Language socialization of Mainland Chinese adolescents in U.S. science classrooms

Fang Yu
University at Albany, State University of New York, lisayu0302@gmail.com
LANGUAGE SOCIALIZATION OF MAINLAND CHINESE ADOLESCENTS IN U.S. SCIENCE CLASSROOMS

By

Fang Yu

A Dissertation

Submitted to the University at Albany, State University of New York

In Partial Fulfillment of

The Requirements for the Degree of

Doctor of Philosophy

School of Education

Department of Educational Theory and Practice

2018
ABSTRACT

Secondary schools in the United States are enrolling an increasing number of Mainland Chinese students, and this cohort of students is often seen as a “model minority” that can achieve academic success without much if any, extra support. However, many Chinese students encounter difficulties not only in learning English but in learning other content areas raising questions as to what they experience as the affordances and constraints to their learning.

Rooted in language socialization theory, this study investigated five Chinese adolescents’ engagement in their science classrooms identifying the specific affordances and constraints to their learning and their positionalities. Three research questions were asked: (1) What semiotic resources (e.g., textual, oral, multimodal) are provided to Chinese adolescents in their science classrooms, and how do these resources affect their learning?; (2) What types of tasks (e.g., oral presentation, written arguments) are provided to Chinese adolescents in their science classrooms and how do these tasks affect their learning?; and (3) How are Chinese adolescents’ positionalities shaped and perceived by others and by themselves in their science classrooms?

Multiple sources of data were collected including student background questionnaires, ten student interviews, five science teacher interviews, 14 weeks of classroom observations, and 142 pieces of student writing samples. NVivo 11 was used to open-code interview and observation data, and student writing samples were categorized into arguments, informative/explanatory texts, mathematics, visual representations, and mechanical writing. A cross-case analysis was also employed to identify similarities and differences across students.

Findings suggest that: (1) Chinese adolescents were offered multimodal learning resources (e.g., illustrations, videos, realia) and teachers’ one-on-one tutoring in addition to the
traditional textual ones (e.g., textbooks, student workbooks). While some of those resources provided affordances to the Chinese adolescents’ learning of science, others caused obstacles, depending on how teachers guided the use of those resources. (2) Chinese adolescents in this study had opportunities to engage in hands-on activities (e.g., laboratory practices, science projects) in their U.S. science classrooms. These activities effectively enhanced their understanding of science content and gave them a chance to practice scientific literacy skills. Chinese adolescents also experienced difficulties in collaborative learning and expository writing. (3) Four types of positionality were identified among Chinese adolescents, including positionality as science learner, positionality as ELL, positionality as Chinese student, and positionality as first-generation student. Meanings of these positionalities were constantly renegotiated and reshaped by the Chinese adolescents as well as other community members.

Implications can be made from this study in both theory and practice. Details and context are added to language socialization theory to further explain what Chinese adolescents experience when they attempt to engage in the new scientific discourse. Chinese adolescents’ negotiation of identity and interactions with other community- as well as non-community members (e.g., Chinese parents) in the socializing process are also discussed. In practice, this study suggests that teachers will need to tap into Chinese adolescents’ “funds of knowledge” and understand their alternative ways of in-class participation. Also, school personnel need to actively engage Chinese adolescents in extracurricular activities and communicate with their parents.
ACKNOWLEDGEMENT

This dissertation is a result of support and encouragement, and I would like to express my gratitude to many people who contributed in various ways to this dissertation.

First, I would like to express my gratitude to my committee chair and my advisor, Dr. Kristen Wilcox. I still remember how she guided me step by step explaining even the most basic research concepts and methods for me when I was a new Ph.D. student. Dr. Wilcox’s expert direction and never-ending encouragement made it possible for me to go through this long journey and walk all the way here.

I would like to thank Dr. Alan Oliveira, who generously provided me his guidance and feedback not only on this dissertation but my first published article on science education. I am grateful to Dr. Julie Learned for her insightful advices on study design and struggling learners’ literacy experience in classroom settings. My appreciation also goes to Dr. Jianwei Zhang, who guided me on the use of theoretical framework and data collection tools.

I have been very lucky to have great colleagues and friends who have supported me academically and emotionally to go through the most difficult time during my Ph.D. years.

Special thanks to all the student and teacher participants, whose names cannot be listed here. Without them, this dissertation would not be possible.

