories. However, with this work [interdisciplinary] I'm targeting different journals to publish my paper. I couldn't put it in the same structures. It's a little bit different, it has more details between

the introduction and the method. It's not my thing, but I need to point out the problems of the sensor. So, which is different from before, before I have a problem and then I will write methodology is my suggested way of solving it, and then my results. Now I have like a part which is not my work, but still, I have credit for this, because I am showing the limitation to others of using it directly... And so that's why it's a little bit tricky because I'm basically saying, Oh, you did the work, it is good, but you should take this into consideration. Otherwise, your work is not that good. I'm talking about other papers, which is, it's a little bit struggle. (Hassan, interview, February 11, 2020)

Hassan seems to understand the need to think about his reader when writing as he clearly shows that his reader changes when his research focus changes. However, it becomes challenging for him to write for readers who don't understand his discipline, especially those who are from the medical field.

In conclusion, to be efficient in writing across disciplines, students need to be able to understand the needs of their audience which is one of the key elements of developing rhetorical knowledge (Council of Writing Program Administrators, et al., 2011). Knowing the audience helps writers choose what type of information to include and what not to include. Therefore, lacking such skills impedes students' ability to present their work and their knowledge in their discipline effectively as in the case of the participants of this study.

### ***Strategies to Improve Their Writing***

In this study participants described ways they helped develop their writing. This includes creating individualized writing strategies, reading model papers, and thinking in one language and writing in another.

**Creating Individualized Writing Strategies.** Participants in this study created their own writing strategies to help them improve their writing skills such as note taking and writing a lot. Some of the participants used some of these strategies but Ameen was the one participant who stood out.

When I asked Ameen about his writing routines, he described taking a lot of notes which was something he learned from his advisor. He explains “I have learned that from my advisor. The first paper I have written, we spend like eight hours together... we sit together and like I think I wrote 11 or 12 pages of notes” (Ameen, Interview, January 15, 2020). His note taking skills go beyond writing 11 or 12 pages. Ameen had intentional focus on vocabulary and kept a notebook of all the vocabulary he encountered throughout his reading. When I asked him how he would describe his ability to generate words, he explained that this was something he needed to work on and develop because he doesn’t feel he had enough vocabulary diction. Therefore, he kept a notebook of new words and used it as a resource he went back when needed.

Another strategy Ameen used to develop his writing was more practice with writing and writing a lot. He explains, “practicing is a good thing... It's very significant. Okay. For us, writing in English, even speaking English and reading English” (Ameen, Interview, January 15, 2020). We see that Ameen links English proficiency with writing

proficiency. For Ameen writing proficiency is achieved through reading and speaking and practicing these skills a lot.

**Students Created their Own Writing Style Through Reading and Using Model Papers.** Students linked good writing to good reading and modeling. Reading is one of the most effective strategies for improving writing (Krashen, 1981) and this is what the students in this study proved.

When I asked Ray about his writing concerns, he mentioned that he has difficulty generating new vocabulary. So, one way to overcome this difficulty is through reading as he explains, “because I don't have enough words, sometimes I read articles and I say, wow, this is like very fancy words. So, I don't have those skills. I don't like have them in my memory” (Ray, interview, December 23, 2019). To understand how these words are used in sentences, Ray sometimes translates them into Arabic to make sure that he is understanding what he is reading.

Ray mostly reads articles that are within his discipline or within his area of research. He explains that reading helps him navigate the writing styles of others which then helps him to understand the academic writing needs of his discipline.

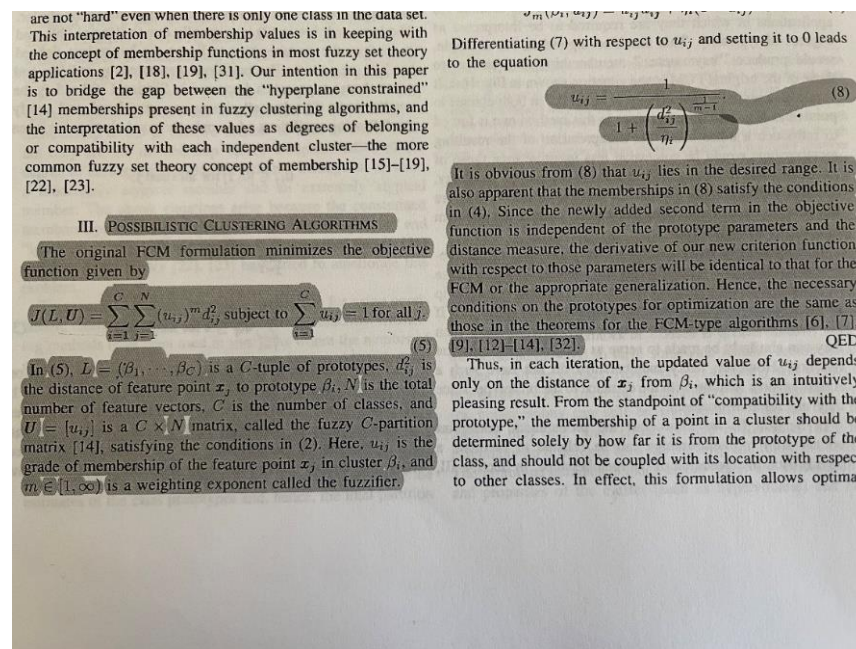
When reading other people's work, Ray also highlights important sentences and paraphrases them into his own words. He gives me an example of what that looks like from the sample model paper he brought with him. He explains that he only focuses on small parts of the article. For example, if he recognizes three sentences or more that have ideas relevant to his work, he paraphrases them and uses them in his own paper.



Figure 4:1 is a highlighted sample from the model paper that shows what kind of paragraphs or sentences Ray focuses on:

Figure 4: 1

*Ray's Sample from his Model Paper*



Note. From *A possibilistic approach to clustering*, by R. Krishnapuram, J. Keller, 1993, p. 101

We can see from the figure above; Ray highlights sentences and algorithms which appear to be an important part of understanding a scientific text. He doesn't seem to have issues with paraphrasing texts that have discipline specific words but rather the difficulty comes from texts or sentences that have vocabulary Ray is not familiar with. He also finds difficulty in paraphrasing papers that have different writing styles. Since his discipline has a very diverse community of writers, Ray often reads

international articles that come from all over the world such as China, the UK, and the US. Even though these articles are all written in English, they have different language and writing style. Therefore, incorporating references from these different language background articles is sometimes difficult for Ray, as he explains:

Like sometimes it's hard for me to put all of this together because each one of them, uh, talking smoothly and start from the scratch and then try to make like growing, like grow his idea. So, to take like part of this paper and if I like this one and paraphrase and then go to another paper and take another sentence or another paragraph and paraphrase, it's hard to make them like together because they use different style. Uh, so I have to write them all in my own style, which is sometime, it's hard for me to do that, but you know, like day by day I get used to it. So, maybe I'm okay with that, but I was still struggling with a lot of other things. (Ray, Interview, January 1st, 2020)

In addition to the different writing styles of all the research papers he reads, Ray also focuses on how these different articles can start from scratch and develop their ideas as they go along. Reading these different articles with different writing styles may be a challenge, but he proves that practice of reading is key to developing and overcoming any writing struggles.

