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Learning Chemistry in English: Challenges Faced by Non-Native English Speakers

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**LEARNING CHEMISTRY IN ENGLISH: CHALLENGES FACED BY NON-
NATIVE ENGLISH SPEAKERS**

A Master's Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Chemistry

By

Arwa Ali M. Alshehri

August 2018

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LEARNING CHEMISTRY IN ENGLISH: CHALLENGES FACED BY NON-NATIVE ENGLISH SPEAKERS

Chemistry

Missouri State University, August 2018

Master of Science

Arwa Ali M Alshehri

ABSTRACT

Every year many international students come to study in the United States. In addition to all the challenges associated with coming to a new country, non-native English speakers (NNES) face the additional challenge of having to learn their content in English. Therefore, in this project, I recruited NNES participants from general chemistry courses since preliminary inquiries indicated that they have the largest enrollments. Because there were relatively few students at MSU who are non-native English speakers studying chemistry, I used a case study design to be able to extract generalizations from an in-depth study of a few individuals. The aim of this qualitative study was to identify the key factors that contributed to language-based difficulties these students faced while taking general chemistry courses. Data were collected in two interviews throughout one semester for each participant. Based on a cross-case analysis, the most significant challenges common to all five participants were: the lack of self-confidence in using English language, avoidance of communication, the speed of discourse, and difficulty in laboratory courses. The utility of this study should be relevant to current and future NNES, their Universities and governments and organizations who sponsor these students.

KEYWORDS: English language learners, bilingual learners, general chemistry, chemistry education research, science education

This abstract is approved as to form and content

Dr. Gautam Bhattacharyya
Chairperson, Advisory Committee
Missouri State University

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Approved:

Dr. Gautam Bhattacharyya

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In the interest of academic freedom and the principle of free speech, approval of this thesis indicates the format is acceptable and meets the academic criteria for the discipline as determined by the faculty that constitutes the thesis committee. The content and views expressed in this thesis are those of the student-scholar and are not endorsed by Missouri State University, its Graduate College, or its employees.

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LIST OF ABBREVIATIONS

CHM-116	Fundamentals of Chemistry Course Code
CHM-117	Fundamentals of Chemistry Laboratory Code
CHM-160	General Chemistry I Course Code
CHM-170	General Chemistry II Course Code
CHM-161	General Chemistry I Laboratory Code
CHM-171	General Chemistry II Laboratory Code
CHM 342	Organic Chemistry I Course Code
K.S.A.	Kingdom of Saudi Arabia
KSAU-HS	King Saud Bin Abdul-Aziz University for Health Sciences
MSU	Missouri State University
NNES	Non-Native English Speakers

1. INTRODUCTION

General chemistry is one of the most important fundamental courses for many majors. However, general chemistry courses can represent significant challenges for some students who pursue their education in the United States. An important factor that can contribute in creating those challenges is the language that is used in teaching general chemistry courses, which can be a different language than the students' first language. This research is designed to better understand some of the difficulties that non-native English speakers (NNES) encounter when they study chemistry in English. (Please note that the terms "first language" and "native language" will be used interchangeably in this thesis.)

The idea of this research stems from my background in teaching chemistry courses at King Saud Bin Abdul-Aziz University for Health Sciences (KSAU-HS) in Saudi Arabia. Unlike most universities in Saudi Arabia, all courses at KSAU-HS – including general chemistry – are expected to be taught in English. As their instructor, I observed that many students struggled with this issue because English was not their first language. In addition, living as an international student at Missouri State University (MSU) has helped me to explore and examine these challenges associated with learning chemistry in English. As a result, there were difficulties which I have noticed either as a student or teaching assistant that face NNES in (general) chemistry classes that are taught in English. As such, developing a research project can help me to better understand those difficulties and can help me, and other instructors, to develop strategies that ensure better outcomes for the process of teaching and learning general chemistry.

2. REVIEW OF RELATED LITERATURE

2.1 The Use of English Language in Teaching

Recent data indicate that many countries have adopted English as the medium of instruction to be used in universities. Alternatively, governmental and private organizations in many countries, such as China, India, Saudi Arabia, and South Korea, sponsor opportunities for their citizens to study in countries where English is the national language (Hu, 2009; Khan, 2011; Choi, Tatar, & Kim, 2014). For example, over the last decade, the Kingdom of Saudi Arabia (K.S.A.) has witnessed unprecedented growth in higher education. The Ministry of Education in K.S.A. has increased the number of the universities from eight public universities in 2006 to 27 public universities by 2016. Many of these universities switched from using Arabic to English as the medium of instruction (Ministry of Education, Kingdom of Saudi Arabia, n.d).

There are several reasons for which countries have begun to adopt English as (one of) the languages for higher education. One of these reasons is that most of the materials that students would need for their education, such as articles, research, textbooks and educational websites, are in English (Lee, 2010). The second reason for adopting the English language as a medium in education by these countries is, according to the Academic Ranking of World Universities in 2017, that most of the leading academic institutions are located in countries that use English as a first language such as the United States, the United Kingdom, Canada, and Australia (Shanghai Ranking, 2017). The third reason is to prepare students for their future careers in an increasingly global work

environment which may use English as a primary language for communication (Briguglio, 2005; Liang & Smith, 2012; Neeley, 2012).

In the case of K.S.A., there are many students who continue to be sent abroad by the Ministry of Education in order to study different specialties currently not well established within the country (Ministry of Education, Kingdom of Saudi Arabia, n.d). According to the World Education Services, the majority of those Saudi students who study abroad are in the United States, the United Kingdom, and Canada (Kono, 2013).

2.2 Studying in the U.S.

For nearly a century, the United States of America has become the main choice worldwide for students wishing to pursue higher education opportunities (Wu, Garza, & Guzman, 2015). The welcoming environment of the American society and culture attract many international students to join its educational system. Additionally, a better quality of education in the U.S. tends to result in better jobs and opportunities in the students' countries of origin after graduation. However, research indicates that international students tend to face significant challenges as they adjust to a new culture, environment, social life and, often, new language (Andrade, 2006; McClure, 2007; Sherry, Thomas, & Chui, 2010; Heyn, 2013; Baklashova, & Kazakov, 2016).

Based on a recent report from Open Door Report in 2017, the numbers of the top four nationalities of international students who study in the U.S., as shown in Table 1, are from China, India, South Korea, and K.S.A. (Institute of International Education, 2017). These data are noteworthy because English is not the majority language in any of these countries. In fact, all of the major languages in these countries use alphabets or symbol

systems different from the one used for English. In addition to the usual challenges associated with studying in a new country, NNES students have to face an additional challenge to learn and study in English, which is not their primary language (Sawir, 2005; Akasha, 2013). For instance, Saudi students, who use Arabic as their first language, face many challenges academically, socially and culturally in relation to their academic English writings during their education period in New Zealand (Ankawi, 2015).

Table1. The top four origins of an international student studying in the U.S.

Rank #	Place of Origin	2015/16	2016/17	% of Total
1	China	328,547	350,755	32.5
2	India	165,918	186,267	17.3
3	South Korea	61,007	58,662	5.4
4	Saudi Arabia	61,287	52,611	4.9
	Total of International Students	1,043,839	1,078,822	100.0

2.3 The Challenges Facing International Students

Chemistry is a challenging subject due to the complexity of the science itself (Herridge, 2016). Like all sciences, chemistry has domain-specific naming systems, equations, and organizational charts, such as the Periodic Table. Along with the typical academic difficulties, NNES face the additional challenge of learning the content in a language other than their native ones (Ryoo, Toutkoushian, & Bedell, 2018).

Commonly, students who study abroad, deal with several academic, social, cultural, and most importantly linguistic issues (Akasha, 2013; Wu, Garza, & Guzman, 2015; Baklashova, & Kazakov, 2016). Researchers addressing some of these factors

have explained that international students have to cope with many fears and perceived difficulties such as learning in a new language, coping with the standards and requirements of classes, engaging with other students and instructors, and taking their exams in English (Mammino, 1998; Khan, 2011). Language is the major problem for students which can result in several limitations such as misunderstanding or miscommunicating between the students and the instructors (Rogers, 1986).

Students, who take classes in a foreign or additional language, whether abroad or in their own country, have been seen as “deficient” in their academic abilities (Cheng, 2000; Clark & Gieve, 2006). However, this notion comes from the limited experience and lack of proficiency in English with students’ process of thinking and reflecting new information (Ryan & Viete 2009; Mammino, 2010a; Choi, Tatar, & Kim, 2014). To make up for the deficiencies in language, students have to put forth additional efforts, time of studying and preparation before each class in order to adequately understand their subject. In addition, it is important to have a supportive environment for these students by understanding their challenges that can negatively affect their understanding within their classes (Andrade, 2006; Flores, & Smith, 2012). This supportive culture can assist in encouraging students to improve their learning experience by overcoming the challenges and difficulties that constrain them from advancement (Al Murshidi, 2014).

2.4 Difficulties of Learning Chemistry in English

Language plays a critical role in learning science because students are required to use academic language to comprehend, communicate, and represent their ideas about scientific phenomena (Yore, Hand, Goldman, Hildebrand, Osborne, Treagust, & Wallace,

2004; Lee, 2010). Scientific language also has specific meaning which may be different than colloquial language. This adds an additional layer of difficulty, one that is even difficult for native English speakers. Some examples include the idea of energy and conservation. Conservation of mass and conservation of energy, which are prevalent in chemistry, are different than “nature conservation” as used in everyday language. A recent study identified language of instruction as an important factor for the NNES’ success due to the significant impact that it has on the process of receiving and applying new information in their second language (Adams, Jessup, Criswell, Weaver-High, & Rushton, 2016). Yet, there are few studies that were performed on a high school level while there is only one relevant study that was performed on college-level students of this experience in chemistry education.

The college-level research examined the challenges and barriers that native-Spanish speakers faced while learning chemistry in English (Mayo & Bodner, 2007). Of the 16 students who participated in their research, five of them were graduate students at Purdue University in the while 11 of them were undergraduate students at the University of Puerto Rico. All of the students were enrolled in chemistry classes and majoring in chemistry. Data were collected by interviewing the students and asking them to explain in English a set of tasks based on general chemistry concepts. The results of these interviews assisted the researchers to create five categories to describe their data. First, students used their first language in order to reach a better level of understanding. Second, students avoided communications that demanded the use of their second language, as much as they could. Third, students misunderstood and misused scientific terms in regard to particular chemistry-related terms. Fourth, they faced difficulties and

challenges in the use of new terms they have learned in their classroom. Fifth, they had difficulties with using scientific words and phrases correctly that fit in the context of the sentence (Mayo & Bodner, 2007).

Another study on Latin American students, by Adams, Jessup, Criswell, Weaver-High, & Rushton (2016), found that language is a major barrier for NNES in order to understand the contents of their chemistry courses. The researchers performed an experimental study on a class in a high school that is located in a district of high minority level in the United States. The class included 19 English Language Learners (ELL's) who participated in a designated chemistry class with a concentration on writing and discussion assessments. One of the main outcomes was that students frequently translated statements to their native language for a better understanding of the subject's contents. The researchers concluded that the ELL students exhibited a higher level of cognitive ability when they used their native languages in place of their second language. Another finding was the lack of teachers' recognition and awareness about the different levels of the learning demands between ELL students and those who used English as their first language (Adams, Jessup, Criswell, Weaver-High, & Rushton, 2016).

A relevant study was performed in 2012 by Flores and Smith which focused on 17 students who were enrolled in a high school with a high minority population. All the participants were given individual semi-structured interviews in English about their experiences. Like the previous study, these students often attempted to translate what they learn in English into their first language (Flores, & Smith, 2012).

2.5 Research Objective

The students' difficulties and challenges can affect the students' ability to understand their courses' content, which ultimately can impact their academic performance during their educations due to the linguistic barriers. Thus, acknowledging and recognizing these obstacles can contribute to enhancing and improving the students' performance in their courses as they overcome those challenges.

The aim of the present study is to explore the difficulties that NNES face as they study general chemistry MSU. Though there is only one study that addresses this topic in chemical education, it was limited to those whose native language was Spanish and included only chemistry major students. However, there are many similarities between Spanish and English language such as the way of using similar alphabetic characters as well as numbers. Our research will build on the authors' groundbreaking work by purposefully seeking participants from a broader first-language background. Thus, this project will include other languages that have different alphabetic characters or even symbols such as Chinese, Arabic, and Bengali. In the next chapter I will describe the methodology that was used in this project

3. METHODOLOGY

The two guiding research questions of this study were:

- How do NNES experience general chemistry courses at MSU?
- What are the significant challenges NNES face as they learn general chemistry at MSU?

Because of my long-term goal of teaching chemistry in English back in the K.S.A., I wanted to conduct this study only with native Arabic speakers. However, due to the limited number of native Arabic speaking students enrolled in chemistry courses, I decided to recruit all students who were native speakers of any language using an alphabet or sign system different than that used in English. The participants and the methodology are described in the sections below.

3.1 Human Subjects Approval

Prior to beginning recruitment of research participants, this study received approval from the MSU Institutional Review Board (IRB) as an exempt study on 15 August 2017. The informed consent document can be found in Appendix A along with my certificate of completion of online IRB training through the Collaborative Institutional Training Initiative (CITI) site (Appendix B).

3.2 Participants and Setting

This research was conducted during the fall semester of 2017 through the Department of Chemistry at MSU (The project timeline is shown in Figure 1). All the research participants in this study were undergraduate students studying at Missouri State

University (MSU). At the time of the study, the participants were taking or had taken, one of the general chemistry courses: General Chemistry I (CHM160), General Chemistry II (CHM170). I intentionally chose general chemistry courses to recruit our research participant because they would have the largest enrollments compared to other chemistry courses.

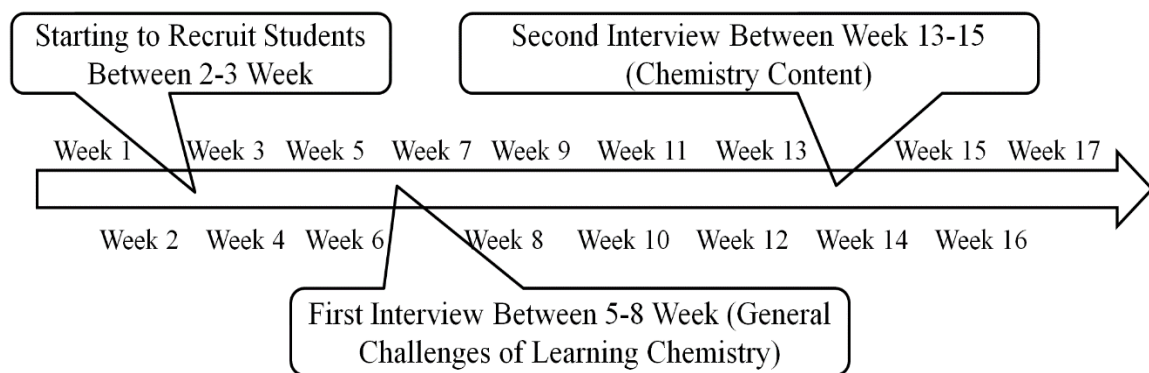


Figure 1. The project timeline

To start the recruiting process, I contacted all the professors teaching general chemistry courses through email and asked for their permission to take 5-7 minutes of their class time during the second and third weeks of the semester to ask their students about joining this study. After receiving each professor's permission, I went to the appropriate lecture and briefly explained the project to the students and the potential benefits of their contributions to such a project. Then, I answered any questions or concerns that might arise by students regarding the project or their participation. The students were then told that they would be sent a link to a Google survey by their professor. The purpose of creating the online survey, shown in Appendix C, was to give

students a confidential way to indicate their interest in participating. It also allowed me to collect some background information on each potential research participant.

As previously mentioned, it was highly improbable that there would be many Saudi Arabian students enrolled in either of the general chemistry courses. As such, I purposefully sampled based on the following criteria (Patton, 2002): 1.) English was not the students' first language; 2.) Their first language used an alphabet or symbol system different than that used in English; and 3.) They were taking general chemistry. I received 20 responses to the online survey. Twelve students agreed to be part of this project, and eight students disagreed. Only four out of 12 fit the criteria and were willing to attend both interviews. The five participants were given the pseudonyms Monna, Susan, Norah, Emmy, and Sarah to keep their identities confidential. Although Emmy was enrolled in organic chemistry I course (CHM 342) at the time of the interviews, but I considered her for this project upon her professor's suggestion because she met the sample criteria.