Finally, I want to express my gratitude to my parents, my husband, and my 11 months old son. Their understanding, encouragement, care, and love keep educating me and making me a better person.
TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION ................................................................................................... 1
  Statement of the Problem ........................................................................................................ 1
  Research Question .................................................................................................................... 4
  Three Foci of Language Socialization Theory ........................................................................ 10
  Language Socialization Research .......................................................................................... 12
  Use of Language Socialization Theory in this Study .......................................................... 15

CHAPTER 3. CHINESE ADOLESCENTS’ EXPERIENCES OF SCIENCE LEARNING....... 17
  Students’ Engagement in Science Classrooms in Mainland China ........................................ 17
  Chinese Students’ Experience of Science Learning in the U.S............................................. 21

CHAPTER 4: METHODOLOGY ............................................................................................... 26
  Study Design: Ethnographic Multiple Case Study ............................................................... 26
  Contexts and Participants .................................................................................................... 27
    Contexts .............................................................................................................................. 27
    Participants ........................................................................................................................... 31
  Data Collection .................................................................................................................... 33
  Data Analysis ....................................................................................................................... 38

CHAPTER 5: Major Patterns .................................................................................................... 40
  Semiotic Resource ................................................................................................................... 41
  Socializing Practice ............................................................................................................... 45
  Positionality in Science Classroom ....................................................................................... 48

CHAPTER 6: JIE: A NEWCOMER ............................................................................................ 54
  Introduction ........................................................................................................................... 54
  Semiotic Resource ............................................................................................................... 55
  Socializing Practice .............................................................................................................. 59
  Positionality in Science Classroom ....................................................................................... 65
  Summary: Barriers, Supports, and Successful Socialization ............................................... 69

CHAPTER 7: XUAN: An Insider ............................................................................................... 70
  Introduction ........................................................................................................................... 70
  Semiotic Resource ............................................................................................................... 70
  Socializing Practice .............................................................................................................. 74
  Positionality in Science Classroom ....................................................................................... 79
LIST OF TABLES
Table 1: Demographics of Springmarsh High School .......................................................... 28
Table 2: Demographics of Pinewood High School ............................................................... 30
Table 3: Participant Demographics .................................................................................. 32
Table 4: Research Question and Data Source Matrix ........................................................ 36
Table 5: Semiotic Resources in Jie’s Science Classrooms .................................................... 56
Table 6: Socializing Practice in Jie’s Science Classrooms .................................................... 59
Table 7: Semiotic Resources in Xuan’s Science Classrooms ............................................... 72
Table 8: Socializing Practices in Xuan’s Science Classrooms ............................................. 74
Table 9: Semiotic Resources in Wei’s Science Classrooms .................................................. 84
Table 10: Socializing Practices in Wei’s Science Classrooms ............................................ 87
Table 11: Semiotic Resources in Wen’s Science Classrooms ............................................. 98
Table 12: Socializing Practices in Wen’s Science Classrooms .......................................... 104
Table 13: Semiotic Resources in Hei-li’s Science Classrooms ......................................... 122
Table 14: Socializing Practices in Hei-li’s Science Classrooms ....................................... 127

LIST OF FIGURES
Figure 1. Three Foci Highlighted in Language Socialization ............................................. 12
Figure 2. Language Socialization of Chinese Science Learners ....................................... 16
Figure 3. Jie’s Chinese Translations for New Terms ......................................................... 64
Figure 4. A Sample of Xuan’s Informative/explanatory Writing ...................................... 76
Figure 5. Sample and Prompts of Eutrophication Comic Strips Assignment .................... 125
Figure 6. A Word Puzzle Game to Prepare Students for Vocabulary ............................... 130
Figure 7. Language Socialization of Chinese Adolescents in Science Classrooms ......... 151
CHAPTER 1: INTRODUCTION

Secondary schools in the United States (U.S.) are enrolling an increasing number of Mainland Chinese students and this cohort of students is often seen as a “model minority”\(^1\) (Lee, 1994) that can achieve academic success without much, if any, extra support (Lee, 1994, 1996; Li, 2005; McKay & Wong, 1996). However, many Chinese students encounter difficulty not only in learning English but in learning in other content areas (Huang, 2004; Lee, 1994, 1996; Liu, 2010; McKay & Wong, 1996; Wang, 2010; Zhou, Knoke, Sakamoto, 2005) raising questions as to what they experience as the affordances and constraints to their learning.