Zee's tools for developing her writing skills are through reading other works and modeling her writing accordingly. She tries to overcome her writing concerns by mimicking or imitating other writers through focusing on their use of vocabulary and sentence structure.

Zee explains that it was through her personal observations of reading other people's work and observing how they write is what helped her develop her own writing skills:

My master thesis actually it was based on what I know, what I notice how people write their papers that I read as literature review or whatever. And then I write my own stuff in that way. (Zee, Interview, December 23, 2019).

Even though Zee tries to imitate other writers when writing her research, through this process she tries to create her own style of writing. This process of reading and using other works as a model for her writing was clear in her reflection on the model text, she had brought with her. In the reflection, Zee writes that the mentor paper served as a guiding tool for her own research and writing as it was similar in terms of content and subject. Her focus was mostly on the organization of the paper, especially the methods section because they used a clear descriptive writing style that was easy to read for any reader. She explains that she is trying to adopt a writing style that is "easy to follow even for people who do not have a strong computational/statistic background" (Zee, Reflection, February 18, 2020). This shows that Zee is not only thinking of her own writing style, but she is also thinking of her readers and giving them importance because of the nature of her writing for interdisciplinary fields.

The mentor paper is also important for Zee because it not only helps her look at other writing styles but also helps her compare her own writing with others. This was apparent when she talks about the difficulties she faces when she writes the result

section and sometimes the methods section particularly when she has difficulty finding research similar to hers. This makes it hard for her to compare her own writing to that of other writers. She explains that the difficulties arise when she needs to write in a way that can sell her research or convince her reader that her methods and results are unique. The challenge increases when she writes for interdisciplinary fields as this means she will need to write for diverse readers.

When I asked Ameen how he overcomes his writing concerns, he explains “you have to control yourself to keep writing and reading a lot” (Ameen, interview, January 15, 2020).

Ameen doesn't like to put himself into the corner of imitating other writers by using their writing as a template. Even though he reads a lot, he never took what he read as a template for his writing because according to him it is:

Not a good strategy because you know, you'll put yourselves into templates, how they organize. But you know, when you open the mind and the door to your thoughts, a lot of different ideas comes to your mind. So, instead of putting your mind in specific path, you have to think out of the box, then organize your thoughts in English. That's why I recently changed my techniques. (Ameen, interview, January 15, 2020)

For Ameen, the model paper is helpful in terms of the ideas, the structure and vocabulary they use. This helps him in terms of the ideas of the research, “since they are working on the same domain that I am working on” (Ameen, reflection, October 28,

2020). He also focuses on the vocabulary that is being used. He explains how the words are concise and how the author summarizes the discussion section in two paragraphs only which he calls as being “impressive.”

In the third interview I asked Hassan to answer questions about the model paper and the sample writing of his that he brought with him. The model paper, “Comparison of the temperature accuracy between smart phone based and high-end thermal cameras using a temperature gradient phantom” (Klaessens et al., 2017), was related to his research which addresses the Forward Looking InfraRed (FLIR) one sensor used in the medical field. The FLIR One sensor is a thermal camera that shows infrared energy / heat inside the human body and changes it into a visual image. Hassan’s research focuses on “the proper usage of FLIR sensor and the limitation in terms of accuracy” (Hassan, reflection, February 13, 2020). Hassan gives two reasons for choosing this paper: 1) it matches his research in terms of content and structure. The model helped him to look at the structure of the article as a way to guide him to structure his own research paper; and 2) because of the “flow from addressing the problem to explaining the methods” (Hassan, Reflection, February 13, 2020) which he highlights throughout the paper. The “flow” is the writing craft that Hassan tries to seek in his own writing but is having difficulty reaching this goal because of the lack of experience in writing and because of the continuous negative and lack of useful feedback.

**Thinking in one language and writing in another.** As students begin their writing journey through their graduate program, they start to develop tools that can help them improve their writing skills. Being multilingual students gives them the advantage of

thinking in their native language and writing in English. This was the case for all the participants as there was thinking and writing going back and forth between languages, through first a direct translation approach and then to a more fluid movement between languages.

When I asked Zee about her writing experience throughout her undergraduate and graduate program, she mentioned that because all her writing in her discipline was in English and because she never had any proper writing instruction, she used her first language as a tool for helping her understand writing within her discipline. She explains, "I just translate whatever in Arabic in my mind, like, okay, I need to write this. I write it in English but the way I think about it was in Arabic" (Zee, interview, December 23, 2019). So, translation in this sense does not necessarily imply translating a text from one language to another but more of thinking in one language and writing in another. This process has helped Zee to understand some of the new concepts and vocabulary she was encountering. Additionally, the process helped her to clarify the vague ideas some of the texts were conveying so that she could present it in her own language.

This process of thinking in one language and writing in another has also helped Zee to understand the differences and similarities between the two languages and at the same time strengthen her linguistic skills as she explains, "I just think it was like, if I think about it in Arabic or English, I still have better understanding," (Zee, interview, December 23, 2019). But as she gained more writing experience, practice, and reading, she began to think and write in English:

When I first started writing in English, I still have the same habit of converting things from Arabic to English, but now I am getting better because I read many scientific papers. (Zee, interview, December 23, 2019)

When talking about his writing issues and past writing experience, Ameen recalls using translation as a means for understanding academic writing. He explains that “We used to translate things. We think in Arabic and translate in English” (Ameen, Interview, January 15, 2020). Once again, the idea of using translation to understand the difference between the two languages is clear for Ameen. The use of translation as a means for understanding writing is a factor that has enhanced his English skills. Even though Ameen points to the errors that can happen when translating between two structurally different languages: “So, when I compare the paper that I used to write and thinking in Arabic and writing in English or thinking English and writing in English, there is a big difference” (Ameen, Interview, January 15, 2020). The process, however, was a means towards an end: “Before we started studying here, um, in the United States. We used to translate things,” (Ameen, Interview, January 15, 2020) but with practice he is now “thinking in English and... writing in English” (Ameen, Interview, January 15, 2020).

To improve his writing skills, Ray, at first, began to translate everything into Arabic whenever he is reading or listening, “I translate from my language in my mind to English” (Ray, interview, December 23, 2021). He would think in Arabic and then translate it into English. Although he believes that this type of learning strategy might create some errors “because when translated, it would give you another meaning sometimes” and that it is “not like professional way to write” (Ray, interview, December

23, 2021). He expressed that this approach helped him to grow and improve his English skills because “at the beginning, like when I first came... my English was, like very bad. So, I was kind of, then when I start like improved my English, when I started translating from my own language” (Ray, interview, December 23, 2021).