3.3 Data Collection

Because of the small sample size, I pursued a case study design because that would allow me to extract generalizations from an in-depth study of a few individuals (Patton, 2002). In a case study, the researcher compensates for the small sample size by getting in-depth and detailed information over an extended period of time. Analyzing data across multiple cases give a measure of generalizability to the results.

Data were collected through two audio-taped interviews with each of the five participants. The interviews were semi-structured to allow for follow-up questions and clarifications as needed. The first interview focused on the students' backgrounds prior to

beginning their studies at MSU. The second interview was based on a set of tasks related to general chemistry concepts in lecture and lab, which was developed and then reviewed by the general chemistry professors to ensure that they were of an appropriate level.

At the beginning of the first interview, each participant was asked to carefully review the informed consent document and ask any questions about the interviews as warranted. Then, I highlighted some important parts of the research protocol:

1. The voluntary nature of participation.
2. The right to withdraw from the study at any point and the right to skip any part of the study.
3. By refusing to participate or withdrawing participating, subjects will not in any way affect the student's standing with their course, with the researcher, with the Department of Chemistry, with the College of Natural and Applied Sciences, or with Missouri State University.
4. The role of the research(er) is to understand the students' experiences, not to judge their knowledge in chemistry or ability to speak English.
5. There will be no tangible benefits from participating in this study.
6. The different types of potential risks and what the researchers will do to minimize them.

After this brief review, the participant was asked, again, if there were any questions and/or concerns regarding her role as a research participant. After that, the researcher asked for the participants' permission to audiotape their voice during each interview while they responded to the questions.

The first interviews, which were conducted during weeks 5-8 of the fall 2017 semester, focused on each participant's academic background prior to beginning their studies at MSU. Specifically, I asked them about the extent of their coursework in chemistry and English language in their home countries. Then, I asked each student several questions about their first impressions of learning chemistry in English and if they can explain their experience (Ankawi, 2015). The entire interview protocol for the first interview is shown in figure 2.

First Interview Protocol			
Age: 18-24	25-30	31-40	+40
Country:			
First language:			
Major:			
Years of study:			
1. If you are not chemistry major, how many classes have you taken in the chemistry department?			
2. How many years did you study the English language in your country?			
3. Have you ever studied English overseas?			
4. If <i>(YES)</i> for how long?			
5. Did you go to international school or public school in your country? International school / Public school			
6. Did you study science in the English language in your high school?			
7. Did you have the necessary English language qualification to enroll in your qualification of choice before you left your country?			
8. What kind of English qualification did you have?			
9. If you obtained your English qualification, where did you get it?			
10. Did you do any course in the United States preparing you before you studied here if <i>(YES)</i> what was the course and how long was it?			
11. Did you take any course preparing you for university study before you left your country?			
12. If you answered <i>(YES)</i> what was the course and how long was it?			
13. Did you do any course preparation for university study before you left your country?			
14. How regularly do you visit the Bear CLAW (Center for Learning and Writing) at MSU?			
15. What kind of support do you have with your class?			
16. Have you been assigned a special tutor to help you understand the class materials other than your instructor?			
17. What kind of support would you like to have to improve yourself in class?			
18. Do you prefer to work in a group or as an individual and why?			
19. Do you think you are/were adequately prepared to cope with other English speaker students and why?			
20. What do you think are your greatest challenges in class and why?			
21. Is there anything else you would like to say about your preparation for studying			

Figure 2. First interview protocol

These questions were asked in the course of a semi-structured interview so that I could ask follow-up questions to each participant as needed.

The second interview was conducted during weeks 13 to 15 of the same semester. In this interview, I focused on the students' approaches to solving a set of tasks. The first set of tasks contained six questions based on general chemistry concepts as shown in figure 3.

- Second Interview Protocol: First Task

 1. Can you explain why a liquid takes the shape but not the volume of its container?
 2. Explain why water changes from a solid (ice) to a liquid when it is heated?
 3. Explain why does a can of soda explode when you shake it?
 4. Clarify why does soda explode when frozen?
 5. Explain why you store food in a fridge to prevent spoilage?
 6. Which factor are you applying to slow the rate of reaction?

Figure 3. The first task of the second interview protocol

These questions were based on the consultation of the students' general chemistry instructors, who provided me with their courses materials, such as textbook that used in class and the class PowerPoint presentations with all topics that was covered on both CHM 160 and CHM 170. The purpose of asking these questions was to observe and better understand how NNES express their knowledge about chemistry in English. Accordingly, I asked the participants to work on the tasks by answering the questions orally followed by writing their answer in English.

The second task was a matching exercise related to the laboratory portion of the general chemistry course, and it was based on the lab manual used in CHM 161 and CHM 171 lab courses. In this exercise, students were asked to match pictures of

laboratory equipment or glassware on the right side of the paper to their names on the left side as shown in Figure 4. This task was developed after the first interview in which all of the participants indicated that the laboratory courses presented the most difficult challenges for them. Such emergent design is common to qualitative research studies (Patton, 2002).

Each student was asked to attempt each exercise twice, the first attempt without any help of a translator such as the Google Translator application. The second attempt they could either use a translator or ask me for further clarification. The purpose of this task was to demonstrate and observe at least some of the difficulties posed by the lab components of their courses. Also, these tasks helped me to better understand how students use translator applications to help them in their lab. All written answers were collected as hardcopy and electronic copy.

3.4 Data Analysis

Every interview audiotape was transcribed verbatim except for the few, brief instances with the three Arabic-speaking participants who spoke in their native languages. Using the transcripts and the students' written responses, I wrote case records for each participant. The case records reflected the main parts of the interviews: background in chemistry and English, experiences in general chemistry, and answers to tasks. I then did a cross-case analysis to find trends that were common to all of the participants' experiences.

1. Goggles
2. Thermometer
3. Graduated cylinder
4. Spot plate
5. Pipet bulb
6. Stirring rod
7. Test tube rack
8. Beaker
9. Bunsen burner
10. Crucible tongs
11. Burettes
12. Balance
13. Volumetric flask
14. Funnel
15. Filter paper
16. Test tube clamp
17. Spatula
18. Forceps
19. Wash bottle
20. Erlenmeyer flask



Figure 4. The second task of the second interview protocol

3.5 Validity

The interview questions' protocol validity was established through consulting with general chemistry professors before creating them and after finalizing them. This step helped confirm that all questions in the interviews were consistent with the students' possible content knowledge. Furthermore, multiple data collection points were obtained from participant over the course of an entire semester, allowing establishing a consistent

pattern of behavior. Finally, the overall conclusions of the research were drawn from the cross-case analysis to minimize the effect of any one case.

In the next chapter, I will demonstrate all results and qualitative findings of gathered data from two sets of interviews for the individual students of their experience on learning chemistry in English for NNES in general chemistry courses at MSU.

4. RESULTS

This chapter includes the results of the interviews that were performed with the participants. The data presented in this chapter reflect two sets of interviews for each individual participant. All findings are supported by direct quotations from the participants. These quotes contain the participants' exact words without any modification or grammatical correction. The initial "I" will be used to indicate the interviewer's statements. To maintain the confidentiality of the participants, the following aliases were used for them: Monna, Susan, Norah, Emmy, and Sarah. Brief demographic information for each case is listed in Table 2.

Table 2. Demographic information of the research participants

#	Participant Name	First Language	Major	Year
1	Monna	Chinese	Biomedical Sciences, Minor in Dietetics	Sophomore
2	Susan	Bengali	Microbiology with Chemistry Minor	Freshmen
3	Norah	Arabic	Cellular & Molecular Biology	Sophomore
4	Emmy	Arabic	Biology	Sophomore
5	Sarah	Arabic	Respiratory Therapy	Sophomore

Each case study will be presented in the following sequence: Background, Chemistry Experiences, Tasks Analysis, and Summary. The background portion will contain the participants' demographic characteristics and their educational backgrounds, including prior experiences learning English and Chemistry in their countries of origin and in the United States. The Chemistry Experiences include the challenges and adjustments that the participants have experienced in taking general Chemistry classes at MSU in lecture and laboratory. The Summary includes the highlights of each case.

4.1 First Case: Monna

Background. Monna is a 20-year-old student from China who came to the U.S. a year and a half ago to pursue her Bachelor's Degree in Biomedical Sciences with a minor in Dietetics. Monna's first language is Chinese. As a student in her second year, Monna completed two chemistry lecture courses at MSU prior to her current chemistry course which is CHM 170. She previously took CHM 116 and CHM 160. She also took the corresponding lab courses CHM 117, CHM 161, and CHM 171.

Monna used to study in a public school back in China so her prior instruction in chemistry was in Chinese. However, she learned English as a foreign language in school for six years starting from primary school until the end of high school. Those English language classes adopted a British textbook and mainly focused on reading activities with few speaking, listening or writing activities.

Because Monna did not have many opportunities to use her English in interactions with other people, she took an English language course outside of her school for two years. The course was mainly about studying and preparing for the Test of English as a

Foreign Language, or TOEFL. In the TOEFL preparation course, Monna did many activities to practice speaking and listening in English with teachers who are originally from China. Although listening is one of the major parts of any language, Monna did not feel comfortable with that practice in her TOEFL preparation course:

I: "Okay, Umm did you have to do a lot of listening activities where umm you know you listen to..."

M: "Umm I do some I do some listen to practice but I do not like listening."

She later described her experience when she first came to the U.S. She indicated that the most challenging factor for adjusting was to understand English not only in school but also in her daily activities as she stated in the following quote.

I: "So what was it, if you can remember, what was that adjustment like first coming here being completely new and then going through the university stuff in the first few days?"

M: "Umm it is the language because sometimes I cannot understand what my roommate is talking about and my teachers talking about ... Yeah."

Even at the time of the interview, Monna still found that communicating with others was the toughest part of living and studying in the United States:

I: "So now that you have to go through that process of being here for the year and a half. What has been the most difficult part of that adjustment?"

M: "For English?"

I: "For everything or English but you know it's something affects that sometimes?"

M: "Umm maybe communicate with people; with Americans."

Chemistry Experiences. After learning chemistry for four years in high school, Monna felt that studying chemistry in the U.S. was much easier than studying it in China. However, her difficulties with conversational English carried over to her chemistry courses, especially with understanding the professor.

I: "So how did you; as in classes, how did you deal with it when you could not understand what the teacher was telling or saying?"

M: "I can preview the course and then go to take the class and I finally I can understand."

I: "So what do you mean 'preview'? You mean doing the reading ahead of time?"

M: "Yeah. Yes."

I: "Do you find that you are better at reading than you are in speaking?"

M: "Oh yeah... Oh, I; when I preview for the class I always translate to Chinese so I can understand what teacher's talking about in class."

Monna later confirmed her preference to avoid spoken interactions when describing her general approach to getting help for her classes:

I: "How about in classroom-related stuff do you ask your roommate also?"

M: "Umm e-mail to my instructor."

I: "You mean your professor here?"

M: "Yes"

I: "Okay right. Do you prefer to email them rather than going up and ask them?"

M: "Yeah"

I: "Can I ask you why?"

M: "Because I.....you know I poorly spoke in English"

I: "Actually you're quite good it is very easy to understand you. But it goes back to you, you just feel more comfortable reading and ummm."

M: "Yeah"

I: "Has you....and so you have been able pretty much to resolve your difficulties by emailing your instructors."

M: "yes"

Though the previous vignettes indicate that Monna avoided interactions with her instructors because she lacked confidence in her ability to speak English, it seems that her ability to understand others may have played a role as well. Consider the following exchange in which she described the reasons for which she used the MSU Tutoring Center or the "Bear CLAW":

I: "What is that experience [referring to going to the Bear CLAW] like?"

M: "Ummm yeah helpful and they are nice."

I: "So what is it because now that you are at that point you are in a speaking interaction right? Do they do something that makes it easier for you to understand and be able to get help?"

M: "They slow down."

I: "Okay, and is that something that you asked them to do or they just kind naturally do that?"

M: "naturally do that."

I: "Okay. And is that one of the reasons you go back there for help?"

M: "yeah"

I: "Okay, umm so what subject you find yourself going to the Bear CLAW for?"

M: "Writing"

I: "Okay, umm and do you try to get the same person or do you work with different people?"

M: "Different people."

I: "And you have always felt that they are able to help you in the way that you need?"

M: "Yes"

Monna's primary reason for using the services of the Bear CLAW was that their tutors spoke at a slower pace than the professors in her classes. As such, the help she received there was more fruitful than during instructors' office hours where she would not have felt free to ask an authority figure to speak more slowly.

Though she did not mention it, Monna's study preferences may have been also affected by the ability to communicate at a slower pace.

I: "Umm do you prefer to work with a group or study with a group or do you prefer to do it alone for test or quiz?"

M: "Maybe alone."

I: "Why can I ask you why?"

M: "Because maybe I have a different way to prepare for the test."

However, when she asked the same question about studying with a group of other international students she changed her answer:

I: "Okay, so if you have a group study for international students will that be easier for you or still the same you prefer to do it alone?"

M: "Yes it will be easier."

It is important to note that Monna specifically chose to have American roommates and seemed to have a good rapport with them. As such, her preference to work with international students is not likely due to a preference to interact only with those from her same cultural group.

The main content area in which Monna experienced language-based difficulty was in the laboratory part of the courses. Interestingly, this was the one area in which she did not have prior instruction during her education in China. Consider the following exchange:

I: "So what are the things that So the fact that you have not done some of these things what were the challenges in trying to learn that so what made it difficult trying to learn it?"

M: "Learning lab course?"

I: "Yeah the things in the lab that you had not done it in China."

M: "Ummm I think is about the language because some words I do not understand the words and the procedure."

I: "So okay the procedure but what type of; I mean because like when they gave you direction their direction of how do you know setup things how to collect data and then how to analyze it right? How to write a lab report or things like that? What are those things were more difficult than the other."

M: "Ummm maybe umm what I need to do in lab course little bit...."

I: "You mean doing the lab?"

M: "Yeah"

[.....]

I: "right, so I do not know if it's easy to tell or not! Do you know what part of the language made it specifically more complicated for you?"

M: "umm what part ummm words."

In her response to give an example of the difficulties that she finds in using the English language for the lab classes, she said some of the names of the lab's equipment and tools.

I: "Rights, the reason that I'm asking if you are able to do the other classes were you read the textbook right. So what's make it different when you are reading this direction of how to set up something to do a lab."

M: "Umm the vocabulary."

I: "Okay, like this specific vocabulary of the..."

M: "Equipment"

Because when she asked about what she normally does if she did not understand any word in the laboratory or the lab procedure, her answer was that she would use the translator or ask her lab partner

I: "Equipment! Okay and so what did you do if you did not understand something."

M: "Use the translator."

I: "Okay, did you feel like asking anybody or....."

M: "Sometimes I asked my partner."

In the preceding quotation, Monna indicated that whenever she was confused about any words she would use her translator or ask her partner or sometimes her roommate which they both were native English speakers. Some of the specialized terminology or equipment may not have been available through a general-language translator found on the web.

Tasks Analysis. Nonetheless, one major observation of the second interview was when Monna had to do multiple tasks she felt much comfortable using the translator than just asking the researcher for more explanation or clarification. In the first task Monna answered all the questions except of the two following questions:

Q1. Why a liquid takes the shape but not the volume of its container?

M: "I'm confused with the first question."

I: "Okay, I will read it in English and I will try to explain it in English okay then if you still cannot understand it I will let you use the translator okay?"

M: "Okay"

I: "Start to explain the following questions to Monna."

M: "Ummmm"

I: "Do you feel you do not get it or you do not know the answer?"

M: "Yeah, I cannot answer."

I: "You are fine if you cannot answer it then that's fine just do the other questions."

M: "Okay"

[.....]

Q4. Clarify why does soda explode when frozen?

M: "And umm I do not know!"

I: "Okay, you are fine but you don't know because you did not understand the question or you do not know how to explain your answer in English?"

M: "I do not know to explain it (nervous laugh)."

I: "Okay, that's fine."

Also, she used the translator to translate the word "spoilage" on the following question:

Q5: Explain why you store food in a fridge to prevent spoilage?

M: "Umm because the temperature for use low so ummmm (laugh) ummm so ummm it's hard to ummmm react (laugh)."