Statement of the Problem

As one of the most rapidly growing immigrant groups in the U.S., students from Mainland China make up 25.4% of the total international student population in North American secondary schools and universities (Ma & Wang, 2014). Chinese students are filling up spots in U.S secondary schools in search of a better education and an easier route into U.S. universities. As evidence of this shift, in 2005, fewer than 1,000 Chinese students were enrolled in U.S. secondary schools, however, by 2015, that number had surpassed 304,040 (Institute for International Education, 2015).

These recent immigrant Chinese students are easily associated with the label “model minority” that is used to describe Asian Americans by public media and some educators (Lee 1994; Lee, 1996; Li, 2005, 2007). These “model minority” Asian students are perceived as intelligent, obedient, hardworking, and able to succeed on their own (Li, 2005, 2007). Lee (1996) identifies three major sources that appear to give credence to this stereotype, including (1) Asian students’ outstanding academic performance as evidenced in national assessments. This is

\(^1\) Model minority stereotype is used in 1960s, extolling the success of Asians and Asian Americans who are characterized as hardworking, disciplined and academically successful (McKay & Wong, 1996).
especially true in natural science areas (Barshay, 2013; Lee, 1996; Lu, 2015; National Center for Education Statistics, 2011), (2) high enrollment of Asian students in the most prestigious universities (Lee, 1996; Ma & Wang, 2014), and (3) success stories of Asian students as “whiz kids” in the media (Lee, 1994, 2005, 2015; Lee, 1996; Li, 2005, 2007).

The model minority stereotype is based on a narrow conception of student performance and one that does not take into account Chinese students’ learning needs and struggles when attempting to succeed in the American academic community. Some studies, though very few, have pointed out that teachers, parents, and fellow students all place high and even unrealistic academic expectations on Chinese students, which can exacerbate the stress and anxiety these students feel to perform well in school, especially in science (Lee, 1996). More and more Chinese students are reported to experience difficulty not only in learning English but in achieving academic success in K-12 school settings (Huang, 2004; Li, 2007; McKay & Wong, 1996). Even in natural science, one of the so-called “culture-free” disciplines (Banks, 1993; Lee, 2003, p. 469), Chinese English language learners (ELLs) may experience difficulty in learning due to a significant gap between their prior learning experiences in China and typical U.S. instructional contexts.

A reason for such dissonance is the curriculum disparity between Chinese and U.S. science classrooms. Since 1949, the government of the People's Republic of China (PRC) has placed great emphasis on science education at K-12 levels (Wei, 2006). The government highlights four areas of skills that students need to acquire through science learning in the national curriculum, and they are (1) higher order thinking skills, (2) independent learning skills, (3) independent experiment skills, and (4) problem-solving skills. A major characteristic of Chinese standardized tests of science subjects, like physics, is to de-emphasize rote
memorization and to emphasize analysis ability (Liu et al., 2009). Intensive training in these areas may explain why many Chinese students outperform their NES (Native English Speaker) peers on science examinations.

While exemplary test scores may be seen as a positive, the negative impacts of test-driven instruction are particularly serious in China, especially at the secondary level. The academic reputation of a school and teachers’ merit pay are typically tied to students’ scores in the provincial and national examinations (Liu et al., 2009). As Au (2007) argues, a primary effect of test-driven instruction is that curricular content is narrowed to tested subjects and areas of knowledge. As the development of creative thinking, decision making, and real-world problem-solving skills are not reflected in the exams, these competencies and skills are largely ignored in science classrooms in China (Liu et al., 2009). At the same time, teachers have to increase their lecturing time to cover as much test-related pieces as possible, and may not offer students opportunities to discuss new scientific discoveries or to apply what they learn in relation to real-world issues (Wei, 2009).