### ***Factors Influence Multilingual STEM Students’ Identity as Writers***

Two factors influenced students’ identity as writers: students’ academic discipline, and when students compare themselves to native speakers.

**Role of Identity in Academic Writing.** In all the four interviews with the participants, none described themselves as writers because they believe that being a writer is more related to non-scientific writing such as writing a novel, poetry, or literature. Therefore, they all see themselves as researchers instead of writers. When I asked Ray how he characterizes himself as a writer, he did not give me a clear answer at the beginning. Instead, he started by talking about his writing experience during his undergraduate and graduate studies which were only limited to lab reports and one capstone. Then he compared his writing experience as an engineer in his country to that in the United States. Throughout his description, he was mainly focusing on the mistakes he made during his writing and how his supervisor edited every single mistake he made on his paper because he wanted to add his name. All this has led Ray to conclude that he only considers himself to be “a researcher because I'm a Ph.D. student here. But I don't know, like in terms of writing, uh. I don't know if I am like a writer, a good writer or not. Well, I cannot judge myself” (Ray, interview, December 12th, 2019).



Zee echoes Ray's idea of linking the term being a writer to something outside of her discipline. Because most of her writing falls within scientific writing, she only sees herself as a researcher and not a writer. In her response to the same interview question, Zee explains:

I think almost all my kind of writing...gets into the category of research. So, I will say researcher. Yeah. This kind of writing I'm doing most of my life, like undergraduate and for my master's and for the Ph.D. All the writing that I do is like something related to scientific writing. (Zee, interview, December 1st, 2019)

Ameen gave me the same description when asked about his characterization as a writer. His answer was, "I'm a researcher. I characterize myself as a researcher. Let's say to scale from 1 to 10. Um, I want to be more optimistic to say seven" (Ameen, interview, January 1st, 2020). He was firm in his answer as he did not believe himself to be a writer and made it clear that he was only a researcher.

Hassan was on the opposite end. Although he did not see himself as a writer, his reason was different. Hassan could not consider himself a writer simply because he did not like writing in general. Even though he loved doing research, he did not even mention being a researcher, and this was due to his bad experiences with writing.

**Students Compare Themselves to Native Speakers of English.** When talking about their weaknesses in writing in English, most participants compared themselves to native speakers of English. This comparison gave them the feeling of being disadvantaged even though they have the knowledge to be successful in their discipline.

Zee compares her ability to generate vocabulary to those of native speakers, and she feels that they have a better chance succeeding in their career because they can write better, as she explains:

Some people who are professional in English or like their first language is English, they can write it in a better way with words. (Zee, Interview, December 23<sup>rd</sup>, 2019)

This comparison between her own writing and that of a native English writer and trying to reach the level of what she calls as the “professional” in English, could be one reason that prevents her from focusing on her writing needs and reaching her writing goals (Lea & Street, 2006).

Hassan also makes a comparison between his writing and his American colleagues. In the interview, he explains that:

I write, I write something small about this...others, for example, I saw Americans how they write. They will make it a big thing, which is the same work. Even if it's less. They know how to show it and they go like, that's why I said, okay, I did the work. It's working and everything, but when I try to write the methodology... I write less than, uh, write like something that won't show I did so much work. However, I did a lot of work compared to others. (Hassan, interview, February 3, 2020)

In this quote, Hassan is explaining that though it was a lot of work for both and sometimes he does more work than others, when it comes to writing, his American

colleagues can write much longer piece while he was only able to write something short. While he was explaining this to me, I felt frustration in his voice especially when he explains that “It’s the same work but they, they put it in a way that make it more significant, even if the work is the same” (Hassan, interview, February 3, 2020).

Ray associates using simple language with weakness or unprofessionalism. He feels that he lacks the skill of using words that native speakers use. He explains,

Maybe for you it's easy to paraphrase it, but sometimes I struggle with paraphrasing. Like American style. They have a very fancy way to write. They use some words that are very fancy that I've never heard about it. (Ray, Interview, December 23, 2019)

When asked what he meant by fancy words, he explains they are usually words he does not normally use in his daily life or use when writing within his discipline. The need for Ray to compare his past writing experience with that of native English speakers seems to affect him and shows how advantaged he thinks native speakers are when it comes to writing especially academic writing.

Ameen also feels disappointed because he cannot easily generate new vocabularies or sometimes organizing his ideas without getting help from English speakers. When I asked Ameen how he generates his sentences and ideas in English, he explained that he sometimes asks one of his American friends to help him revise his paper and tries to sit with and see how he makes that revision because “all these are

experience to us because we are not English speakers” (Ameen, interview, January 15, 2020).

Ameen even goes further in generalizing and comparing his own culture with the culture of native English speakers. When asked if he practices any other types of writing outside his field, he explains,

The big issues when you come to the United States of one of the English countries. We don't have a lot in our mind to write about it. That's what I just recently discovered. You know, let's say the first day, my first day was in the IEP. They ask us to write something and what's your hope? But we feel that this is not important in our life. (Ameen, interview, January 15, 2020)

In this quote Ameen makes a comparison between the type of writing he was used to back home and the type of writing he was asked to do at the IEP center. He explains that he was not used to writing personal narrative as this is something uncommon in the classes he took in Iraq. This shows the type of classroom culture Ameen came from and how that differed from the U.S.

### ***What does the Writing Show?***

In this section I will present the various writing elements that emerged from the interviews, the writing sample, the model article, and the student's reflection on both papers. These elements formed a framework to describe the students' writing and explanations of effective writing. For each category I provide a description from the interview. As shown in table 4.1, I was able to obtain the student and their advisor as a

source, and for others I was able to obtain the student, the advisor, and the reviewers. The writing elements are based on the Higher Order Concerns (HOCs) and Lower Order Concerns (LOCs) (Higher, Lower Order Concerns - Purdue OWL® - Purdue University, n.d.). The HOCs include important writing elements such as thesis or focus, audience and purpose, organization, and development, while the LOCs include mechanical issues such as sentence structure, usage, punctuation and other conventions. I am using these elements to guide me through the participants' writing and to see where their writing concerns fall based on what they say in the interview, what their writing samples show, what their supervisors say in their feedback, and what their journal reviewers say in their feedback. By doing this step, I am evaluating the consistency of each participant to see how they compare across their descriptions of writing. It also adds validity to the data (Denzin, 2009; Merriam, 1998; Stake, 2010).

*Table 4. 1*

*Ameen's Writing Elements*

Writing elements from interview	Source	Participant	Advisor	Notes
Thesis or focus	Writing sample		X	*Lacking thesis statement
			X	*The use of unnecessary ideas
	Sample article	X		*Switching ideas
		X		*Focus on the ability to summarize an idea in one or two sentences.
Development	Writing sample		X	*Needs to give further explanation to develop his idea.