Monna did the second task twice. In the first attempt she did the exercises without any help but on the second attempt she was allowed to use the translator or ask the interviewer. Thus, on her first attempt, Monna answered all of the names correctly however on the second attempt Monna asked to use the translator because she wanted to check her answer of the following words: thermometer, crucible tongs, spatula, and forceps. But, she did not ask the interviewer for any help.

Lastly, Monna indicated that she would have preferred to have a translator if she was able to have any resources or tools that could help her in learning chemistry in her second language. By having a translator during the class time, Monna believed it would give her a better chance to understand what she should do either in the class or in the lab:

I: "Okay, so if you could have anything that you want to have for your classes if there something you think that would help you with the language part?"

M: "Ummmm translator."

I: "Okay, umm do you think...What do you think ... So if you had a translator how do you think that would affect your work or be able to do the work because the work is in English right?"

M: "Yeah."

I: "So do you think that the translator would be able to help you with that or not?"

M: "It can tell me what I need to do."

In the second interview Monna did not understand the meaning of following two questions; can you explain why does a liquid take the shape but not the volume of its container? Clarify why does soda explode when frozen? Thus, she did not know how to answer those two questions even after I tried to explain the meaning of these two questions using different words. I then asked Monna again to write whatever she felt that

can answer them. She simply said: “I do not know the answer”. Hence she ended up leaving those two questions with no answers since she did not understand them.

Summary. Monna is a 20-year-old student who came from China to study Biomedical Sciences with a minor in Dietetics at MSU two-and-a-half years ago. She took three general chemistry courses at MSU as required by her major. Her experience in learning chemistry in a second language was challenging in many aspects. The challenge involves the communication with classmates, which prevented her to participate in informal group work, or having direct interactions with her instructors since she felt that speaking was her weakest part of using the English language. Another problem for Monna was the difficulties of coping with the pace of the lecture. Thus, she had to take many notes in her first language or go to the Bear CLAW to get help when she had questions because they spoke at a rate that at which she could better understand.

Besides those issues, she found the lab was very challenging for her since she had not taken any lab in her country previously. The greatest difficulties she experienced were with the names of the apparatus and other materials. Thus, she usually preferred to work with American students so they can help her with the language barrier. In addition, she preferred to use the translator during lecture and lab time to translate every new word.

4.2 Second Case: Susan

Background. Susan is a 19-year-old student, who came to the U.S. from a Southeast Asian country in January 2017 (the student’s nationality was not revealed, in this case, for confidential purposes as long as there are very few students from her country). Her native language is Bengali. She was in her second semester at MSU, and

her major was microbiology with chemistry minor. She was enrolled in CHM 160 with lab CHM 161.

Susan studied in a private, international school in her home country from kindergarten to high school. English was the medium of instruction in that school. Since both parents speak English, they decided to enroll her in an international school using a British curriculum, because they believed that would help her to have a better future to get a better higher education and better job opportunities.

Thus, Susan spoke English from an early age. None of the teachers in her school were native English speakers but they were certified on teaching in English by the Cambridge International Board. In addition, it was mandatory for all the teachers to speak English all the time with their students in or out of the classroom, even during their office hours.

Susan had to take one of the common English language proficiency tests for higher education and global migration, The International English Language Testing System (IELTS). She enrolled in extra tutoring to prepare for that test:

I: "So did you take any course to prepare you for the IELTS?"

S: "Umm I was just taking some like private lessons so just I can enhance my writing and reading that's all."

I: "Oh okay, so do write a lot in school do they assign you to write..."

S: "Yeah, I have to in biology lab classes I have to write a lot of lab reports."

I: "But yet you still feel that you needed an improvement in writing after that?"

S: "Umm well there is always room for improvement (laugh)."

I: "Right."

S: "Yeah exactly since English is the second language I do not want to think that I'm the best at it so!"

Chemistry Experience. Susan was very firm on saying that she did not find difficulties in her experiences, and she was very specific that she did not have any difficulties in lecture. Thus, in every question in which I used the words like difficulty,

challenging, hard, or struggle, Susan would disagree politely that she had any kind of difficulty or struggle. There seemed to be two reasons for which Susan did not feel challenged in CHM 160. The first reason is Susan covered most of the general chemistry and introduction of organic chemistry in high school and she learned it in English.

I: "So what about the lecture is it challenging for you to understand the contents and what is going on?"

S: "umm no it is fine I like it."

I: "So did you like cover what you learn now like before in high school or it is new concepts for you?"

S: "Yeah ummm everything I learned in high school it is more like the lecture classes it is very easy for me [...] Yeah because in ummm our high school we had to give an A-level so we had to learn advanced organic chemistry."

This sense of confidence is further supported by the following exchange about preparation for course lectures:

I: "Yeah, so if you want to prepare for the class do you prepare before or just go there and...."

S: "Uh I just go there (laugh) since I know everything."

I: "Yeah, that's fine some people like to prepare first then go back...."

S: "Yeah, I used to do that in the first few classes then umm I just umm I do on not have time."

I: "Okay, do you think like preparing before coming to the class when you read the textbook you can understand all the materials?"

S: "Yeah, I usually go through the lecture slides and umm there are like additional problems yeah those are very helpful."

As the vignette illustrates, in the beginning, she used to read the materials right before the class but after a couple of weeks, she stopped preparing before lectures.

The second reason that Susan found CHM 160 to be straightforward course was that she thought that the textbook was much easier to understand compared to the British textbooks that she used in her high school.

I: "Okay, so you told me in school you used English textbook."

S: "yeah"

I: "Is it different from American style textbook?"

S: "Maybe yes because umm in American umm textbooks it is very simple and easy."

I: "Oh really."

S: "Yeah."

I: "So you can like understand..."

S: "It is easier but in our textbooks, those is very critical and it's so hard"

I: "Oh, yeah some English textbooks use more complicated sentence structure and things like that."

S: "Yeah."

Though she may have found the course content easy, Susan had difficulties with the length of her chemistry lectures and with the amount of technology used in the lecture. For Susan, it was hard for her to concentrate and understand all the information in that duration of time. She preferred to have more activities such as solving problems to feel more engaged with the class the whole time.

S: "Umm it is usually easier because..... But umm I think lecture classes are too long."

I: "So how many hours?"

S: "It is one hour and 30 minutes it is very long."

I: "But you have to take it like two times ..."

S: "Yeah two times a week."

I: "Okay, so you find it Ummm....."

S: "I find it very umm theoretical but I like to solve problems if there like more clicker questions and umm there are more questions solving ummm like if it is a questions ways I think we will get the information better yeah."

I: "Oh, so you prefer to actually work in the lecture more than giving the information."

S: "Yeah it is too much to maintain."

I: "Do you find it hard to concentrate the whole time?"

S: "Yeah it is Ummm I mean he tries a lot to like make the class engaged even after... he has to give the information even if he does not want to but he tries a lot like he shows a lot of videos and umm funny jokes cartoon jokes and tries to make us engaged in the lecture and I think those are very nice for him."

In addition, using technology in class such as Blackboard, online quizzes, and online lectures was a bit of a struggle for her. For example, students in CHM 161 and CHM 171 labs had to take the pre-lab quizzes online prior to their lab time. Susan had a difficult experience with these online quizzes at the beginning since she was not familiar

with Blackboard and nether to the online quizzes. Lab for example, she could not do the quizzes in the first week even after she asked her instructor she still could not find the quiz.

S: "Yeah, big different because everything is online like you have to keep up with the blackboard or where else you are out of date."

I: "Oh so you mean it's something new for you to use Blackboard?"

S: "It is my second semester so I'm not feeling that new about this so when I was in my last semester I was facing a lot of ... I was struggling with keeping up with the information like everything you have to do it before the class and yeah the preview labs like before coming to the lab and after what to do."

I: "So did take any chemistry course before?"

S: "No, I did not this is my new one."

I: "Okay, and umm you have to also an online quizzes in chemistry in blackboard."

S: "Yeah before coming to the lab I have to do preview lab quizzes."

I: "Oh yeah so you find this one a difficult for you?"

S: "Umm I did not know where it was in the blackboard honestly (laugh) then I emailed my instructor what should I do I could not find it I thought it was on the lab manual because it is very weird because there are like prelab questions and post-lab question I thought that's only the prelab question that I have to do."

I: "So you go to the lab manual and tied to answer those questions."

S: "Yes (laugh) I thought I have to do that."

I: "So how did you figure it out that this is not the preview quizzes?"

S: "After the lab."

I: "Oh so you missed the first one?"

S: "Yeah like after the second lab I understood I had to do it on the blackboard"

I: "How did you understand it's not...."

S: "I just go through all the ...you know the options on blackboard..."

I: "And you found it?"

S: "Yeah, I finally found it (laugh)."

I: "So you did not ask your lab instructor?"

S: "I asked him a lot of questions and he was trying to make me umm like he was telling me to go there but I did not know even understand it was there."

I: "Oh okay, so did you explain to him?"

S: "Yes, I told him that I found the prelab questions."

I: "And did you show him that you did it here and...."

S: "No, so I completed then he was like first lab umm the first prelab I submitted out of the time so he told me that at the end he will see if I'm out of like ummm like if I have problems or my marks if very low hopefully is not then he will give me that's marks."

These difficulties extended to an online biology course Susan took as well.

S: "Yeah, I was in bio 122 an ummm I had to study like everything Ummm I did not even have the book."

I: "Oh really why?"

S: "Yeah, like a hard book, I was so afraid so much."

I: "Was it back in your high school?"

S: "No, last semester in Biology BIO 122 (at MSU)."

I: "Oh okay."

S: "It was so bad then I... you know if I need any instructions I would be like where is the real book (laugh)."

I: "So you had to learn everything ..."

S: "Online! I know it is very difficult."

Susan preferred to have a direct contact or communication with her professors as long as she had her education in school in English language. Thus, she used to have more English conversation experiences as well as communication with her teachers in English while she was in her international school.

I: "Okay, so do you find it okay to ask him questions during the class or after?"

S: "Yeah, will I usually ask him questions after the lecture."

I: "Oh so do you go to his office hours or right after the lecture?"

S: "Umm yeah after the lecture I just go to him."

I: "Did you try to go to his office hours or maybe someday?"

S: "Umm maybe if I have more problems umm until now I have not."

She would prefer to go ask her professors in person rather than writing them an email since she felt that she can ask more questions or clarification which means better communication

I: "Okay, but you would umm if you need to ask him a question you will go there or just send him an email?"

S: "Yeah, umm I can do both but umm whenever I have problems."

I: "Okay. so you do not mind to go to his office then and talk to him."

S: "Yeah."

I: "So do you usually prefer to speak to him or just write an email."

S: "Speaking is better yeah so you can ask more questions."

I: "Okay, so do you think that you have a weak point in your second language like for me writing even for my first language... really I always prefer when someone to go to his office and talk personally."

S: "(Laugh) yeah personally is good."

I: "Do you feel the same or... in writing?"

S: "I....I do not know umm writing is not a problem for me but I prefer meeting with them in person."

However, with massive enrollment number in general chemistry classes, Susan did not feel comfortable asking her professor during the class period when she has any questions. Interestingly, she assumed that by using clickers that the professor did not welcome interaction with the students during lecture time.

S: "No, and not only that but lecture classes are very big."

I: "Oh so....um yeah."

S: "So there are so many people."

I: "Oh yeah so this is another question do you find it really hard to be with a really huge class?"

S: "It is different because it is not personal interaction we have to answer everything with clicker...Yeah."

Susan's communication with her classmates was very limited. In many parts of the interview, she explained that making friends or social contact with her classmates was challenging for her. Consider, for example, her description of studying for exams:

I: "So to prepare for the ummm I know you took your first midstream right?"

S: "No, not yet in this semester not yet."

I: "Oh okay, so do you know how you will prepare for the test?"

S: "I think I will just go over the questions because it is helpful for me when I do not know."

I: "Okay, so you do not like to have a group for study?"

S: "I like umm I like to study alone."

I: "So you are always like to study alone."

S: "Yeah."

I: "But you do not have a problem to communicate with other students for umm."

S: "Maybe if I have a problem I will ask the instructor but I personally prefer to study alone."

In addition, she never went to Bear CLAW even though she did not give a direct reason why. Thus, she prefers to learn by her herself or ask her professor if she has any questions these two options are the best fit for her.

I: "Okay, do you ever try to go and ask for help other than umm your classmates or the instructors, for example, the Bear CLAW?"

S: "No, I did not...I did not use that facility yet."
I: "Why not?"
S: "Because I umm up to now I do not need it."
I: "Okay, not even for chemistry?"
S: "No, in chemistry I umm became very....umm found of it because it's easy for me. So I do not like to ummmm if I have a problem I will just ask the instructor yeah."
I: "Okay, so you did not use the writing center or the Bear CLAW."
S: "No, not yet."
I: "Okay, are planning to go there in the future?"
S: "I'm not sure! I have to see if I cannot do it I will go and ask."

Susan did not try to introduce herself to any students in her course lecture because she believed that everyone was busy and she did not want to interact with anyone unless they knew her very well. Hence, her assumption was that they are not interested to make any social contact with her.

I: "And umm do you find it really challenging?"
S: "Yes, because over here in class you do not know anyone but in school back home, you know everyone and if you miss any class or umm you came late umm your friends will help you in school."
I: "Because umm you knew them...umm I mean you said that you know them even outside of school?"
S: "Yeah, like in [her country] I know everyone."
I: "Yeah, I understand, so why it is different for you to communicate with 30 students but over here you cannot communicate with your classmates."
S: "Everyone is there like everyone over here like in their own umm like ...you know."
I: "Okay, so even...like the student who sits next to you?"
S: "Yes, they will never umm you will not know what's going on in their life."
I: "So you did not try like to like introduce yourself?"
S: "I don't umm I don't want to like disturb them because they don't seem like they want to make friends in class now."

However, in CHM 161 lab Susan did not mind working with her lab partner; in fact, she found it very useful for her. She explained why it is useful and easier for her to communicate with her lab partner and that because she had the opportunity to work with the same lab partner throughout the semester. Thus, they together make equal efforts to know each other and work together throughout the lab to do experiments.

I: *"Oh okay and you have the same lab partners for all lab session?"*
 S: *"Yeah."*
 I: *"Is it really helpful?"*
 S: *"Yeah, it is very helpful because they can help me with whatever I do not know and I can help them like we can fill in each other and ummm understanding."*
 [.....]
 S: *"Yeah, everyone is like that mostly but in the lab, classes are easier to communicate with...you know."*
 I: *"Okay, so you have friends now in the labs or like let's say kind of?"*
 S: *"Yeah, kind of."*
 I: *"Okay, so did you like exchange number or...?"*
 S: *"Yeah, I add her on Facebook umm like my chemistry lab partner only and that's it."*
 I: *"Only."*
 S: *"Yeah."*

On the other hand, Susan compared between how her experience of working with one partner in CHM 161 and how she felt working with a group of students in her Genetic lab course. She prefers to work with the same person in every lab throughout the semester more than working with the group throughout the semester. Thus, making a personal connection with her lab partner is very important for Susan.

I: *"And what about another lab?"*
 S: *"Other lab I do not know because for chemistry lab partner there is only one person."*
 I: *"Oh so for other labs you have more than one?"*
 S: *"Yeah, like four people usually."*
 I: *"Oh really so you did not communicate with them?"*
 S: *"No, like there is not that much personal conversation."*
 I: *"Oh okay, so if you like let's say in future that you missed one lab you do not have their number to ask..."*
 S: *"No, I do not think so. I do not know but I will have to ask the instructor for any help."*
 I: *"Okay, so do you find it like really hard for you to make friends here?"*
 S: *"It is hard because you have to make an effort and you have to do everything on your own..."*

In addition, Susan's lab partner in CHM 161 was an international student as well, which make it much easier for her to build this mutual friendship with her lab partner. When she got asked if she would like to have international students as lab partner on the

future lab course, her response was yes because she would love to have lab partner who can understand her experience as an international student.

I: "Is he or she an American?"

S: "They are umm my chemistry lab partner she is from Germany yeah."

I: "Okay."

S: "She is good."

I: "Oh really!"

S: "Yeah, even though she is always complaining like I do not like so and so and why we use milliliter (laugh)."

I: "So she is also an international student."

S: "Yes."

I: "Oh okay, so do you feel related because she is an international as well?"