	Writing sample	X		*Has issues with explaining how his work is connected with others in few words.
Sentence structure	Writing sample		X	*Sentence fragments
			X	*Sentences does not make sense
Word choice/ vocabulary	Writing sample		X	*Need to be more concise (not using the proper word to make better meaning)
			X	* Using more than one transition word in one sentence.
	Reflection	X		*Unable to use various vocab to explain the same idea.
	Writing sample	X		* Focuses on the discussion section to develop his own vocabulary.

As shown in Table 4.1, Ameen's main higher order concerns fall within lacking thesis statement, focus, and development. While his lower order concerns are word choice and sentence structure. His lower concerns were the overarching issues when compared with his higher order concerns, especially word choice. Ameen often talks about the lack of vocabulary and the need to build up this writing element as he regards it an important factor in improving his academic writing. This is evident in his writing sample, his reflection on his writing sample, and the mentor text. For example, in his reflection he mentions that he needs to expand and work on his vocabulary to present his ideas in different ways. In his writing sample, his advisor points out in several places where he needs to use better vocabulary to make his ideas clearer.

It is also clear from the interview response where Ameen was focusing more on mechanical issues of writing rather than content as he feels he needs to increase his vocabulary and improve his grammar. When I asked Ameen about his writing skills, he explains:

The second thing is grammatical issues and vocabulary. I think I need more skills to collect more vocabulary that I didn't use. I'm a good writer, but I still have, I still need to add more things on my vocabulary list. (Ameen, Interview, January 15, 2020)

The type of vocabulary Ameen is talking about are vocabulary that he does not use on a daily basis or vocabulary that is not related to his discipline as he mentions several times throughout the interview. Unfortunately, I was not able to trace the changes made to the sample paper that he gave me. Ameen only provided me with his first draft copy of the introduction and the final published version of the same paper.

*Table 4. 2*

*Zee's Writing Elements*

Writing elements from interview	Source	Participant	Advisor	Reviewers	Notes
Development	Reflection	X			*Lack of disciplinary details to satisfy the needs of other discipline.
		X			*Need to present her work that can be appreciated and shows the novelty of her work

	Writing sample	X		*Writer is sometimes lacking details or writing too much.
	Writing sample		X	* Writer needs more clear detailed information throughout the article.
Audience awareness	Writing sample	X		* Writer is “lecturing” or using “tutorial” writing style.
		X		* Writer is “questioning the intelligence of the audience”
Organization	Writing Sample	X	X	*Needs to reorganize and add some sections
Word choice/vocabulary	Writing sample	X	X	*Need to use correct terms and less words to explain a meaning.
Grammar	Writing sample	X		*Need to be consistent with verb tense.

The feedback Zee received whether from her advisor, her fellow graduate student, or the journal reviewers mainly focused on the content. As for the writing elements as seen in Table 4.2, her higher order concerns are development and organization. Sometimes Zee tends to write more details than needed and other times her paragraphs seemed to be cut in half. Her lower order concerns, mainly focused on some word choice and sentence structure – grammatical usage, such as verb tense.

Zee’s major writing issues revolve around development, vocabulary, and issues with conversational English. When I asked her about her writing concerns, she explained that:



The only concern is, like if I have a problem communicating my idea. Sometimes I'm writing something, the other side or the reader, like say my advisor when he reads, he doesn't understand what I want to say or maybe I write too much about something that can be written in two sentences. Sometimes I write a whole paragraph about something that's still cannot communicate my idea. (Zee, Interview, December 23<sup>rd</sup>, 2019)

Zee provided me with five versions of her writing sample which allowed me to trace the changes she made throughout her revision and editing process. The first version of her writing sample had only the feedback from her colleague which consisted of five comments. The comments mainly focused on word choice, grammar, and some content related matters. Of the five comments, Zee only edited one part which focused on the content. The second version of the paper was mainly from her advisor who gave her detailed feedback. Out of the 28 comments provided by the advisor, Zee used 99% of the feedback. She made changes according to the feedback and modified and expanded many sections of her writing sample. In the other 3 versions of the paper, which were seven months apart, Zee gradually begins to address all the writing elements that were mentioned above. Thus, the subsequent feedback became less harsh, and more content focused. This shows that during the first phase of her writing, Zee seemed less confident and was willing to change and modify her writing according to the feedback she received from her advisor without any objection that made her revisions become significantly different from her original text. However, as her writing

progressed, she became more confident and independent about her writing as demonstrated by her ability to choose the feedback she sees fit for her paper.

*Table 4. 3*

*Ray's Writing Elements*

Writing elements from interview	Source	Participant	Advisor	Reviewers	Notes
Development	Reflection	X			*Need to develop his ideas from general to specific connecting the lit review with his own work.
	Writing sample		X	X	*Writer is either giving too many unnecessary details or not enough details.
	Writing sample		X	X	*Need more examples.
Word choice	Writing sample		X		*Need to use correct acronyms and appropriate words in sentences.
Sentence structure	Writing sample		X		*Some rephrasing
Grammar	Writing sample		X		* Need to be consistent with verb tense.

The feedback Ray received from his advisor and the reviewers was mostly focusing on the content. As for his higher order concerns, development seemed to be his main issue and his lower order concerns were word choice and sentence structure.

Ray's writing sample reflects the issues the advisor mentions in his feedback. Ray brought a sample of a research paper he was working on. The sample paper includes two versions: one version has the supervisor's feedback, and the other is the final published version. Through reading and comparing the two versions, the supervisor mostly commented on issues of clarity and development. For example, he asked Ray to provide additional information to clarify the meaning of the sentence and develop it so that the reader can understand its meaning.

Another example, in the first version of the paper, Ray changed the sentence "if full sleep stages signals are used to train the whole network on sleep stages data, it will take too much time to train since we have overnight data per person" (Ray, Frist Sample, p. 9) into "Training overnight raw sleep stage data using DNN is time-consuming" (Ray, published sample, p. 7). When looking at the two sentences, we see that in the first sample paper, Ray uses a long conditional if-clause with some action verbs to convey a simple meaning which he modifies in a more simplistic yet effective sentence in his published sample. Additionally, of the 30 comments provided by the supervisor, only 12 of them were used and out of the 12, only 10 led to significant changes. Ray seems to understand the feedback and the comments given by his advisor, but he only chooses what he thinks would be suitable for this research, thus making a step towards creating an independent writing style.

Table 4. 4

*Hassan's Writing Elements*

Writing elements from interview	Source	Participant	Advisor	Notes
Development	Reflection	X		*Struggles with connecting sections or parts of his work especially his method section.
	Writing sample	X		* From researcher observation of his two versions of the writing sample, Hassan has added big chunks of information including more images to his method section.
	Writing sample Reflection	X X		*Adding more ideas and constant rewriting.
Organization	Writing sample	X		* From researcher observation of his two versions of the writing sample, Hassan has restructured his whole paper especially his method section and added literature review as a new section.

From my observation of the two versions Hassan provided, his higher order concerns are more related to development and organization. He is constantly adding new ideas to his research and not sticking to one specific subject. This issue was clear in Hassan's writing sample, and the interview where he constantly talks about this concern. And although he thinks about the reader, he has difficulty in developing his ideas with clarity. The difficulty comes when he tries to show how his work fits in with the work of others, especially when writing a literature review.

As for his lower order concerns, it was hard to trace as he did not provide me with enough documents that contained detailed feedback.

## Summary

Through the conversations I had with the participants in their interviews and the model article papers and writing samples presented in this study, I was able draw a bigger picture on their experiences with academic writing:

1. Students' prior writing experiences in their previous educational context impact their language development, especially academic writing and writing across disciplines. Such experiences vary from one educational context to another. In the case of the participants of this study, their writing experiences came because of an educational system that was influenced by the economic and political situation of their home country. As a result, they were exposed to an educational system that used writing as a mere product where they were mostly memorizing sentences and grammar rules without looking at the actual process of writing. Thus, they did not experience effective writing instruction that focused on developing their writing skills, writing to learn, and boosted independent thinking to develop their voice, and communicating this to others.
2. Lacking effective writing instruction had its consequences when students entered graduate school in an environment that differed from their home environment which presented a real challenge for their future.
3. When writing classes and positive writing instruction are not provided for graduate students from their academic institutions, students become their own advocates to solve their own writing issues. They begin to look for strategies to improve their writing as in the case with several of the participants of this study

who found switching between two languages helpful in understanding the needs of their academic writing. Additionally, they found reading and using some texts as models for their writing as means to develop their writing skills.

These findings will be discussed further in chapter five where I will be connecting the findings of this chapter to the literature reviews presented in chapter two. I will also present the implications of this study and recommendations.

## **Chapter Five: Implications and Recommendations**

This chapter presents lessons learned from the data presented in Chapter four and how the findings connect to the literature in Chapter two. I will first give a brief review of the study, including the purpose and the research questions. Then I summarize the findings that I obtained from the data analysis, and finally I discuss my recommendations and implications based on what I have learned from this study for classroom instruction and future research.

### **Purpose of the Study**

The purpose of this study is to examine multilingual graduate PhD STEM students' perceptions of their academic writing. The study explores students' experiences with academic writing, strategies used, and their identity as writers.

The following questions guided this study:

1. What experiences shaped multilingual STEM students' thinking about academic writing?
2. How do students use strategies to help improve their writing skills?
3. What influences multilingual STEM students' identity as writers?

### **Summary of Results**

The findings answer the main research questions that are briefly summarized below:

## ***What Experiences Shaped Multilingual STEM Students' Thinking About Academic Writing?***

**Students' Prior and Present Experiences with Academic Writing Instruction Impacts Their Writing Development.** A student's background knowledge of writing impacts their writing development. Generally, the participants' background knowledge of writing in both Arabic and English was limited. Such limitations came from the type of classroom culture in their home country that did not provide them with effective writing instruction. The teaching of writing in their home context was more of a traditional method that focused only on grammatical errors, memorizing sentence structures, and drilling exercise. Therefore, STEM instructors should take into account the classroom culture multilingual students come from and their history with writing instruction to be able to effectively help them in developing their English writing skills.

The Conference on College Composition and Communication (CCCC) highlighted in their 2014 review that, even though graduate STEM students possess the knowledge of their discourse and content of their discipline, they lack the necessary academic writing skills. They attribute this to the type of writing instruction they received at the undergraduate level, as the focus is more on writing lab reports and short essays than actual analysis and synthesis of their work (Colwel, Whittington, & Jenks, 2011). This was the case with all the participants of this study. The participants had the content knowledge of their discipline, but their previous writing experiences were limited to lab reports and tests. Participants experienced minimal to no formal writing instruction during their undergraduate and graduate studies in English.



This was also the case for the participants of this study during their doctoral program in the U.S. Whether a native or non-native speaker of English, the conventions and norms of the discourse community that students belong to influence their writing. When the discourse community values research and writing but marginalizes writing instruction (Russell, 2022), this creates a dilemma for students whose first language is not English, especially those who have no or minimal writing instruction. The dilemma then creates misconceptions about writing that can get in their way of producing good writing.

We recall in the literature Irvin (2010) and Cheng (2009) show in their studies that students' academic writing success depends on how they conceptualize their writing. However, their misconceptions about writing can affect their writing development. These misconceptions include.

- Writers only start writing when they have everything figured out.
- Writers often arrive at the higher education level with the notion that writing is both objective and informal which can lead to the idea of “artificial, puffed-up prose” (p.6).

This was the case with all participants. They believe that they could not start writing anything unless they have a full picture of what they're supposed to write and have full information about the topic. They also believe that scientific writing is not simple writing and should only be objective which makes the writing filled with jargons to make it look “professional.”

In addition to the misconceptions, the study also fits within the theme of Russell's (2002) idea of who should take the responsibility of teaching writing in the content area. If academics assume writing is acquired naturally, they may expect students to come with strong writing experiences. Ameen, Ray, Zee, and Hassan were expected to write and publish in high impact journals without receiving effective writing instruction or attending any writing classes. Their graduate departments and institutions did not offer them any writing classes and some of the advisors did not have time to offer any writing instruction or give them the necessary feedback.

For example, all the participants attended an intensive English Language Program (IEP) at their institution. While one participant stated that the program was helpful in understanding basic English, others felt the program did not prepare them for academic writing.

### **Students' Academic Writing Improves When Positive and Constructive**

**Feedback is Provided.** The role of feedback in academic writing was one of the major themes that emerged in this study, especially for students who come from a classroom culture that looked at feedback as mere correcting of errors. Therefore, the type of feedback and the way it is provided for these multilingual STEM students helps them understand their strengths and areas of weakness which in turn helps them develop their writing skills. When feedback is positive and constructive, students tend to do better and look at their mistakes from a positive perspective and learn from them. When feedback was negative, students tend to withdraw, feel less motivated and lack confidence in their writing abilities. This theme parallels Bandura's (1997) social

cognitive theory especially the aspect of self-efficacy and how negative and positive modeling influences graduate international STEM students' writing.

This study also aligns with Krashen's (1987) and Lightbown & Spada's (2013) Second Language Writing theories (SLW) who suggested that learners who have positive writing experiences were more likely to be successful in achieving second language acquisition including developing their writing skills. Three of the participants, Hassan, Ray, and Zee have negative feedback experiences from their advisors that affected their motivation to write and impacted their self-efficacy in reaching their writing goals. While one participant, Ameen, received positive feedback experience from his advisor, had confidence, and was motivated to write. He was able to publish over 10 papers during his doctoral program.

**Writing Across Disciplines Leads to Unique Challenges.** Once students start their graduate PhD program, they face the challenge of writing in an interdisciplinary field for which they were not well prepared. According to the National Academies' report, interdisciplinary research is,

A mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice. (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine., 2005, p.2)

The participants of this study belong to a set of groups that have goals and use different types of communication to obtain such goals which Swales (1984) calls discourse communities. The participants fit into what Swales (2016) call the folocal discourse community as those students usually work with other graduate students and within a defined space such as labs or university departments. In addition to this, they are required to submit conference papers and publish articles in international and national journals.