S: "Yes, and she is very funny (laugh)."

I: "Okay, so would you prefer in the future to work with an international as well or you don't mind if you have an American?"

S: "I think umm personally umm obviously I would want someone from like my same experience and background."

I: "Okay, so you mean someone from [Susan country] or any international?"

S: "[Susan country] or any other country someone who gets me and like use unites international system (laugh)."

I: "Okay, so you would feel comfortable to work with international...."

S: "Yeah."

I: "Because they would have..."

S: "Yeah he or she will go through all those ummm same experience as I have."

In the following quotation, Susan stated that she had a major difficulty with the American units. She continuously referred to that issue during the interviews since she is not familiar with that system. For instance, Susan had to answer a few questions about her communication with the course professor and the class atmosphere. Her answer was about how she felt when the class professor of CHM 160 class stated that they would adopt the international system of units (SI Units) as a system of measurement which made her very relieved.

I: "But what about the language to communicate in class between you and the professor?"

S: "I think umm it easier for me now because of my professor Doctor.....he umm you now units it's all in the systematic umm international system like cm³ (cubic centimeter), kilometer (km), and Celsius."

I: *"Oh really."*
S: *"Yeah."*
I: *"So he uses that?"*
S: *"Yeah, he said that is better if we adjust with that system"..... "It is like difficult to convert always."*
I: *"Yeah, so he decided to use that."*
S: *"Yeah."*
I: *"Do you know why? Did he tell you why?"*
S: *"He just told that everyone uses that outside the U.S. that's why he told us to use it (laugh)."*

Unlike the lecture courses, Susan found the lab courses less straightforward:

I: *"So umm you find the lab is more confusing than the lecture right?"*
S: *"Umm I like labs but it gets a little challenging."*

Even though Susan had the experience of taking chemistry lab course in high school, she still found CHM 161 lab a challenge because the lab taught was different from what she used to. In addition, Susan stated that part of the difficulties with the lab course was the names of glassware instruments and equipment which was new or different from what she used to since her high school used a British curriculum and they follow the British style of naming and pronunciation of the lab instruments and equipment

I: *"Do you find it difficult for you?"*
S: *"For the labs, I think those names are very weird for me."*
I: *"Names of what?"*
S: *"Like instruments."*
I: *"Oh really can you give an example?"*
S: *"Yeah, like pipet we call it pipet and it is a pipette (difference in pronunciation)."*
I: *"Okay"*
S: *"And the conical flask (Erlenmeyer flask) they called it over here it umm it is very weird I have no idea what is that!?"*
I: *"The conical flask what do you mean? Volumetric flask"*
S: *"Oh no the volumetric flask are bigger it like"*
I: *"Oh so you mean the smaller one?"*
S: *"Yeah (laugh)."*

In addition, one of the major skills that all students must achieve in the CHM161 lab is using Excel to analyze their data. Working with Excel was an actual struggle since it is a new skill for her and she never worked with it before.

I: "So you think Excel is the hardest part of the lab."

S: "Yeah, I think that's the most challenging part."

Also, she used to do all the analyzing part manually back in her high school. Besides it is a very sensitive program which means any minor mistake in either entering their data or typing the written formula that will destroy their whole work.

I: "Did you take your first quiz in the lab?"

S: "Yes."

I: "How was it? Do you find it hard?"

S: "I find it is hard to do Excel."

I: "Can I ask why?"

S: "Because there is a lot of systems (laugh), oh my god if I made a mistake in one it will continue like an add-on in the next one."

I: "Yeah, do you use Excel back home?"

S: "No, I do not."

I: "And you do not take lab in school?"

S: "In school we had to use ummm we were given much harder labs but we had to it like not on the computer."

I: "Oh okay, so you had to do it manually."

S: "Yeah."

I: "All the calculation and everything."

S: "Yes, everything."

I: "Even if you have to umm."

S: "Writing and draw the graphs yeah everything"

Although Susan explained previously that she would usually ask her lab partner when she needed help to understand some of the difficult parts of doing the experiment, in the Excel part Susan, stated that she would try to teach herself by reading the instructions in the lab manual and asking her lab instructor during the lab time. Whenever she had questions about Excel outside of the lab time, she stated that her

options would be either emailing the instructor or choosing not to do the Excel part completely.

I: "Okay but when you come here did you learn how to do Excel by yourself or do you ask for..."

S: "There are on the lab manual and there are like many instructions and I had to follow every single step."

I: "Okay, so you understand the instructions very well?"

S: "Yeah, sometimes if I do not I have to ask the instructor."

I: "Okay, and in class ..."

S: "Yeah, in class."

I: "So when umm what about if you are at home and you have to do it by yourself?"

S: "Umm if I can understand what to do then I just do not do it (nervous laugh) that's much easier."

Tasks Analysis. Susan did not participate in the second interview thus she did not respond or answer any of the second interview tasks.

Summary. Susan is a 19 years-old student who studied biology with chemistry minor. She speaks Bengali as first language; however she was in international school in her country which means the language of the instruction is English. Susan did not want to be perceived in having any difficulties on course lectures. Even though she did not have major problems with the language, she still had adjustments with the accent since she used to British English accent. The most difficulties for Susan was based on cultural differences such as education culture and in a social culture which affected her communication with other students.

The other significant challenge for Susan was the lab course since she was not familiar with doing lab before and in communicating with her lab partner. Thus, she always chose to work with international students since she felt it easier for her to communicate because they both will relate to their challenges as international students.

4.3 Third Case: Norah

Background. Norah is a 23-year-old student who came from the K.S.A. She speaks Arabic as her first language. Norah decided to come to the U.S. after she graduated from high school to study cellular and molecular biology. Norah is in her second year, and she previously took CHM 160 and the corresponding lab CHM 161. During the interview, she was enrolled in CHM 170 without the lab CHM 171 and stated that she is not going to take the CHM 171 lab in the future.

Most public schools in K.S.A. use the Arabic language as a medium of teaching. Thus, Norah took all courses, including science courses, in Arabic, which is also her first language. The only exception was the English language class which she took for the three years before she came to study in the U.S. Norah received a conditional acceptance from MSU which means her acceptance was upon the completion of the English Language Institution (ELI) at MSU. Thus, Norah spent eight months at the ELI before she started her degree.

Chemistry Experiences. Norah explained that she used to do well in chemistry classes when she was in high school but when she came to study in the U.S., chemistry begin to be her hardest subject.

I: "Okay, but umm do you do well in chemistry in high school?"

S: "Yeah, in high school because it is basic so it is easy but here is difficult I got a B grade in CHM 160 and B- in CHM 170."

Norah stated during the interview that the way of the teaching structure in her chemistry classes was different from what she was used to in high school. As such, she hardly understood the chemistry content because of the language that used in the class. Due to these reasons, Norah did not think that she was at the same level as American

students. She felt that American students had more advantages than international students especially those who do not speak English as the first language. For example, she thought American students were more familiar with the education system, and they did not have to deal with a language barrier during instruction:

I: "Do you think umm that you are prepared to cope with other English speaker students for example if you like if you are in the same level with English speaker students when you come here in the U.S.?"

N: "Umm no."

I: "Can I ask why?"

N: "You mean why I feel that (asking in Arabic the participant first language)."

I: "Yes."

N: "Because they were prepared from an early age like high school (answering in Arabic the participant first language)."

I: "Oh okay so you mean they were prepared to form high school."

N: "Yeah."

I: "So different background that's what you mean."

N: "Yes."

I: "And for the language level do you find there is a gap between you and the other students?"

N: "Yes (her answer was said with emphasis)."

Thus, Norah believed if she had the opportunity to improve her English language before she came to study in the U.S. that might help her more to understand her classes and to be more prepared for academic language.

I: "Okay, so if I ask you that if you would have something before you come here to study for example if I ask you like three years ago what you should do to prepare yourself before you come here do you know what you should do?"

N: "Yeah."

I: "So do you want to do that like before you came here?"

N: "Yeah, just improve my language for academic."

Norah used to go to the writing center at MSU whenever she had any writing assignments especially when she was taking ENG 110 Writing I, which is a required general education English course. Norah stated that she liked to go there. However, she never went there for any of the science courses that she took so far.

I: "Okay... so how regularly do you visit the Student Learning Center at your university?"
 N: "Maybe three times."
 I: "Per week?"
 N: "No, just when I take 110 (ENG 110 Writing I) yeah English 110."
 I: "So when you were at the university or still in the ELI?"
 N: "In the university."
 I: "So you did not go there for any other course like chemistry?"
 N: "No."
 I: "Did you find it really helpful for you when you go there for 110?"
 N: "Yeah...yes it's really helpful."
 I: "Are you planning to go there (to the learning center at MSU) more in the future?"
 N: "Yes, when I need and have time to go."
 I: "Umm so you will consider going there only for the language or you will go there...."
 N: "Yeah, if it was about the language."

In the chemistry lecture, Norah used the textbook as one of the most important class materials to help her to understand the class, and she stated that she did not use any other class materials. Nevertheless, she preferred to have an Arabic version of the textbook to exclude the language difficulties for her.

I: "Okay, so what kinds of support do you in class so for example if you are in chemistry class....and what you...umm like the most support for you is it the lecture, blackboard, the book?"
 N: "The book."
 [........]
 I: "Okay, but the English (language) it is of.... for example, if you read the same book (chemistry book) in Arabic and in English what you will prefer?"
 N: "I will prefer Arabic."
 I: "Why is that?"
 N: "Because I will understand it but it is still difficult."
 I: "You mean the content it is self?"
 N: "Yeah."

Moreover, Norah described how she would perform on the test if she had an extra support in the class such as translator. She believed that having a translator would help

her to understand those questions better and then she would most likely choose the right answers.

I: "So if in your test the instructor told you I will provide you a translator would that help you to do better on the test or no?"

N: "Yes."

I: "Really?"

N: "Yeah."

I: "For when aah for like understanding the questions or just writing the answer?"

N: "No, just for the question."

I: "Okay, so if you have a translator for the test do you think you will do better?"

N: "Maybe yes."

Norah tried to prepare for her class but then she found difficulties to understand the content thus doing the preparation before the class was a difficult task for her. In addition, she was confused about what she should do before the class and what her class instructor was expecting from her to be prepared for the class.

I: "Okay, and do you prepare before the lecture?"

N: "I tried but it is really difficult to understand what they (the class instructor) want!"

I: "Is it difficult because chemistry is difficult or ..."

N: "Because yeah chemistry is difficult for sure."

As result, Norah stated that studying with a group was the best option for her to understand the class and to prepare for exams. However, she preferred to have an international students group to work and study with because that would be much easier to communicate with each other. Hence, she had an international group when they all spoke her first language.

I: "Okay, so in the lecture do you find it really easy for you to ummm what the professor is talking about"

N: "Yeah and we study as a group."

I: "Oh really so you used to study with a group?"

N: "Yes."

I: "Is it for the same class or different?"

N: "Yeah, same class."
I: "Are they international students?"
N: "Yes (laugh)."
I: "Do you prefer to work with international students?"
N: "Yes (laugh)."
I: "Why? Can I ask why?"
N: "It is easier to understand each other."
I: "So do they speak the same language?"
N: "Yes."
I: "So they are all from Arabic countries?"
N: "Yes."

On the other hand, when asked about CHM 161 lab, Norah felt it was much easier to work with a native English speaker as a lab partner to help her in the experimental procedure and to explain to her if she did not understand any steps of the experiment.

I: "Okay, do you remember the lab partner you used to work with is he/she an international student or an American student?"
N: "Aaah American but I do not remember his name."
I: "That's okay, so do you find it easy to communicate with your lab partner in the lab?"
N: "Yes."
I: "Okay."
N: "He was helping me."

When she was asked if she could do the procedures by herself on the lab exams, she answered that she would not be able to perform the experiment alone especially in her second language.

I: "Okay, so I kind of finish but I want to ask you about the lab. Do you find it difficult for 161 labs do you find it difficult to go through the procedure of the experiment and do the experiment by yourself?"
I: "Yes."
I: "Do you know why?"
N: "Ummmmm maybe the language."

In addition, Norah explained that she would not ask her instructor whenever she had a question during the class or lab time, and she rarely went to their office hours. Thus, she usually preferred to send an email to her instructor with all her questions. In

that way, her questions would be answered and she could go back to the email whenever she wanted.

I: "So you don't prefer to go to the instructor and ask him?"

N: "Umm no."

I: "Can I ask why?"

N: "Ummmm I do not try (nervous laugh)."

I: "But do you try it with other classes to go to the instructor and ask him?"

N: "Umm yes, I try it one week ago and it is really helpful."

I: "What prevents you to do that before is it the language or you do not have the time or you just don't prefer ...?"

N: "I just do not do it (nervous laugh)."

I: "Okay, if you have to contact your professor did you prefer his office or email him?"

N: "E-mail him it is easier."

I: "Easier for you?"

N: "Yes."

I: "So do you find it easier to write an email then go there and contact him in person?"

N: "Yes."

I: "Can I ask why?"

N: "Ummmm (long pause)."

I: "Is it simpler for you like talking?"

N: "No, because I can come back to the email and I can read in my time."

Tasks Analysis. In the second interview, Norah asked to skip the first set of questions after she read them because she claimed that she did not know the answers. Even when I told her she could answer them in Arabic, she still asked to skip them:

I: "That's okay, take your time and read it again then see if you can give me at least your better guess!"

N: "No I cannot (nervous laugh)."

I: "That's fine, do you want to try to answer it in Arabic or translate the questions in Arabic?"

N: "(Speaking in Arabic) Umm I cannot answer them."

I: "Okay ...can you please do your best and just try to give me an answer...or the best guess and you can answer in both languages."

N: "I cannot."

Since Norah did not answer the first set of questions set, I asked her to describe or explain each question to observe the level of understanding of the questions in English.

Norah used her first language (Arabic) to describe the meaning and what she understands of each question.

I: "Okay, what about the questions can you explain the questions to me?"

N: "Okay."

N: "(Speaking in Arabic) the first question is why the liquid made the shape but did not take the volume of the container itself."

I: "Okay."

M: "But I did not know why."

I: "That's fine but you understand the questions?"

N: "Yes."

N: "(Speaking in Arabic) second question why Ummm the ice changed from ummm."

I: "cube or solid."

N: "(Speaking in Arabic) yeah umm when there is a heat."

N: "(Speaking in Arabic) the third question is why the gases drink umm I do not know what's happened to it."

I: "Shake it (speaking in Arabic) its mean when you shake it."

N: "Oh okay."

N: "(Speaking in Arabic) the fourth question is umm what happened when you froze soda.... (Norah did not understand the rest of the question)!"

I: "Okay!"

N: "(Speaking in Arabic) the fifth question is why you store food in the fridge Ummm I do not know the last word."

I: "(Speaking in Arabic) its mean spoilage."

N: "(Nervous laugh) yeah."

N: "(Speaking in Arabic) the last question is what you usually do to slow the reaction."

Even though Norah used her first language to describe the questions, she still could not provide the whole meaning of each question. For example, she explained only one part of the third and last questions, and she seemed that she could not understand the whole meaning of those questions.

The second exercise, which was the matching questions, Norah had to take it twice because on her first attempt she was only able to solve six out of 20 without using the translator and without any future help from me.

N: "(Speaking in Arabic) I do not know most of them."

I: "That's okay, just try your best or you can just guess the right answer."

The six names that Norah knew were as follows: thermometer, spot plate, goggles, balance, wash bottle, filter paper. All these words were commonly used in every lab course and also they can be related to everyday words such as paper and wash bottle.

After the first attempt, I asked Norah to do the exercise again but with help either by asking me for further explanation or by translating the words using any translator. Yet, Norah had difficulties understanding some of the names even after she used Google Translate, and she was only able to answer 11 out of 20 names.

N: "(Speaking in Arabic) I do not know this one (laugh)."

I: "The volumetric flask (the interviewer start to explain it in Arabic)."

N: "(Speaking in Arabic) oh okay this one right."

N: "Umm I did not know this one."

I: "(Speaking in Arabic) explaining the picture and the use of it."

N: "(Speaking in Arabic) still I do not know it."

I: "You can translate the words if you want."

N: "(Speaking in Arabic) I did (laughing)."

I: "You are fine. Just make a guess or just leave it if you want."

N: "(Speaking in Arabic) okay, I think I'm done."

Summary. Norah is a 23 year-old student who speaks Arabic as the first language. She studied at the ELI for eight months before she started her program. Norah took CHM 160 lecture, CHM 170 lecture, and only one lab CHM 161, and she had no intention to take CHM 171 lab. Norah claimed that she did very well in chemistry classes when she was in high school. However, that was not the case when she started to take chemistry classes at the college level in English. She stated that now chemistry is considered one of the hardest classes for her. It is hard for her because the content is becoming more challenging and because of the language barrier. Norah said that she depends a lot on the textbook when she studied for the lecture even though that she prefers to have an Arabic textbook. In addition, she said that she usually studied with her

Arabic speaking friends to prepare before the test. Norah did not try to do any other methods to overcome the difficulty that she faced in chemistry class such as asking for tutoring, going to the learning center, or going to the office hours. However, in the lab course, Norah stated that she prefers to work with native English speaking students because she feels that would help her to understand the process of the experiments, and she can rely on her lab partner whenever she has any difficulties. Yet, Norah stated that she would not be able to perform the lab procedure alone like on lab test because simply she won't know how to do that.

On the second interview, Norah skipped the first exercise claiming that she did not know the answers. Though I asked her if she can explain the question to observe how far she understood them, she starts to explain the questions in Arabic, not in English, and she missed the complete meaning of some of the questions. Norah did the second exercise, the matching questions, twice because the first time she did not know most of the names. Thus in the second try, she was allowed to use the translator or ask the interviewer for more clarification about the meaning and she was able to get half of the words.

4.4 Fourth Case: Emmy

Background. Emmy is a 20-year-old student from Egypt, and she speaks Arabic as her first language. Emmy is majoring in biology thus she took both general chemistry courses, CHM 160 and CHM 170, with their corresponding lab CHM 161 and CHM 171. During the time of the interview, she was enrolled in CHM 342. Also, she was planning to take more chemistry courses in the future like CHM 343, organic chemistry II, and CHM 352, introduction to biochemistry.

Emmy studied English as a foreign language subject for 14 years in her school in Egypt. However, she explained that her English teachers used to explain in both languages Arabic and English during the class period to ensure that their students understood had a solid understanding. This way of presentation is a very common method in any foreign language instruction. Emmy believed that going between two languages helped her to understand the English grammar, but it did not help her to speak English fluently, because she did not practice to speak in English enough when she was in school.

I: "And do they speak English all the time I mean during the class period or they would go between both languages to explain...?"

E: "Yeah, they go back and forth, and they will use umm like if we do not understand something they will use analogy in Arabic to make it much easier it feels like it kind of helpful to understand the grammar English but to learn more English in my opinion we just we need to speak English most of the time."

Emmy used to learn British English in school and due to the difference between American and English accents; Emmy had difficulties when she first moved to the U.S.

I: "And in public school in Egypt you take English as a foreign language subject?"

E: "Yes, I learned it from elementary school until high school and we do not learn American English we learned a British accent basically so also when I came here I had some kind of ummm."

I: "Conflict between the two accents?!"

E: "Yeah."

After she finished high school, Emmy joined the university in Egypt where she also studied English and took science courses such as chemistry, physics, and math. According to Emmy, most universities in Egypt prefer to use the English language as a medium of teaching especially for science majors. However, after her experience, she felt that English was not the dominant language that the instructors used within the class.

I: "Okay, so all the professors they will use English in the classroom or some of them...."

E: "In my country?"

I: "Yes,"

E: "They would explain in Arabic but say the terms in English?"

I: "Okay and what about tests and quizzes?"

E: "The test and the quiz will be in English but like the whole explanation process would be in Arabic rather than just English,"

[.....]

I: "And they do they (professor) use like PowerPoint?"

E: "Oh yeah they use PowerPoint."

I: "Is it usually in English or in Arabic?"

E: "Umm in English."

I: "So the PowerPoint in English but some of them (professor) would rather explain in Arabic?"

E: "Yeah, in Arabic."

After one year Emmy left the university and decided to study abroad. During the application process, Emmy joined an English course program offered by the America-Mideast Educational and Training Services (AMIDEAST) which prepares students for English languages proficiency tests such as IELTS and TOEFL

I: "When you graduated from high school did you feel like you are ready to ummm like do you feel that you had the necessary English language qualification to enroll in your qualification of choice before you left your country?"

E: "Okay, umm I kind of felt that's I'm ready but my scholarship wanted to make sure of that so I had one year like gap year just to study American English and preparing me for umm TOEFL and other stuff....just to make sure that I'm in the same level as other students should be."

Chemistry Experiences. According to Emmy, she took most of the topics that were covered in the general chemistry courses at MSU in her high school which means she was familiar with the class content. Even though, she described her experience of taking a chemistry class in English as "much work".

I: "Oh okay, so do you feel when you come here to your chemistry class do you feel the content of the subject is hard for you or learning the content in your second language is harder?"

E: "I guess studying it in my second language would be much harder but some of the other classes like genetics which is I take it now the content is hard but for chemistry I feel understanding in the second language is much harder because I

know most of the stuff the professor explain it but when I have to read the information in the book I don't understand it."

I: "Is it because of the language?"

E: "Yeah, the language barrier."

Though Emmy studied the English language before she came to the U.S., she still felt that her English was not adequate to cope with her classes. For example, some of the professors used to talk fast which made it difficult for Emmy to keep up with all the information. To help with this difficulty which is dealing with the pace of the lecture, Emmy conducted her cognitive functions in her native Arabic and constantly translated between English and Arabic. In the following quote, Emmy explained how this affected taking lecture notes:

E: "Umm actually depends on the professor so I umm kind if notice if the professor talks kind of slow pace I can take good notes and I can just write and understand and some of the time I can interpret what he said in Arabic even while he is explaining but some other classes I cannot just write every word he is saying or writing or whatever because he said a lot of information that I cannot catch all of it."

Additionally, since Emmy used to take chemistry classes in Arabic, she knew all the scientific terminology and names in Arabic. Therefore, when she started to take chemistry in English she had to learn and memorize them again in English so she used to translate every new word that she came across, sometimes she using an internet translator to help her.

I: "Okay, do you find it hard for you to like follow up when you took classes here?"

E: "Aaah, well I learned it (science) in Arabic so I did not have the chance to learn science in English but once I came here (MSU) so I had to learn like chemistry in English for example so it was kind of hard to understand my professor because he speaks fast and second of all in all these terms in Arabic you see and you recognize the shapes but I cannot relate it to English! So in my note, I had to write in Arabic, one I tried to interpret what he says in English to my language in Arabic first to know what he is saying then I have to interpret back in

English to absorb the question. So it was kind of hard work at first in my first semester to understand what it means.....”

[.....]

I: “So umm now you feel like you are umm developing in how to learn chemistry in your second language than the beginning?”

E: “Yeah! So like if I stayed in my country I would have more hard time to learn chemistry in English. But once I came here I have no choice to understand it in Arabic so I have to just work and do other stuff to learn it in English and maybe if I did not understand something I can google it.”

Furthermore, writing in English, especially in science class, was challenging for Emmy because she had to write in the scientific and academic styles. She believed that most of the time she could not deliver her answer or ideas correctly in English.

I: “Okay, so do you feel umm like when you go to chemistry classes and you have a test do you feel more comfortable when the professor told you that the test is only multiple choice questions or it is an essay based questions what make more comfortable?”

E: “Umm well in my country I used to more short answer questions and we did not have any multiple choice so when I came here I thought that I do better in short answer questions rather than multiple choice but what I absorbed so far that’s I do better in multiple-choice rather than short answer and I think that because umm I cannot deliver what I’m thinking about and how to use the right terms to describe it and maybe I use different analogy that is maybe wrong or maybe right so that’s why I guess I would perceive better in multiple choice.”

Emmy also spoke of her fears that she might not be able to adequately explain her ideas in English on exams.

I: “Okay, so do you feel like during the test when you have short answer questions or essay based questions do you feel like you make an extra efforts to write a whole sentence with a good words structure and spelling do you feel that pressure during the test or you do not mind those minor things?”

E: “Well I get more pressure on how I explain this stuff. I know that the professor does not care about the spelling because all people have mistaken with spelling but I make sure that I can explain what I really mean but by somehow I do not get it so I just like feels the pressure of I need to explain better so I tried to give more example and then I will write a lot than usual.”

I: “Okay, so you mean you end up writing a lot for short answer questions right?”

E: “Yeah.”

I: “And do you had like umm if some professors told you just answer the question in one sentence no more than that for short answer do you feel a lot of pressure when they do that or you would write whatever you want?”

E: “Umm actually I did not notice that some of them will require me to answer short answer questions in just one sentence I guess like they know that it’s about how we understand this stuff, yeah so they won’t require that. So I do not feel like the kind of stuff that gives me pressure more is the time limit because like I write a lot and I have to answer other questions and other stuff so that will be more pressure.”

Emmy usually ends up writing more than the question requires just making sure that her ideas are delivered correctly. More importantly, she takes more time to write in English so she always feels that she is under stress with time.

Due to these difficulties, Emmy stated that she puts extra effort and pay more attention to her professors while they are explaining the material during the class.

I: “Okay, so what did you do to come over this problem?”

E: “So usually umm I’m trying to pay much attention in the class and then umm I go over the questions to make sure that I have the same idea and if I have problem I will go ask my TA in the lab, or my friends or the professor so that umm yeah approaching the professor will be one of the main options for me when I do not understand.”

In addition, whenever she had a question she would go and ask her professors during their office hours.

I: “Okay, so do you go to their office or in the class like you would ask your question in class?”

E: “I do not feel confident to ask in the class because I tried before in certain class and I could not deliver what I was thinking about so I just keep the questions and once I feel the time that I need to know the answer I just go to their office and ask.”

I: “So do you prefer to go and ask your question face to face in their office or just email them your questions so what do you think is more comfortable for you?”

E: “It depends but I feel comfortable more when I talk to the professor’s face to face just like to show him that I’m kind of ummm that I’m interested in what I’m learning and I’m trying also to show them that I’m an international student and I have an issue with this!”

Besides, she used to prepare for the class especially when she was taking CHM 160. She would study the class materials before going to the class and translate new words until she became more familiar with the lectures. Then, she stopped doing that because according to her preparing for the class consumed too much time.

I: "Do you do some preparing before you go to the class...chemistry class or do you feel more comfortable if you have a translator during the class?"

E: "Umm so when I took CHM 160 the professor told us that we have to prepare for the class and have an overview of all of that so I kind of like study the materials not just have an overview because I do not know how the professor will teach this. So it's kind of help me and save me time after I finish the class so I kind of know what is happening but then I felt this one is taking more time than usual so I stopped preparing for the class and I still get the information that's I want so I guess I feel comfortable now that's I know that it's better to have an overview of what we are learning about but it's just I still get kind of the same amount of information that I learn if I got to the class without any preparations and professors just start to teach us all that stuff and I go over it afterwards and since most of the professor have clicker questions between the class time it's kind of like gave us umm make us learn somehow."

I: "Do you feel you did well in the clicker questions since umm....?"

E: "I do okay like I do not expect myself that I learn every single stuff that the professor says so umm and the questions that I got wrong just because I did not pay attention when he explains that stuff not because he did not explain it."

She also felt that clicker questions gave her the opportunity to apply what she just learned from the lecture.

Another method Emmy used to help her with her general chemistry courses is her translator during the class periods or while she was studying because that helped her to understand some of the new words and to understand any questions related to the class.

I: "And do you use like umm google translator for example during the class?"

E: "Oh yeah yes even I use it in the exam or sometimes I ask the professor is this means something."

I: "Okay, so do you feel you will be more comfortable if have the translator with you in the in the classes"

E: "Yeah, it's a real relief."

I: "Do you notice if you did better...?"

E: "Yeah."

I: "So you still do that until now?"

E: "Yeah."

Also, Emmy frequently visited the Bear CLAW, especially for her English and science classes. However, sometimes her experience of going to the learning center was not satisfying especially if there was a lack of communication between her and the tutor. She stated that sometimes she had to draw her questions to them to make sure that they understood the questions.

I: "Okay, umm did you regularly go to the learning center or writing center in the Bear CLAW."

E: "The learning center! Oh yeah in my freshmen year I visited it a lot for my English classes and the tutors there will help me to just identify the idea if I do not know how to write something so they just help me out and I also still go there until now for chemistry or biology help."

I: "Okay, and do you find it easier for you to contact them in English?"

E: "Umm no it's hard because like I understand stuff in certain analogy and they understand it in a different analogy so it's hard for me to explain what I understand so I use to draw or whatever to them to make it so basic and it's just umm it's kind of work..."

However, Emmy found an Arabic-speaking tutor who worked in Bear CLAW. She described her experience with that tutor as "better" because she could more easily communicate with him, and he could explain his answer in a way with which Emmy felt more familiar

E: "But actually I had the chance that I meet a tutor that he speaks an Arabic too so he kind of helping me especially in math he was like I have this like Arabic mentality of math or whatever and just I learned that's stuff in Arabic I cannot think in English again so he explains the stuff in Arabic and that's made me perceive faster to learn math in English."

[.....]

I: "Okay, so when you go there do you make sure first that's he is there too?"

E: "Kind of but actually like he is also qualified because umm so the other America tutoring they could not understand what is my problem is the questions that I was asking for so they asked him if he knows the answer so because he

knows the answer and he knows that I speak Arabic he kind of explain it to me better.”

In regards of the chemistry laboratory courses, Emmy finds the laboratory part was much harder than the lecture for several reasons. First, she never had previous lab experiences.

I: “Did you take any lab course in high school?”

E: “No.”

I: “So this is all new to you?”

E: “Yeah, so like that was the challenging that I still even face it now that I had no background in laboratory stuff like usually the professor like show us what is happening and maybe she would do the experiment by herself and that’s it and you are not even allowed to touch or do anything (laugh) and even like if we have laboratory exam or whatever like you have to go and like on the table an see and recognize stuff and then answer questions about it so basically just photos and that’s it.”

I: “Okay, so when you come here and you start to do labs what was the greatest challenge for you?”

E: “Oh it’s still challenging for me the lab skills like to measure the stuff and do stuff in a certain way like I remember that in general chemistry lab my colleague would just finish the experiment in five minutes and I will just repeat the experiment over and over again because I do not maybe hold the pipette well or something like this I did not measure the stuff well.”

[.....]

I: “Okay, and what about the lab equipment and glassware.”

E: “I was not familiar with any of these when I came here.”

I: “Even the name in Arabic?”

E: “No, I do not umm like we use beakers and thermometer Ummm yeah we did not have even the mechanical pipette.”

Second, she found that it’s difficult to understand the procedure and instructions to follow up with questions in English.

I: “Okay, and do you feel like it hard for you to follow up with the procedure in your second language?”

E: “Yeah, it’s super hard to follow the instructions for me at first like I do not understand what is the instructions mean and I still even like kind of like I go back and forth to my TA just to make sure what I have to do here like I have this pipette or whatever should I use it or not something like this.”

I: “Do you tried like before you come to the lab to translate all the umm the procedure?”

E: "Actually in organic chemistry lab we have to write the procedure by my own words so I tried to write some stuff in Arabic if I do not understand it in English so I will write something like you have to do this and this in Arabic and then I tried to follow the procedure and I see like umm I kind of see what my colleagues and kind of imitate what they are doing if I still do not get it."

Third, she could not correlate between what she learned in lecture to what she did in the lab. Thus, she was confused about the objective of doing the lab part in general chemistry classes.

I: "So do you like when you do lab do you feel like you are connecting what you learned in the lab to the lecture concepts?"

E: "Not really I still cannot connect of what happening in the lecture and what's happening in the lab I know that they are connecting somehow but I cannot really apply what I have learned."

[.....]

I: "Oh okay, so when you go to labs do you like ummm do an extra effort to memorize all the names and terminology?"

E: "Umm no I do an extra effort to understand the procedure and that cost me a lot of time and to know what I should do in the experiment and what's happening like why we do this and that and I have to translate it to my mind in Arabic and just like to make the stuff make sense."

The fourth reason was that Emmy faced a problem to cope with her lab partner who was a native English speaker. Emmy preferred to work with NNES because she believed they would better understand her and would have experienced similar challenges. In labs, however, she usually chose to work with native English speakers in order to avoid any additional linguistic problems she may face. However, after an experience of working with a native English speaker, Emmy realized that native English speaker students did not need a similar period of time as she did in order to understand the procedure and perform the experiment.