Although the students possess the necessary disciplinary literacy (Shanahan & Shanahan, 2012) knowledge, their graduate programs go beyond their discipline. Their study requires them to work within the interdisciplinary fields which means they are expected to have the knowledge to write for multiple audiences. Writing for interdisciplinary fields also requires a deep understanding of the ways each discipline approaches research and knowing how to adapt writing according to different needs. This was deemed a challenge for all participants in this study as they have not had any writing experience or writing instruction about the targeted interdisciplinary fields they are required to work with.

All four participants found it challenging to write for journals that are outside the engineering field. Audience awareness was the most challenging aspect. The participants did not feel they had enough knowledge about the readers in the other disciplines. They did not know what information they should include and what information is regarded as irrelevant. For example, for Zee computational formulas in biology journals are not relevant. While for Ameen, writing for NSF audience is a new

experience which means he needs to adjust his language in a way that allows readers to understand what he is writing.

### ***How do Students Use Strategies to Help Improve Their Writing Skills?***

#### **Students Created their Own Writing Style Through Reading and Using Model**

**Papers.** One of the key strategies the participants of this study used to develop their academic writing skills and understand some of the writing needs of their discipline is through reading and using model papers. This theme aligns with the genre-based approach (Hammond et al., 1992) and Bandura's (1986) social cognitive theory with respect to the concept of modeling. The genre-based approach focuses on the use of model texts to help learners read and examine the overall structure and linguistic features of the text. Bandura's (1986) social cognitive theory also attests to the importance of modeling as a key component in obtaining literacy skills as it helps the learner's self-efficacy and self-regulation which are critical for reading and writing development (Schunk & Zimmerman, 2007).

All four participants had some writing element issues, especially development, word choice, and sentence structure. They used reading and modeling as writing strategies to help them overcome some of those issues. Although one of the participants had an advisor as a guide on how modeling and use of models work to improve writing, the rest of the participants did not. Even though some were advised to use model text, there was no guidance on how the process works. They had to figure out what modeling is and how it works and adjust it to their own needs. For example,

they looked at complex sentence structures and tried to imitate them in their own writing or look at how certain vocabulary is used in some texts.

**Thinking in one Language and Writing in Another.** Students in this study found that using their first language helps them to navigate and understand academic writing. Thus, being multilingual helped them to think in their native language and writing in English. This theme aligns with the World Englishes approach to language learning that views academic English writing from a monolingual perspective (Canagarajah, 2006; Jenkins, 2006; Matsuda & Matsuda, 2010). This approach allows learners to investigate their sociolinguistic reality and negotiate language to co-construct meaning through conversations as means of exploring possibilities of writing (Canagarajah, 2006; Canagarajah, 2009; Gee, 2008).

Zee, Ray, and Ameen described how thinking in Arabic and writing in English helped them overcome some of the difficulties in academic writing especially understanding some phrases, vocabularies, and clarifying vague ideas. Additionally, it helped them understand the differences and similarities between the two languages and at the same time strengthen their linguistic skills (Canagarajah, 2006; Canagarajah, 2009; Gee, 2008).

### ***What Influences Multilingual STEM Students' Identity as Writers?***

**Role of Identity in Academic Writing.** Writing within an academic discipline influence how students think about themselves as writers. Lea & Street (2006) discussed the approach of academic literacies from a “social practice perspective” that change

according to the context, culture, and genre. This means students' interaction and interpretation of their own writing depends on their past and present practices and experiences in the situation in which it took place. In this study, the participants' practices and experiences with writing were limited to their discipline and within certain academic contexts. Thus, their interpretation of their writing as writers came from their interaction with scientific texts and scientific situations only. They were not able to report on any writing experiences outside their discipline, not even in their first language. Therefore, all participants identified themselves as researchers rather than writers because in their own mind they link the idea of being a writer to something outside of their discipline. This means that their interpretation of what a writer and writing means is influenced by their social and academic environment which Bandura (1986) calls reciprocal interaction.

#### **Students Feel Less Empowered when Comparing Themselves to Native**

**Speakers of English.** One of the main themes that emerged from this study is that when students have negative experiences with writing, they tend to negatively compare themselves to native speakers. This type of thinking or belief which Irvin (2010) describes as the "some got it: I don't--the genius fallacy," tends to put limits on the student's academic writing ability.

The source of this mindset comes from language power dominance. We recall Lea & Street's (2006) notion of academic literacies that suggest the pluralization of "literacies" meaning as, a) the diversity of academic writing and its users who come from various disciplinary contexts; and b) writing as ideologically shaped by institutions,

reflecting power relations (Lea & Street, 1998, 2006; Lillis & Scott, 2015; Lillis & Tuck, 2016). The notion of academic literacies fits well into the context of this study since the participants of this study come from various disciplinary contexts and their writing is “ideologically shaped by institutions, reflecting power relations.” Even though the participants have the necessary academic knowledge that has been gradually developing through their undergraduate studies, they still feel disadvantaged because their knowledge production is shaped by institutional language power dominance. To be publishable, they are bound by “institutional practices in which writing- and other communication practices-are generated and sustained” (Lillis and Scott, 2008, p. 18). For example, when Ray talks about the feedback he receives from his advisor, he also mentions that,

Uh, he used to edit everything, talk about everything and like every single mistake. So, he would like to get like very good writing. He wants to add his name on a paper, which is not writing, which is like, has written like in a bad language, they say, or like very weak English. So, we have to put more effort, like when writing a paper here than back in Iraq. (Ray, Interview, December 23, 2019)

This example of the instructor wanting his name on the paper is an example of power relation and that is the impetus for the feedback.



### ***What Their Writing Shows***

Shanahan's and Shanahan's (2008) Disciplinary Literacy model views literacy as a progression from basic to intermediate to disciplinary literacy. The participants in this study, however, come with enough a disciplinary literacy skill and are knowledgeable in their discipline, but they lack the "intermediate literacy" skills where more generalizable skills are used across contexts.

All the participants struggled to recognize and use complicated words that were less frequently used in oral communications and texts. For example, one participant explained that he doesn't have the skills to use different vocabulary to convey the same meaning. This issue then affects their way of developing ideas as they write, a struggle all four participants shared that was reflected in their interviews, in their sample writing, and their reflections.

The analysis of the participants' writing, as mentioned in chapter four, is used as a lens that helps me look at the language and terms that describe their writing and compare that to what they say in the interviews. This serves as an evaluation of each participant writing. Therefore, the analysis of the participants writing shows that there is consistency between what they say about their writing and what their writing shows.

This also ties to some of the participants' experience with writing and how lacking guided writing instruction and constructive and positive feedback impeded their academic writing development. For example, all participants had issues developing their ideas. If proper guided writing instruction such as the one provided at the workshop and

focused feedback were available, they would not have to face this struggle at a higher level of education.