I: "Okay, so do you prefer to work with international or it does not matter?"

E: "For me I had the experience to work with American student and I worked with international student and for my experience so far I prefer to work with other international students because both of us were trying to learn English so we give more attention to the regular students I know this is not good but like it happens and most of the international students here they came for scholarship so they must be good at something so that's why I trust them umm not trust but like I prefer to work with international student because like they understand the struggle that you have."

I: "So when you choose your lab partner or group do you look for international students?"

E: "So umm that's what happened at the beginning of the organic chemistry lab so I came to the lab and you have to choose where you want to stay so I saw an American student and I saw an international student so I was just like umm I know the struggle that I have I don't understand or explain stuff to other students so maybe she has the same thing so I just choose to stay with the American student but then I discover like she does not care like she perceive faster than me and she does not care what I'm doing so it's kind of like frustrating because I was trying to understand and she wants to get out as soon as she finishes so then I made umm I became friend with the international student and now we kind of like work together umm like we work individually but once we have umm one of us have a problem we will help each other."

Thus, the time gap and the linguistic difficulty made Emmy uncomfortable.

Tasks Analysis. In the second interview, Emmy answered the first task questions twice. The first attempt she used English to answer the questions, and she was able to address them all except one question, as shown below when she said that she did not remember the right answer, but she gave her best guess

Q 3. Explain why does a can of soda explode when you shake it?

E: "Okay, so next explain why does a can of soda explode when you shake it? I think that a physics question that's not."

I: "Well there is a chemical reaction for sure."

E: "Umm I know there is an explanation in general chemistry but I forgot it."

I: "Oh you are fine if you do not know the answer or cannot give your better guess then you can skip that question."

E: "Oh okay, so I guess because of the movement of gasses in the container that's my guess!"

However, after Emmy answered her first question in English, she asked if she can answer it again in Arabic because she said that she would prefer if she can answer in Arabic.

E: "So like Ummm can I explain it first then write it down."

I: "Yeah, that's fine."

E: "I explain it in English?"

I: "Yes, please, the first try I want you to answer it in English and then the second try we will do it in Arabic and you can use the translator."

E: "Okay, so the first question asks why the liquid take the shape but not the volume that was explained the question and do you want me to answer it in English?"

I: "Yeah."

E: "So it is because of the connections between the atoms of the liquid like for example water so we know that liquid umm connections atoms umm no I said that but yeah connection the atoms of the liquid is umm is not that strong as solid and that ummm that low in umm in gases and that's why because of umm yeah the atoms of the liquid connections."

I: "Okay... [.....]."

E: "Okay, so should I answer the first question in Arabic now?"

I: "Umm we will go through the rest in English then we will do it again in Arabic."

E: "I like to answer them in Arabic (laugh)."

I: "Yeah, the second try we will do it in Arabic because I want to see how you can answer in both languages okay."

At the end of the first attempt, Emmy stated that she was not pleased with how she answered these questions because she said that explaining science in English is difficult for her.

I: "Okay, so if you can write down your answers in English please."

E: "Okay."

I: "Also if you can just mark the question that you did not answer or if you feel like you want to give it a second try and just write your better guess."

E: "Okay, but all my answers I said I guess so I'm not sure if that's a proper answer."

I: "Will I'm not looking for right or wrong answer I only want to see how you can express your answer in your second language."

E: "Oh yeah, that's defiantly a big problem for me."

For example, I noticed that Emmy misused some of the words while she was answering the questions in English. For instance, the following quotation is Emmy's answer to the first set of questions in which she used the word "connection" instead of "chemical bond"

E: "Okay, so the first question asks why the liquid take the shape but not the volume that was explained the question and does you want me to answer it in English?"

I: "Yeah."

E: "So it is because of the connections between the atoms of the liquid like for example water so we know that liquid umm connections atoms umm no I said that but yeah connection the atoms of the liquid is umm is not that strong as solid and that ummm that low in umm in gases and that's why because of umm yeah the atoms of the liquid connections."

Another example is when she answered the following questions: Explain why you store food in a fridge to prevent spoilage? She said "cold status" meaning in a lower temperature. Moreover, she did not understand the word "spoilage" but guessed the meaning of the word in the context of the question.

E: "[.....] so other question explains why you store food in a fridge to prevent spoilage? Umm, I do not know umm spoilage meaning it will get ruined I guess!"

I: "Yeah."

E: "Maybe because of umm some biological interactions of bacteria and other staff in the food and when we put it in like cold status I guess it is like stops those interactions umm yeah like from keep it going."

When Emmy started to write her answers in English, she said that she had to think about how she can put her answers in sentences.

E: "[...] I'm trying now to remember my answers that I said!"

I: "In that question, you said something about the bond."

E: "Yeah, I remember the words but I'm trying to form the whole sentence."

The second attempt Emmy did the same set of questions but this time she can explain them in Arabic. Emmy did the task with the aid of the translator; she used the right scientific terms/words to describe these phenomena.

E: “(Speaking in Arabic) the first question asks why ummm.....”

I: “Well if you want to just answer the questions you do not have to re-read the question in Arabic.”

E: “(In Arabic) oh okay okay!”

E: “(Speaking in Arabic) [...] okay we said before that liquid takes the shape but not the volume because of the chemical bonds between particulate leads to that phenomena and because bonds in liquid is different than solid and gas every state of matter have their own condition so that’s why I believe that happens because of the bond in the liquid form.”

The second task, which was the matching exercise, Emmy stated that she might know some of the names because her lab instructor required them to restock the drawer at the end of each lab and that frequency of this simple step helped her to memorize some of the names.

I: “You are fine just do your best and we will see after that.”

E: “I guess I know some of them because we have to check what I have in my drawer in every lab.”

I: “Oh okay, so you do that in the lab.”

E: “Yeah, like you have to check if something missing [...].”

As such, Emmy was able to answer all of the questions except for a few words that she asked to use the translator. These words were; test tube rack, crucible tong, volumetric flask, test tube clamp, and forceps.

Summary. Emmy is a 20-year-old student from Egypt who spoke Arabic as her first language. She took both general chemistry courses CHM 160, CHM 170 with both laboratories courses, CHM 161 and CHM 171. Emmy stated that her difficulty in the lecture was the speed of the discourse, which affected her ability to understand the lecture. She stated that she tried to overcome this problem by paying more attention during the lecture time, taking more notes in both languages, preparing before the class by reading the book if her time allowed, and asking her professors during their office hours. In addition, Emmy stated that she always took more time than other students

during the tests because she had to think and analyze in Arabic then translate that back into English.

Another major problem for Emmy was with the laboratory courses. She had difficulty understanding the lab procedures which affected her ability to understand the purpose and objectives of in the chemistry laboratory course. She also felt that she could not connect what she learned in lecture to what she did in the lab. She always tried to have English speaking student rather than working with NNES because she believed that a native English speaking would not have the language barrier problem. Yet, Emmy stated that the disadvantages of working with native English speakers were they did the experiments in short amounts of time which made it hard for her to keep up with and understand all the steps of the lab procedure.

4.5 Fifth Case: Sarah

Background. Sarah is a 24-year-old student from the K.S.A. who spoke Arabic as her first language. Her major was in respiratory therapy, and she took both general chemistry courses CHM160 and CHM 161 and during the interview she was taking CHM 170 and CHM 171. Sarah studied English in school for five years before coming to the U.S. However, she described her experience in learning English in school was not enough because she did not have the opportunity to practice what she learned in the class.

I: "Uh okay, and in school teachers who teach English they were Arabic?"

SA: "Yes, she was Arabic."

I: "But does she speak English all the time in classes?"

SA: "No."

I: "So she would talk more Arabic in classes?"

SA: "Yeah, she was teaching in Arabic also in exercises but not the test."

I: "Okay so you do feel like you practice English..."

SA: "No, I do not."

[.....]

I: "Oh okay, so you take it for 5 years maybe?"

SA: "Yes, but the way I taught it was not that much.....yeah they teacher were speaking Arabic so that's the way it was not that much."

After she graduated from high school, she studied for one year in a university at Saudi Arabia. During that time, she took intensive English courses as well as chemistry, biology, statistics, math, and physics course which were provided in English. However, Sarah was not pleased with the intensive English class because she felt that the course did not significantly improve her English since she did not also practice the English language.

I: "Okay, got it, so back to the foundation year at the university in K.S.A. did you study English... (Asking in Arabic)"

SA: "Oh yes, but it was not that good at all completely it was not that good (speaking in Arabic),"

I: "So did you take English also as a course like an intensive English language courses,"

SA: "Yes, it was three hours class daily but I did not learn English as much as I did here because here we practice English more since everyone here speak English so we must speak with them in English which means we practice the language more but in Saudi when I was in KAU students or the people around us speak Arabic so we only practice English inside the classroom and that's all (speaking in Arabic)."

In addition, some of the teachers who taught her science classes would use the Arabic language rather than English even though the classes were designed to be taught in English. However, according to Sarah, learning science classes in Arabic was much easier for both the teachers and the students.

I: "Like in class why your teacher teach in Arabic? Do you know why?"

SA: "I think Ummm I do not know why but I think she may think that that is easier for students to understand her so yeah that umm that would save her time."

I: "Okay, so do you find it easier for you when she is speaking or explain in Arabic more than when you like when she explains in English?"

SA: "Yeah it is easier (laugh)."

I: "Can I ask why?"

SA: "It is my first language so I understand it like in one second maybe less than a second, not like English I had to think maybe..."

Therefore, before Sarah came to the U.S., she decided to take a private intensive English language program for three weeks to enhance her language skills. This program was designed by the British Council in the K.S.A. and all the teachers, textbooks, class assignments were from the U.K.

I: "So you did not take any extra English courses besides school?"

SA: "I went only once to aaaah English learning institute but that was like for three weeks only!"

I: "Okay, so this was in Saudi Arabia?"

SA: "Yes."

I: "So why you went there if I can ask you that?"

SA: "Aaah that was before I came here so I want to prepare myself."

I: "Okay, so do you feel you learned a lot in these three weeks?"

SA: "Yes."

Sarah said that speaking in English was one of her major problems since she could not practice it enough with native English speakers while she was studying in K.S.A.

I: "Okay, so you would use English to communicate with them (asking in Arabic)."

SA: "Yes, but when the problem was we talk and communicate with the classmates more than your teacher so usually I speak in Arabic with my friends in class so I we did not practices English enough as we should we but when I studied English in the ELI here all students in my class were international students and they speak different language like Chinese or Spanish so we all required to speak English between us in or outside the class so that gave us the opportunity to practice what we learn in the class more (speaking in Arabic)."

I: "Yes, it is all about practice and how the environment around you can help enhance the process of learning (speaking in Arabic)."

SA: "Yes, especially in speaking because for example I studied English grammar in school before I came here but for the speaking part it was very bad when I studied English back home because we did not have the chance to speak English more unless if you speak to your English teacher if she cannot speak Arabic and that is the only way you can practice speaking (speaking in Arabic)."

I: “And do you feel that your conversation with your teacher is limited to the class content? (Asking in Arabic)”

SA: “Yes, exactly there is not much we can talk about it with our teacher except anything related to our class which we can talk about it in two sentences that’s it (speaking in Arabic).”

When Sarah came to the U.S. she had to join the ELI before she started her program at MSU. Thus, she spent one year studying at the ELI. She believed that her English significantly improved after she graduated from the ELI compared to the intensive English course in the K.S.A. because she had the opportunity to practice the language outside of class.

I: “So do you find your English improve between your now and back in high school?”

SA: “Yes, especially after the ELI.”

I: “Oh really so it was like a turning point for you when you were in the ELI.”

SA: “For sure.”

[....]

I: “Okay, so do you likeumm if you compare the two intuitions you went to in Saudi Arabia and here do you feel there is a difference? Like when you went to the ELI here and took the course back there do you think they are different or not.”

SA: “Yes, big difference between them because here I have to ummm talk a lot in English and to see people that are not from my country so I have to talk in English with them not like in Saudi Arabia they are all Saudis so I talk Arabic more than English with them but here is the opposite.”

Chemistry Experiences. Sarah stated that her experience in CHM 160 is different than her experience in CHM 170; because in CHM 160 she was familiar with the topics since most of them she already studied it in high school. However, she chose to take a tutoring session to help her with CHM 170; these sessions were arranged by the department which was also called Peer Assisted Study Session (PASS).

I: “And do you feel comfortable especially in chemistry classes do you feel comfortable to ask the question if you do not understand something?”

SA: “Yeah, but actually I had a tutor here for chemistry 170.”

I: “Oh okay.”

SA: “Because it was hard for me harder than 160 so I needed a tutor.”

I: "Oh okay, so did you get it from the university or outside the university?"

SA: "From here from the university."

I: "Okay, so is he students or ...?"

SA: "Ummm I think yeah he is a student."

I: "Okay, so did you like ask for that help or you go find it by yourself so did you go to your professor and ask for help?"

SA: "He (the professor) put his (the tutor) information in the blackboard when I took chemistry in the blackboard for chemistry class 170 uuh he put his information and then I contact him and I said I need a tutor."

Sarah's reasons for having tutoring were that most of the topics in CHM 170 were new concepts for her. Also, she took the course during the summer semester which meant, according to her, a lot of information in short period of time, and it was difficult to keep up with the class without the extra help.

I: "Do you...you feel better after this meeting?"

SA: "Yeah, because I took 170 in this summer and ummm it is not like a regular semester it's only two months so it was a lot of information so that's why that why I needed a tutor and the materials I did not study it before even in Saudi Arabia."

I: "Oh so all the information it was new for you?"

SA: "Not all of them but most of them was new for me not like 160 I studied all of them in Saudi Arabia but 170 it was hard...umm yeah."

One of her main concerns was the pace of the lectures, which she believed affected her ability to understand all of the details that were discussed by her professor.

I: "Okay... so umm what do you feel like the most weakness point in you English is it writing, speaking, listening, umm reading what do you feel like this is the most harder for you?"

SA: "Understanding the point like if I was listening to the professor Ummm I always pay attention to make sure that I get the point not only like skipping the point no."

I: "So you feel like it's harder for you to get the exact point that he saying?"

SA: "Yeah, because every problem has details in it so I always make sure that I get those details."

Whenever Sarah had questions during the lectures or she felt that she missed some details, she would not ask her professor during the class or right after the class

period to repeat or clarify any details for her because she believed that will waste the time of the class.

I: "Okay, and if you feel like you did not get those details do you ask him again to explain it again."

SA: "In the class?"

I: "Yes."

SA: "No nooooo!! (Nervous laugh)"

I: "Okay, why you do not ask him in the class?"

SA: "I do not know maybe I feel like I would waste his time."

I: "Okay, so you do not feel comfortable to ask him in the class?"

SA: "Yeah, I ask him I ask him like in his office hours or yeah after I study and make sure I did not get that ..."

I: "So in other classes do you prefer to not ask in class or only in general chemistry?"

SA: "No, for me I never ask in the class."

Thus, usually if she had questions, she would wait until she finished studying all the materials again and make sure that she could not find an answer to her questions. If she could not find the answer, she would go to the professor's office hours. According to Sarah, meeting with the professor directly was much better than sending an email because writing an email in English was difficult for her. Also sometimes she could not fully understand the email from her professors due to the language.

I: "So back to the questions Ummm yeah if you have a question about the lecture do you prefer to ask the professors in person in class or go to their office during their office hours or just send an email to them...what do you prefer?"

SA: "Umm I prefer talking to him in his office hours."

I: "Okay, so you usually if you have questioned you did not ask in lecture..."

SA: "Yeah, because after the lecture I have to study so I make sure that I did not get the problem or the ...so, yeah I go to his office hours and ask him."

I: "So you did not try to like send him an email?"

SA: "Yeah, but I feel like it is better to meet with him face to face and then he explains to me the problem face to face."

I: "Uh okay, and do you feel it is easy to like contact with him I mean with your professor directly so he can get your question?"

SA: "Through email?"

I: "No, like face to face?"

SA: "Yeah, it is okay."

I: "So you will feel comfortable...okay so he will get what you mean quickly you do not have to explain ...?"

SA: "Yeah."

[.....]

I: "Okay, and that for listening or understanding but what about writing for example if you want to write an email do you take more time?" (Asking in Arabic)"

SA: "Yes, I always take time to understand any email and what the hidden meaning or messages between the words is not like when I have an Arabic email because Arabic is our language you know (speaking in Arabic)."