### **Implications and Recommendations**

Before entering their academic program, graduate multilingual students usually need to enter an intensive English program (IEP) to obtain their TOFEL and GRE. After obtaining the required TOFEL and GRE scores, they begin their academic program and start to work with their graduate program departments and academic advisors. For this reason and in this section, I identify the implications of this study for college supervisors, instructors, and any faculty who work with graduate students, graduate departments, and campus Intensive English programs.

#### ***Implications and Recommendations for College Supervisors, Instructors, and Faculty***

**College Supervisors, Instructors, and Faculty Should Understand the Writing Needs of Their International Multilingual STEM Students.** As seen in chapter two, studies prove that academic writing affects both native and non-native speakers, especially in the STEM fields (CCCC, 2014; Colwel, Whittington, & Jenks, 2011). As identified in this study, graduate multilingual STEM students have different language and writing experiences, and such experiences differ from one culture to another. Therefore, college advisors must not assume that such students are equipped to write in a language that is not their first language, especially with the demands of academic writing. They should not set writing expectations until they know and understand the writing background and needs of the students.

**Students Need Constructive Feedback.** Faculty members and graduate advisors should take into consideration that non-native students, whether undergraduate or graduate students, come from all over the globe with different writing needs and different individual academic and writing experiences. Therefore, creating a positive work atmosphere is crucial. Providing time and positive informative feedback is of great importance as this study proved. The type of feedback students receive from their advisors affects their motivation and their writing development.

***Implications and Recommendations for Graduate Departments and Campus Intensive English Writing Programs.***

**Graduate Departments Should Provide Graduate Multilingual STEM Students with Academic Writing Classes and Writing Workshops.** This study shows that graduate multilingual students, especially in the STEM fields, benefit from a range of writing instruction which can be provided through writing workshops and writing classes. Therefore, it is important that graduate departments provide students with academic writing courses and round the year writing workshops that can help them develop their writing skills, especially academic writing. As seen in this study, some of participants did not have effective academic writing classes or workshops. The only writing instruction they had in their home country was geared towards mechanical issues, and the only writing workshop they had was a two-week intensive workshop. Since two of the participants attended the workshop, this had implications on the students' academic writing development as a helpful start for improving or getting started with academic writing.

For the purpose of understanding how the workshop supported some of the students, I am providing a summary and the general structure of the workshop as well:

***General Structuring of the Workshop.*** The two weeks workshop covered the following topics:

- Freewriting, loop writing, a writer's block, and writing routines (Elbow, 1998)
- Goals for research and purpose of writing
- Reading and annotating
- Synthesizing literature
- Form of scientific writing: Figures and tables, material and methods, results and discussion, conclusion, and abstracts
- Feedback
- Citation and reference
- Plagiarism
- Paraphrasing, revision, and editing

***Outcomes of the Workshop.*** These two weeks included the following outcomes:

- Development of productive and positive writing routines.
- Uses of freewriting to generate writing (Silvia, 2018).
- Understanding the role of Audience, Purpose, and Format in publications.
- Practicing peer and small group feedback

**Graduate Departments and Advisors Should Prepare Graduate Multilingual STEM Students for Interdisciplinary Writing Situations.** As seen in this study, all the participants were involved in interdisciplinary research but were not well prepared for such a writing situation. Their writing situations were limited to writing within their specific discipline, i.e., engineering. They never experienced writing outside of their discipline which made it difficult for them to understand the needs of writing across discipline and what it means to write for different audiences.

Therefore, graduate departments and advisors should not only provide support for students within their discipline, but also find ways to help students become aware of the academic writing needs within fields outside their discipline. This can be achieved by incorporating general academic writing with interdisciplinary writing in workshops and academic writing classes. Faculty who work with graduate student writers should also make their students aware of how to write for different audiences, and one way is to share their own experiences developing rhetorical flexibility to adjust for audience, purpose, genre, and context (Hynninen & Kuteeva, 2017; Kaufhold, 2015)

**Campus Intensive English Writing Programs Should Provide Graduate Students with Academic Writing Classes.** Almost all graduate international students have to enter an intensive English language program (IEP) at their institution before they can begin their academic program. This is a good opportunity for such programs to help these students develop their academic writing skills and understand the needs of academic writing by providing academic writing class in addition to providing ongoing or additional (beyond a one-course or one-workshop) experiences. As identified in this

study, all of the participants entered an intensive English writing program but did not feel it helped them improve their academic writing skills.

### **Recommendations for Further Research**

By reflecting on the whole research process of this study, I make the following recommendations for conducting further research in the future.

1. Since this study was limited to participants who were studying engineering, I suggest a study that expands the participants to include other STEM field students such as math, biology, physics, chemistry...etc.
2. The study could also include native and non-native STEM students in the sample from various cultural and language backgrounds.
3. A longitudinal study to see how students' writing process evolved throughout their program is beneficial and would improve this study's findings.

### **Limitations Revisited**

This study had limitations that would limit its ability to generalize the results. My inquiry is an intrinsic case study that used a convenient method (Creswell, 2013) to select its participants and collect data. The cases were highly skewed toward the College of Engineering instead of other STEM fields (Lincoln & Guba, 1985) even though participants ranged in their majors from computer science, computer engineering, and software engineering.

Another limitation is that the interviews took place right before the pandemic. Although I was able to do some follow-up questions, the timing of the pandemic did not allow me to make further follow-up interviews.

## **Conclusion**

Despite the global implication of COVID-19 on the number of international students studying in the US, international graduate students seeking a degree in STEM fields, will always consider applying to American colleges and universities, especially R1 universities. Therefore, it is important for US academic institutions to consider ways for these students to have a successful educational experience in the US, and part of that success is having the necessary academic writing skills. Also, the global, cross-cultural educational environments help both native and non-natives alike. It increases the understanding of each other's values, norms, and behaviors that exist in cultures.

Academic writing is important for both graduate and undergraduate students and being able to write in an academic style is necessary to disciplinary learning and crucial for academic success. Providing relevant writing instruction through writing classes and writing workshops makes their program experience positive.

Additionally, this study raises important issues of how well US institutions are preparing students for interdisciplinary writing situations. We have to remember that students come from different backgrounds in writing and are being placed into an interdisciplinary writing situation with different writing expectations. Has it become a situation of sink or float?

There is also the matter of language power dominance in academic ethics and knowledge production. Academic writing is an important skill for knowledge production in all academic fields, and publication in the English language is regarded as the standard of academic writing, especially in science. But what is the norm or standard of academic writing in science? With the dominant ideology about the use of standard English in many journals, there is little space for allowing linguistic variety. Embracing diversity of language and literacy practices and using what international students bring to academic situations is an important step toward acquiring equity and equality.



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## Appendix

### Appendix A

#### CONSENT FORM TO PARTICIPATE IN A RESEARCH STUDY

**NAME(S) OF RESEARCHER(S): MAHA K KAREEM**

**PROJECT IRB #: 2015189**

**STUDY TITLE: GRADUATE MULTILINGUAL STUDENTS' PERCEPTIONS ON ACADEMIC WRITING IN THE STEM FIELDS**

The research study is about graduate multilingual students' perceptions of their academic writing with a focus on students in the STEM fields. The study will look into how graduate students perceive their academic writing and the challenges they face during their writing process.

Research studies help us to answer questions that may improve our understanding of human behavior, attitudes, beliefs, and interactions. Taking part in a research study is voluntary. You are free to say yes or no.

#### **WHY IS THIS STUDY BEING DONE?**

The purpose of this research study is to investigate graduate multilingual students' perceptions on their academic writing with a focus on students in the STEM fields. The study will look into how graduate students perceive their academic writing and the challenges they face during their writing process. The study will help practitioners and researchers interested in teaching writing to culturally and linguistically diverse students. The study will be used to understand and explain a variety of writing issues students may encounter within their discipline as well as how their cultural and language backgrounds affect the way they write.

#### **WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?**

- If you agree, I will first send you a short survey to make sure you are within the restrictions of the study.
- I will choose a private and accessible location where I will be asking you a series of questions that focus on your past and current writing experiences.

- I will also ask you to bring two writing samples; the first will be a model or a mentor text you use for your writing and the second is a paper you are currently working on.
- I will also ask you to bring narrative or informal paper you might have worked on in the past as well.
- I will also ask you to write a reflection on your writing and a reflection on the model text.
- I will give you the chance to look at the questions ahead of time to give you an idea on the type of questions you will be asked. After transcribing the interview, I will allow you to look at it to make sure I have captured your answers correctly. I will also be recording and videotaping the interview.
- Follow-up interviews may be needed to clarify following the initial transcription and analysis.

### **HOW LONG WILL I BE IN THE STUDY?**

The interviews will be conducted within three rounds and will roughly last between forty to sixty minutes each with an optional 30-minute follow-up interview.

### **CAN I STOP BEING IN THE STUDY?**

Yes, you can stop being in the study at any time without giving a reason. Just tell the researcher right away if you wish to stop taking part.

### **WHO CAN I CALL IF I HAVE QUESTIONS, CONCERNS, OR COMPLAINTS?**

If you have more questions about this study at any time, you can call Maha K Kareem at [mkk3d@mail.missouri.edu](mailto:mkk3d@mail.missouri.edu) or call 573-639-1797. You may contact the University of Missouri Institutional Review Board (IRB) if you have questions about your rights as a study participant at 573-882-3181 or [irb@missouri.edu](mailto:irb@missouri.edu)

**Appendix B**

Project Title: Graduate Multilingual students' perceptions of academic writing in the  
STEM fields

Subject: General survey questions

Name:

Email:

First language:

Do you know any other languages?

Where did you finish your undergraduate degree?

What did you study for your undergraduate degree?

What did you study for your graduate degree?

Where are you at in your PhD program?

Are you currently working on a research article or project?

## **Appendix C**

### ***Writing History***

1. How would you characterize yourself as a writer? (e.g., blogger, researcher...etc.)
2. How do you feel about your own writing skills?
3. Have you ever been taught how to write an academic paper in your L1? If so, can you explain?
4. Have you ever been taught how to write academic paper in English? If so, can you explain?
5. Have you received any instruction, advice, and handouts about writing in your field so far? If so, could you describe them with examples?
6. What are your writing strengths?
7. What are your writing weaknesses?
8. For whom do you write your paper? (e.g., journal paper, dissertation, reports, proposal...etc.)
9. To what extent do you know your reader?
10. In your opinion what is the difference between your first language writing practices vs. your English writing practices?

### ***Writing Experiences***

1. What kind of writing activities have you done throughout your undergraduate and graduate programs?
2. Is there anything that concerns you about your writing? If so, please explain.
3. How do you overcome those concerns?

- 4 Have you ever taken any writing classes? If so, what, where, and when?
- 5 Do you receive feedback from your supervisor and or your peers about your writing? If so, can you talk about that?
- 6 Do you have a study group? If so, what do you normally do in that group?
- 7 Do you practice any other types of writing outside your field? If so, can you talk a little bit about this?

### ***Writing Strategies***

1. Describe your writing routines: how do you begin a piece of writing? what do you?
- 2 do between beginning and submitting? How does this vary based on the type of
- 3 writing?
- 4 What type of papers do you write?
- 5 Can you explain step by step what do you do to write a research paper? What are the reasons or purposes of each action you go through?
- 6 What is your criterion for choosing your sources? For example, literature review, methodology...etc.
- 7 How do you incorporate your source materials into your writing? Give me an example.
- 8 Do you have any concerns about incorporating source materials into your writing? Please explain.
- 9 How do you show the differences between the ideas and language of others and your own ideas and language in your writing?

- 10 Do you use any Arabic terms when you write in English? How?
- 11 What do you do when you start writing your first draft?
- 12 Do you do any editing? If so, how and when do you start this process?
- 13 Do you do any revising? If so, how and when do you start this process?
- 14 How do you brainstorm your ideas?

***Fluency***

1. How do you generate your sentences and ideas in Arabic?
2. How do you generate your sentences and ideas in English?
3. How would you describe your ability to generate words?
4. How easily can you put your ideas into words?
5. When is it easy to get started?
6. When is it hard to get started?
7. What do you do when facing that blank screen?

## Appendix D

Please write a reflection on why you use this text as a model or mentor text? You may use a computer or paper. Use the below questions as a guide for you:

1. Why this text?
2. How is this text a mentor or a model?
3. Who do you think this text targets?
4. Which part of the text impresses you the most and why?
5. Which part of the text doesn't appeal to you and why?
6. Please include anything else you think is important.

## Appendix E

Please write a reflection on a paper that is in process. You may use a computer or paper.

Use the below questions as a guide for you.

1. How did you choose the topic of this paper?
2. What would you consider as the strength of this paper? And why?
3. Do you feel there is a particular section that you get stuck with and why?
4. Who are the target readers?
5. Please include anything else you think is important.



### **Vita**

Maha Kadum Kareem taught English language and literature at the University of Baghdad/ College of Languages for 21 years. She completed her M.A. degree in English literature from the College of Education, University of Baghdad in 2001. She was a Fulbright Foreign Language Teaching Assistant (FELTA) teaching Arabic at Sweet Briar College in Virginia. She worked as a graduate research assistant at the College of Engineering at the University of Missouri for five years assisting international students. She also worked as a graduate research/teaching assistant in the Department of Learning, Teaching & Curriculum and the Missouri Writing Program at the University of Missouri throughout the remaining of her doctoral program. She graduated and received her Ph.D. in Curriculum and Instruction with an emphasis on English education in May 2023. Her research interests include academic writing instruction and TESOL.