Another challenge for Sarah was expressing her ideas in answers because she believed that required showing not only the content but also the English language skills

I: "Do you feel that you have the necessary English language qualification to be enrolled in chemistry classes do you feel like you are qualified in English before you come here?"

SA: "I think that ummm that (switching from English to Arabic) I struggled in the beginning so it was necessary for me to be patient especially in the beginning. However, I always believed that I will get there eventually."

I: "(Speaking in Arabic) so you felt at the beginning you do not have the language qualification (switching back to English) but still you believe that you can go through it."

SA: "Yes, I believed in myself and I believe that I can pass the class with good grades and I can get a straight A but my only fear that might stop me from getting it was the language so you asked me about if I had the necessary language right (speaking in Arabic)."

I: "Yes, right (speaking in Arabic)."

SA: "Yes, so for example if the professor asked me to explain something I won't be able to do so in English but if he asked me to explain it in Arabic I will explain it very well !) I do not know if I make my point clear to you or not (nervous laugh) (speaking in Arabic)."

I: "Yes, I got your point....so you feel like you understand the content but you cannot explain it in your second language."

SA: "Yes, and also I need time, yeah my problem is that I need time so when I read question I will read it more than once especially if it some new information for me I will have to read it a hundred times to understand it and when I understand it will be much easier for me (speaking in Arabic)."

Moreover, Sarah compared the ability level of understanding the lecture in English between her and other native English speaking students due to the language.

I: Do you think you are adequately prepared to cope with other English speaker students and why? (Speaking in Arabic)"

SA: "No."

I: "Do you still feel that way now? (Asking in Arabic)"

SA: "Yes (Speaking in Arabic)."

I: "Why? (Asking in Arabic)"

SA: "Sometimes I feel they are smarter than us and they understand the information really quick and as I told you before that I always had the same issue which is the fear of not getting all the information in class right or not correctly understands it...yeah....and for them (American students) they will understand everything in class so I feel we are not like them we always fear from missing any important information in class (speaking in Arabic)."

I: "Okay, so do you know why exactly I mean what is the reason behind that? (Asking in Arabic)"

SA: "Language yeah the language (speaking in Arabic)."

I: "So you do not think it is because the educational.....? (Speaking in Arabic)"

SA: "Maybe...maybe but I believe the language difference has more effect on us because for American students English is their language so is not like us when English is our second language for example if the professor was speaking in Arabic we will get the information faster than them even though we did not pay attention 100% but for them they have to focus more on what he said since he will talk in their second language ...you know what I means? Even if your English is perfect still it will be different to catch the information and to understand everything as long as it not your first language (speaking in Arabic)."

As result of the above, Sarah avoided working with others in lecture unless they were international students, because she thought that international students would not be able to cope with American students with language skills such as in discussions, exchange of information, the level of understanding of the language (words and idiom) and that it would unintentionally affect the group's work.

I: "So do you prefer when you are in class...Do you prefer to work as a group for homework or assignment or presentation?"

SA: "No."

I: "So you prefer to work individually?"

SA: "Yes."

I: "Can I ask why?"

SA: "I do not know but umm working umm do you mean with international students or American?"

I: "Well do you prefer working as a group with international more than working with American?"

SA: "Yeah, with international more because they always see international. Americans they umm see international students... maybe less intelligent than them and they are right sometimes they are right umm so yeah."

I: "So you prefer to work with international?"

SA: "Yeah"

I: "So if there are two groups one of them is an international and the other American what... you will go with the international?"

SA: "With the international."

I: "So if you have an international group in chemistry class would you work with them all the time and study with them or just for like homework and that's it?"

SA: "No, my friends are with me so I study with them all the time."

I: "And they are all international?"

SA: "They are international."

I: "So you do all the studying and homework together?"

SA: "Yes."

I: "Okay and they are taking the same classes?"

SA: "Yeah, they are in the same major so same classes."

Furthermore, Sarah believed that international students needed more time to think, write, read, and express their thought in their second language

I: "And did you have the chance to like for example for the test to ask for more time especially if you have written based questions."

SA: "(Nodding) no, I did not ask for more time."

I: "Do you feel like you need more time?"

SA: "Yeah."

I: "Like comparing to the American or English speaker students?"

SA: "Yeah, I think international students always need more time."

I: "So to write and everything you have to do it in more time than the usual?"

SA: "Yeah."

Sarah relied on two main learning techniques to help her with her language

difficulties: taking notes and recording the lectures.

I: "Oh okay, that's good. So umm when you go to classes here what preparation in chemistry classes what did you do before the class to prepare yourself.....(long pause) do you do something or nothing?"

SA: Umm nothing (nervous laugh)"

I: "That's fine I'm just asking. So when you go to the class do you get like another support, for example, do you had your laptop with you or the translator for example or your book?"

SA: "Ummm I get my PowerPoints slide so I can write my note in the same slides."

I: "Okay, so you write also in English?"

SA: "Yeah, in English."

First, she started to take notes in class, and she usually writes her notes on the slides. Most of the time Sarah writes her notes in English but when she felt that the sentence is too long, which she cannot write in English, she would switch to Arabic in that way she can write faster.

I: "Oh okay, so do you feel like when you are taking the note back then....do you write it in English or Arabic?"

SAA: "Umm I did not take the note back then (laugh)."

I: "That's fine."

SA: 'But I take note here.'

I: "Okay, so it is in Arabic or English.... I mean most of the time... especially in chemistry class?"

SA: "Umm yeah, it was both.... so when I feel I will not catch the sentence that the professor said I write it in Arabic so that's was faster for me that's why."

I: "Okay, so when you start to write your note in English?"

SA: "Umm from the first year for me here."

I: "Okay, so you go between English and Arabic while you take notes?"

SA: "Yeah but most of the notes were in English."

I: "Oh that's good actually ...so do you feel..."

SA: "Actually I learned to take notes here (laugh)."

I: "Oh really, so do you learn it while you were in the ELI or after that?"

SA: "No, after."

I: "Okay and do you feel like taking note in English it's more ummm more comfortable for you like sometimes if you take in Arabic....ummm for example, if you take notes in Arabic it will be much easier for you?"

SA: "Since I started to learn taking notes here I feel comfortable either way."

Second, she is recording the lecture since sometimes taking notes becomes harder especially when the professor speaks fast. Also, when she wrote in English, she usually took more time than writing in Arabic. Thus, she decided to record the lectures to make sure that she did not miss any information or details about the professor's explanations.

SA: "Oh umm this semester I started to record the class so I listen to it at home."

I: "Okay, so do you feel it is much better..."

SA: "Much better! Yeah"

I: "Really"

SA: "Yeah yeah, I regret I did not do this from the first semester here."

I: "Okay, so why you start to do it this semester?"

SA: "Umm the classes are getting harder (nervous laugh) so I need time to listen to the professor again."

I: "Okay, so you feel like writing notes is not enough in these classes?"
 SA: "Yeah, because I will not write all of his speech."
 I: "Yeah so you prefer to ..."
 SA: "To listen and also I take notes."
 I: "Okay, so you record and take notes."
 SA: "Yeah."
 I: "Oh okay and do you feel when you..."
 SA: "My grades got better... Much better"
 I: "Okay, so do you feel when you go there and hear him explain again do you like feel when you heard it for the second time that you get the point?"
 SA: "Yeah, better."
 [... ..]
 I: "Okay, so you record the whole lecture?"
 SA: "Yes."
 I: "Okay, so do you go over them again before you go to the test?"
 SA: "If I have time, yes but most of the time I do not have time."
 I: "Okay, so usually you go and hear it after the lecture?"
 SA: "After the lecture and I also read my notes I read the book and the slides and I get a perfect score on the test."

In addition to taking notes and recording the lectures, Sarah regularly visited the Bear CLAW whenever she had a question about her classes, especially science classes.

I: "That is good. So did you try to go to the Bear CLAW or any other....?"
 SA: "A lot (laugh)."
 I: "Okay, so you go there..."
 SA: "They help us a lot."
 I: "Okay, do you go there for science and another language (subject) or..."
 SA: "Ummm only for science classes."
 I: "Okay so do you go there for chemistry classes?"
 SA: "Yeah."
 I: "Okay, do you ask them for like certain questions or ummm....what what is the most question you ask them about when you are there?"
 SA: "When I study and I find something that is not clear to me I go to them and they explain it to me."

According to Sarah, the chemistry laboratory was harder than the lecture courses because she had not had any previous experience working in the lab. It was hard for her to handle the lab procedure and understand all the steps.

I: "So you took the lecture and lab in the summer at the same time?"
 SA: "Yeah."

I: "Okay, do you when are you comparing between lecture and lab what do you find it easier for you?"

SA: "For sure the lecture."

I: "Okay, so the lab is harder for you?"

SA: "The lab is hard to even for 161 is harder than the lecture."

I: "Okay, but can I ask why?"

SA: "Ummmm I do not know but for... I do not know about other international students but for me...umm I have not studied lab in my country like in my country the teacher was preparing the experiment and do all of the experiment by herself we did not do anything so I do not know!... I also the lab manual we did not have something like that in my country."

[.....]

I: "Okay, so when you have a test in the lab you will have to run an experiment on your own is it a struggle for you? Or is it hard for you to do it alone?"

SA: "Yeah! (Nervous laugh) yeah, it is very hard."

I: "Do you know what the most...?"

SA: "And I hate those questions (laugh) about like the procedure and experiment I hate this type of questions on the test."

I: "So do you prefer when you go to the lab to do the paper-based question more than the practical...?"

SA: "Yeah...yeah, I usually get them wrong the experiment questions."

I: "Okay, can I ask you why I mean what are the most major difficulties for you when you go to do the experiment?"

SA: "I do not know ummmm the procedure it is Ummm I do not know if I do it right or wrong but mostly I do it wrong (nervous laugh) I do not know it's just hard to get."

Sarah tried multiple times to translate the experiment steps into Arabic hoping that could help her to understand them better. However, Sarah stopped translating the procedure because she realized that the process of translating every step consumed a lot of time. Besides, it would not benefit her when it comes to the lab test since she had to do the experiment part without any help.

I: "Okay, so you feel it is something new to you and the lab martial."

SA: "Yeah and it is hard to translate all of the experiment and do it by myself."

I: "Did you translate the experiment before...?"

SA: "Yeah, I tried it more than once."

I: "Do you feel you do better when you translate the experiment?"

SA: "Yeah, but even if I prepare for the experiment I feel I do not know anything in the class so my partner always helped me."

Since language was a major hindrance for Sarah to understand the experimental procedures, she preferred to work with native English speakers to help her with language difficulty.

I: "Can I ask if the partner you had in 161 and 171 are they both an English speaker students?"
SA: "Yeah yeah, they were Americans."
I: "So did they help you...?"
SA: "Yeah, a lot a lot and they did not prepare but when they read ummm when they read the sentence or the steps they understand it quickly not like me I have to read it like three times to make sure that I understand it very well."
I: "Okay, so you feel like they are more comfortable with the language..."
SA: "Yeah, I noticed that in all my labs I took here."
[.....]
I: "Okay, so when you choose your lab partner do you feel like if you choose international students it will be easier for you than choosing American students?"
SA: "No."
I: "Why if can I ask?"
SA: "International students will have the same problem."
I: "Oh okay."
SA: "Yeah."
I: "So do you mean the problem with language or the contents of the lab?"
SA: "The language...maybe... because Americans I think they do not face problems like us in translating in the class... Yeah"
I: "So you will prefer to have an English speaker..."
SA: "Yeah."
I: "Okay."
SA: "That would save my time because we will do the experiment faster than me or another international student.....yeah."

Tasks Analysis. In the second interview, Sarah was also asked to answer all the questions of the first exercise twice. In the first attempt, she took some time to read the questions then she asked me a few questions about the meaning of some of the words on the questions such as "spoilage" in questions four. Her answers on the first exercise were good but yet she had difficulties explaining her answers in English.

1:30-5:00 long pause to read the questions
I: "Do you have a question?"
S: "Umm yeah what does mean (spoilage)?"
I: "(explaining in English)."

S: "Okay, (speaking in Arabic) can I answer now?"

I: "Yeah sure!"

S: "In English?"

I: "Yes, we will try in English first then in Arabic."

Sarah was able to give general answer for most questions except for the two following questions

Q 3: Explain why does a can of soda explode when you shake it?

S: "That one I'm not sure about it... .. but there is a reaction for sure but I do not know but I think when we shake it we make the reaction go fast."

I: "Because?"

S: "Umm long pause."

I: "Okay, that's fine you can write this down."

Q4. Clarify why does soda explode when it frozen?

S: "I do not know this one too but something related to reaction!"

I: "Okay."

In the second exercise, Sarah was able to match all the names except for burettes and funnel. However, on the second attempt, she asked to use of Google translator because she said that she guessed the right answers for few names and she wanted to check her answers. Sarah translated the following names; spatula, forceps, crucible, funnel and burettes, and she correctly answered them but she did not correctly answer burettes and funnel. In fact, she switched between burettes and funnel even after she used the translator.

Summary. Sarah is a 24-year-old native Arabic speaker from the K.S.A. Sarah took both general chemistry courses with the lab courses. Sarah struggled with the speed of the discourse and that led to many challenges such as not understanding all the information during the lectures and stressing about missing important information. She stated that she would not ask her professors whenever she had questions or concerns

about the class during the class period. Furthermore, Sarah believed that she could not work with native English speakers in any informal group work sitting since she did not have the adequate language skills. As result, Sarah adopted a new method in her class to help her with the language barrier such as taking notes in English and Arabic language, recording the lecture, and going to the learning center. Also, Sarah stated that she always translated new words and phrases to learn their meaning, and she believed that using the translator could also help her to better understand the content of her classes.

Another major problem for Sarah was the lab courses because it was difficult for her to understand the lab experiments and its procedures in English. Even when she tried to translate the procedure, she stopped translating because she felt that translating her lab procedure would not help her to understand and preform in the lab in English. Also, it took a lot of her time to translate. Thus, Sarah always chose to work with native English speakers to help her with the linguistic obstacles, and she would rely on her lab partner which can affect her from doing the lab experiment by herself in the test.

5. DISCUSSION

This chapter discusses the common difficulties among participants based on the cross-case analysis of the five individuals' interviews. In this research, the results show four common difficulties among the participants, which were the lack of self-confidence in using English language, avoidance of communication, the speed of discourse, and difficulty of laboratory courses. Under each subtitle of these four difficulties, there are examples and direct quotations from the interviews transcripts.

5.1 Lack of Self-Confidence in Using English

Data showed that the research participants believed that their English skills were not good enough to work with native speakers of the language. Sarah, for example, felt that the American students were “smarter” and that they “understand the material really quickly”. Norah also expressed that she would not be able to “cope” working with native English speakers for course-related activities. Because of these feelings, the participants tended to avoid informal group work or discussions during lectures. Those who formed study groups when preparing for exams either sought students speaking the same native language or they preferred to work with other NNES.

Despite this lack of self-confidence, however, almost all of the participants chose to work with native English speakers when performing lab experiments because of their partners' facility understanding the language. Consider the following exchange with Sarah;

I: “Okay, so do you prefer to work with international or it does not matter?”

E: "For me I had the experience to work with American student and I worked with international student and for my experience so far I prefer to work with other international students because both of us were trying to learn English so we give more attention to the regular students I know this is not good but like it happens and most of the international students here they came for scholarship so they must be good at something so that's why I trust them umm not trust but like I prefer to work with international student because like they understand the struggle that you have,"

I: "So when you choose your lab partner or group do you look for international students?"

E: "So umm that's what happened at the beginning of the organic chemistry lab so I came to the lab and you have to choose where you want to stay so I saw an American student and I saw an international student so I was just like umm I know the struggle that I have I don't understand or explain stuff to other students so maybe she has the same thing so I just choose to stay with the American student but then I discover like she does not care like she perceive faster than me and she does not care what I'm doing so it's kind of like frustrating because I was trying to understand and she wants to get out as soon as she finishes so then I made umm I became friend with the international student and now we kind of like work together umm like we work individually but once we have umm one of us have a problem we will help each other."

Another observation of the absence of self-confidence was using indirect communication. For example, Monna stated that she would never go and ask her professors questions during office hours because she felt her English was not good enough to have this direct conversation with her professors. The exception was Susan whose entire schooling prior to coming to the U.S. and MSU was in English.

5.2 Avoidance of Working in Informal Groups

Mammino (2010b) argued that "Language is the fundamental instrument for the development and communication of thoughts" (p.8). Due to the language barrier and the lack of self-confidence in using English, the students tended to avoid communication during the class time. All the participants avoided informal group activities in or out their classes because they assumed that they might not be able to understand another student or

that they might hold back the group. When they did work in groups outside of class, it was usually with students who spoke their first language, as was the case with Norah:

- N: "Yeah and we study as a group."*
I: "Oh really so you used to study with a group?"
N: "Yes."
I: "Is it for the same class or different?"
N: "Yeah, same class."
I: "Are they international students?"
N: "Yes (laugh)."
I: "Do you prefer to work with international students?"
N: "Yes (laugh)."
I: "Why? Can I ask why?"
N: "It is easier to understand each other."
I: "So do they speak the same language?"
N: "Yes."
I: "So they are all from Arabic countries."
N: "Yes."

5.3 Speed of Discourse

All the participants struggled with the speed of the discourse, because they were prone to thinking in their native languages. As such, they mentally translated English into their native languages. They then conducted any higher-order cognitive functions in their native languages and, subsequently, translated those thoughts back into English when, for example, answering a question on an exam. For these reasons, the research participants spoke of feeling stressed for time on exams.

The participants used multiple strategies to address this difficulty. For example, Sarah stated that she recorded the lectures, which helped her because whenever she felt that she missed any information during the lectures, she could listen to the recording and hear what she missed. Alternatively, Monna prepared for the lectures by reading the materials ahead of time and translating new words. Finally, most of the participants stated that they usually visited the Bear CLAW at MSU. It was helpful for them because the

tutors spoke at a slower pace and explained in a way that made it easier for the participants to understand the course material.

5.4 Difficulties of Laboratory Course

The major finding between all participants in this project is the difficulties of understanding the laboratory. The gathered data from the first interviews indicated that all five participants found the laboratory section as the most challenging part of general chemistry courses. One of the main reasons for their difficulty was that, unlike the lecture component, most of the students did not have any prior lab experience. One of the biggest difficulties was remembering the names of the equipment. Learning vocabulary is one essential aspect of language and content material development, and it is an important priority for all students, especially NNES (Liang & Smith, 2012). For instance, in the second interview, the participants had to do the matching exercise about lab glassware and equipment names. All of them used the translator to either look up or to confirm the meanings of at least some of the terms. Even Susan, who had prior chemistry lab instruction in English, was confused about the naming of some of the lab glassware because she used to know them by different names or even different pronunciation

I: "Do you find it difficult for you?"

S: "For the labs, I think those names are very weird for me."

I: "Names of what?"

S: "Like instruments."

I: "Oh really can you give an example?"

S: "Yeah, like pipet we call it pipet (laugh) and it is a pipette (laugh) (difference in pronunciation)."

I: "Okay."

S: "And the conical flask (Erlenmeyer flask) they called it over here it umm it is very weird I have no idea what is that!?"

I: "The conical flask what do you mean? Volumetric flask"

S: "Oh no the volumetric flask are bigger it like ..."

I: "Oh so you mean the smaller one?"

S: "Yeah (laugh)."

In addition to the difficulties with the terminology, all of the participants struggled to understand and follow the procedures. For example, Emmy stated that she took most of the lab period to try to understand what she should do in every step

I: "Okay, so when you come here and you start to do labs what was the greatest challenge for you?"

E: "Oh it's still challenging for me the lab skills like to measure the stuff and do stuff in a certain way like I remember that in general chemistry lab my colleague would just finish the experiment in five minutes and I will just repeat the experiment over and over again because I do not maybe hold the pipette well or something like this I did not measure the stuff well."

[.....]

I: "Okay, and do you feel like it hard for you to follow up with the procedure in your second language?"

E: "Yeah, it's super hard to follow the instructions for me at first like I do not understand what is the instructions mean and I still even like kind of like I go back and forth to my TA just to make sure what I have to do here like I have this pipette or whatever should I use it or not something like this."

I: "do you tried like before you come to the lab to translate all the umm the procedure?"

E: "Actually in organic chemistry lab we have to write the procedure by my own words so I tried to write some stuff in Arabic if I do not understand it in English so I will write something like you have to do this and this in Arabic and then I tried to follow the procedure and I see like umm I kind of see what my colleagues and kind of imitate what they are doing if I still do not get it."

[.....]

E: "Umm I do an extra effort to understand the procedure and that cost me a lot of time and to know what I should do in the experiment and what's happening like why we do this and that and I have to translate it to my mind in Arabic and just like to make the stuff make sense."

Unlike in lecture settings where the participants avoided interactions with native English speakers, the participants preferred to work with native English speakers during labs. They relied on their lab partners to explain and, in some cases, even for doing the experiments. However, in the latter situations, it negatively affected them when they had to do the experiments on their own during exams. For example, they stated that they

would not be able to do the experiment alone especially on the test with the tight time frame. As Sarah substantiate that in the following example

I: "Okay, so when you have a test in the lab you will have to run an experiment on your own is it a struggle for you? Or is it hard for you to do it alone?"

SA: "Yeah! (Nervous laugh) yeah, it is very hard."

I: "Do you know what the most..."

SA: "And I hate those questions (laugh) about like the procedure and experiment I hate this type of questions on the test."

I: "So do you prefer when you go to the lab to do the paper-based question more than the practical..."

SA: "Yeah...yeah I usually get them wrong the experiment questions."

I: "Okay, can I ask you why I mean what is the most major difficulties for you when you go to do the experiment?"

SA: "I do not know ummmm the procedure it is Ummm I do not know if I do it right or wrong but mostly I do it wrong (nervous laugh) I do not know it's just hard to get."

More importantly, their reliance on their lab partners might have affected their ability to understand the objective of doing the experiment and trying to connect it with what they learned in lecture. The following quotation supports this assumption:

I: "So do you like when you do lab do you feel like you are connecting what you learned in the lab to the lecture concepts?"

E: "Not really, I still cannot connect of what happening in the lecture and what's happening in the lab I know that they are connecting somehow but I cannot really apply what I have learned."

5.5 Responses to the Guiding Questions

There were two guiding questions in this project that gave focus to this research. As I respond to each of the questions, I will rewrite each question in italics as a bulleted item and give my response below it

- How do NNES experience general chemistry course(s) at MSU?

There were several factors that affected the participants' individual experiences.

These characteristics included: their background of learning English language;

their prior content knowledge in chemistry; preparation methods before their classes; coping with communication in English with their instructors and other students; and approaches to overcoming challenges. Despite those differences, however, there were similarities between all participants in this project. For example, most of them compensated for the fast pace of spoken English during lectures by reviewing materials before attending lectures. All of them avoided contact with fellow students during lectures. However, all of them preferred to work with native English speakers during the lab. Lastly, all of the participants found the lab courses more difficult than the lecture courses.

- What are the significant challenges NNES experiences while learning general chemistry?

There are four common challenges among these students; the lack of self-confidence in using English, avoidance of informal group work with other native English speaking students, speed of discourse, and difficulties of the laboratory components. All these challenges were described in before in this chapter and supported with direct quotations from every participant.

6. CONCLUSION

This chapter concludes what has been accomplished in this study by presenting a summary of the findings in regarding the common challenges and difficulties that are faced by NNES Students in general chemistry courses at the MSU. In addition, this section presents the limitations of this study and recommendations for future research in this area.

6.1 Conclusion

By collecting data through two sets of semi-structured and individual interviews with five NNESS, who are taking or had one of the General Chemistry Classes, the results indicate that there are common challenges those students face in these classes. Those challenges have been organized into four major themes. The first one is the lack of confidence in the use of the English language. The second issue is the avoidance of working in informal groups with other students either in or out their class. The third one is the speed of discourse. The last significant insight is the difficulty of laboratory courses. As a result, the findings of the study cases have led to developing these four shared and common challenges that NNES face in their general chemistry classes. Additionally, understanding the language barriers is an essential factor that can contribute to improving the instructors' self-pedagogical contents knowledge (PCK).

As result, there are few recommendations for teaching general chemistry to NNES students;

- Facilitating formal or informal group work by understanding and figuring out how that would assist the NNES students when and why they usually reluctant to participate which because of the language in addition of other cultural and social reasons.
- People who work in the Bear CLAW should check with NNES to know whether or not they are speaking at an understandable pace for the student.
- In regards to the lab course, instruction should contain more visual than verbal content. For example, there could be sequential pictures or simulations to describe a complex concepts and procedures.

6.2 Research Limitations

There are several limitations to this study. The first limitation is that I intended to include more participants in this study. However, there were difficulties in contacting additional participants who have participated in filling out the participation survey form. Another limitation is that all the participants were only female students who agreed and attended both interviews. Although male students who agreed and signed the participation survey form were contacted to participate in this study, they did not respond when they were contacted. The cultural background about the communication between women and men can be one of the reasons for this avoidance by those male students to participate in the interviews. Another assumption is the lack of the incentives to participate in this study, especially for international and freshmen students. However, in this project, gender plays a minor role in the findings of such a study.

6.3 Recommendation for Future Work

The outcomes of this research can contribute to building a valuable foundation for further research by identifying and understanding the challenges of learning chemistry in English for international students who do not speak English as a first language. Based on this study and its findings, few recommendations arise which can be done in future work concerning NNES students. At the first place, it is important to observe the students' performance in their classes for the long-term in order to identify and monitor the areas that represent challenges for those students due to the language barriers. Thus, designed in-class activities can be developed in order to help these students to overcome those language barriers such as reluctant on participating in any informal group work sitting or activities. Furthermore, considerable efforts should be made in order to identify the details of what makes the laboratory part the most challenging part for NNES students. Thus, observing the laboratory classes of these students and developing more practical exercises for better evaluation of this issue would contribute to assess the factors that students struggle with them. In addition, including more participants with different educational background and experiences in learning English language can contribute in exploring more common challenges that confront NNES students.

Teaching chemistry in English is one of the main tasks of this study's researcher which has to be performed in one of the countries that adopted English as the medium language of chemistry classes, which is Saudi Arabia. Because of that, this research can contribute to improving the way of understanding the challenges that are faced by NNES students in General Chemistry Classes. Moreover, this study acts as a first step towards understanding the students' challenges of learning chemistry in their second language and

in countries that English is not their official or first language. Students in those countries may have less exposure to the use and practice of English language which ultimately can contribute to increasing the challenges that are presented in this study. Thus, further research is needed to investigate and explore the challenges that are faced by NNES from non-native English countries that use English as the medium language to teach chemistry courses.

Using the first language for at least some of the instructional time helps those learners achieve content learning as well as second language and literacy development, because it allows them to transfer their cognitive and metacognitive skills from their first language to a second language. Thus, it is necessary to provide students with supplementary English lessons and ensure their full mastery of academic content through the first language until students can make a smooth transition to English-only instruction (Kang, 2012).

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8. APPENDICES

Appendix A: The Informed IRB Consent Document



To:
Gautam Bhattacharyya
Chemistry

RE: Notice of IRB Approval
Submission Type: Initial
Study #: IRB-FY2017-641
Study Title: Learning Chemistry when English is a Foreign Language
Decision: Approved

Approval Date: Aug 15, 2017
Expiration Date: Aug 13, 2018

This submission has been approved by the Missouri State University Institutional Review Board (IRB) for the period indicated.

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

Researchers Associated with this Project:

PI: Gautam Bhattacharyya

Co-PI:

Primary Contact: Arwa Alshehri

Other Investigators:

Appendix B: Collaborative Institutional Training Initiative (CITI) Certificate

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM) COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Arwa Alshehri (ID: 5909003)
- **Email:** Arwa242@live.missouristate.edu
- **Institution Affiliation:** Missouri State University (ID: 750)
- **Institution Unit:** Chemistry

- **Curriculum Group:** Human Research
- **Course Learner Group:** Social-Behavioral-Educational Researchers
- **Stage:** Stage 1 - Basic Course

- **Report ID:** 21166990
- **Completion Date:** 21-Oct-2016
- **Expiration Date:** 21-Oct-2019
- **Minimum Passing:** 80
- **Reported Score*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction (ID: 1127)	19-Oct-2016	3/3 (100%)
History and Ethical Principles - SBE (ID: 490)	20-Oct-2016	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	20-Oct-2016	5/5 (100%)
The Federal Regulations - SBE (ID: 502)	20-Oct-2016	5/5 (100%)
Assessing Risk - SBE (ID: 503)	20-Oct-2016	5/5 (100%)
Informed Consent - SBE (ID: 504)	20-Oct-2016	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	21-Oct-2016	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	21-Oct-2016	5/5 (100%)
Students in Research (ID: 1321)	21-Oct-2016	5/5 (100%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	21-Oct-2016	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	21-Oct-2016	5/5 (100%)
Missouri State University (ID: 1169)	21-Oct-2016	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: <https://www.citiprogram.org/verify/?c9564363-d234-4274-b0ce-c225989652ef>

CITI Program
 Email: support@citiprogram.org
 Phone: 888-529-5929
 Web: <https://www.citiprogram.org>

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT**

** NOTE: Scores on this [Transcript Report](#) reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Arwa Alshehri (ID: 5909003)
- **Email:** Arwa242@live.missouristate.edu
- **Institution Affiliation:** Missouri State University (ID: 750)
- **Institution Unit:** Chemistry

- **Curriculum Group:** Human Research
- **Course Learner Group:** Social-Behavioral-Educational Researchers
- **Stage:** Stage 1 - Basic Course

- **Report ID:** 21166990
- **Report Date:** 21-Oct-2016
- **Current Score**:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Students in Research (ID: 1321)	21-Oct-2016	5/5 (100%)
History and Ethical Principles - SBE (ID: 490)	20-Oct-2016	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	20-Oct-2016	5/5 (100%)
Belmont Report and CITI Course Introduction (ID: 1127)	19-Oct-2016	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	20-Oct-2016	5/5 (100%)
Assessing Risk - SBE (ID: 503)	20-Oct-2016	5/5 (100%)
Informed Consent - SBE (ID: 504)	20-Oct-2016	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	21-Oct-2016	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	21-Oct-2016	5/5 (100%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	21-Oct-2016	5/5 (100%)
Missouri State University (ID: 1169)	21-Oct-2016	No Quiz
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	21-Oct-2016	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: <https://www.citiprogram.org/verify/?c9564363-d234-4274-b0ce-c225989652ef>

Collaborative Institutional Training Initiative (CITI Program)

Email: support@citiprogram.org

Phone: 888-529-5929

Web: <https://www.citiprogram.org>

Appendix C: Participation Form Survey

Dear Students:

Thank you for your time. I'm looking for volunteers students to join my research which is about "Learning Chemistry when English is a Second Language: Challenges faced by Non-native Speakers of English" This study is being conducted to complete my Master's Degree in Chemistry at MSU. The purpose of this study is to determine the obstacles that faced by international scholars to learn Chemistry due to the difference in language and background comparing to USA educational and cultural systems. Understanding these challenges should help in setting up strategies to ensure better outcomes for students. More importantly, it will help every international student to know how important for you and for other educators to acknowledge these differences. In this study, we will take the first steps to better understand the experiences of non-native English speakers as they learn chemistry in their second language. Thus, the researcher confirms that as a participant, you will be given full respect in all matters related to the conduct of the research.

Please read the following before your final decision about joining this project,

- Participation is completely voluntary.
- You may stop any at any time.
- Your identity will be anonymous
- This project will take nearly one semester. During this time you will take multiple individual audio recording interviews with the researcher.

Contact information:

- Name:
- Email:
- Phone number (Optional):
- Course name and number:

The decision to participate:

- YES, I agree to participate
- No, I do not agree to participate
- If (YES) please write your availability time: (write the Day and time)

Researcher Information:

This project has been approved by the MSU Human Subjects Review Committee. The researcher affirms and the committee believes that the research procedures sufficiently protection participant's human dignity, privacy, welfare, civil liberties, and rights. The project is being supervised by Dr. Gautam Bhattacharyya If you consent to participate in this important research project, please fill out this survey and then submit it after you finish. You can contact me by email (Arwa242@live.missouristate.edu) or my office number (417 836-5150) if you have questions or concerns about your participation.

Thank you again for your time and consideration.