In contrast to the emphasis on scientific literacy and hands-on skills in U.S. education standards (e.g., CCSS, NGSS), oral presentation and disciplinary writing are not required in national examinations of science and math subjects in China. Su, Su, and Goldstein (1994) identify an absence of opportunities to carry out hands-on activities and science projects are major problems in Chinese science classrooms. In a teacher-centered learning context, Chinese students are not offered opportunities to express their original thoughts or to question authorities such as their teachers or textbooks. As a result, Chinese students who have not engaged in such activities common in Western science classrooms may feel unfamiliar and experience challenges when they are required to write a lab report, engage in a classroom discussion, or to deliver a

To gain a better understanding of Chinese students’ experiences in the U.S. secondary school science community, this study identifies the specific affordances and constraints to Chinese adolescents’ engagement in scientific discourse in U.S. secondary science classrooms. I focus on Chinese adolescents who were born or raised in Mainland China with Chinese as their first language (L1) for the following reasons: (1) Mainland Chinese students may encounter even more challenges than their Chinese American counterparts, due to their non-native English facility and fewer resources such as social networks (Louie, 2001; McKay & Wong, 1996). (2) Mainland China has the largest body of Mandarin speakers if compared to other regions where Chinese students may come from (Singapore, Hong Kong, Macau, and Taiwan) (Xu & Cao, 2017). (3) Mainland Chinese students have fewer opportunities to speak English than their counterparts in Hong Kong, a former British colony, Macau, a former Portuguese colony, and Singapore where English is an official language (McKay & Wong, 1996). (4) Students from Mainland China have less exposure to Western culture if compared to those from Taiwan due to the Chinese government’s restrictions of certain information from the Western world (Xu & Albert, 2014).

**Research Question**

Rooted in language socialization theory, as a former ELL originally from Mainland China, I employed an ethnographic multiple case study of five Mainland Chinese adolescents’ learning experiences in their U.S. science classrooms. The overarching question guiding this study is: How do Mainland Chinese students experience engagement in scientific discourse in U.S. secondary school classrooms?
The study asked:

(1) What semiotic resources (e.g., textual, oral, multimodal) are provided to Chinese adolescents in their science classrooms and how do these resources affect their learning?

(2) What types of tasks (e.g., oral presentation, written arguments) are provided to Chinese adolescents in their science classrooms and how do these tasks affect their learning?

(3) How are Chinese adolescents’ positionalities shaped and perceived by others and by themselves in their science classrooms and how do these positionalities affect their learning?

Definitions of Terms

In this section, I define three critical terms that are central to this study: scientific discourse, scientific literacy, and positionality.

*Scientific discourse.* From a sociocultural perspective, Gee (1989) proposes the concept of “Discourse”\(^2\) as a combination of “saying (writing) - doing - being - valuing - believing” (p. 526). It captures the process of becoming a member of a cultural group and developing a particular identity through Discourse. Gee perceives Discourse as an “identity kit”: a combination of language, actions, interactions, objects, tools, technologies, beliefs, and values, rather than simple linguistic and discursive structures. Extended from Gee’s Discourse, Duff (2010) defines academic discourse as “a social, cognitive, and rhetorical process and an accomplishment, a form of enculturation, social practice, positioning, representation, and stance-taking” (p. 170).

From Gee (1989) and Duff’s (2010) perspectives, scientific discourse, is a unique type of academic discourse combining the language, norms, culture, and stance-taking of scientists and is an expression of one’s science identity. As Bazerman (2005) argues, scientific discourse is

---

\(^2\) This definition of Discourse with a capital D differs from lower case “discourse” in that Discourse sets a larger context for the use of discourse, namely the language in use.
“evolving and multiple, emerging in relation to the specialties, projects, methods, problem, social configurations, individual positioning and other dynamics that drive scientific activities” (p. 16). It embodies the semiotic representations of scientific language (Halliday & Martin, 1994), the particular genres of science (Bazerman, 2005), and one’s attitudes and positioning in the science community (Lemke, 1990).

I adopt Duff’s notion of academic discourse to define scientific discourse in this study. In this view, Chinese adolescents not only acquire the language of science but learn to use the language as a tool to engage in the particular ways of scientific thinking and expressing. This can be difficult for them as the scientific discourse in a Chinese classroom is significantly different from that in an U.S. classroom. For example, a student who gains high scores on science exams will be acknowledged for his or her potential to be a scientist in China, while in the U.S. classroom, he or she needs to demonstrate the abilities and skills to complete a variety of tasks such as reading science articles, writing argumentations, and carrying out scientific investigations to construct a scientist identity.

Scientific Literacy. The National Science Education Standards define scientific literacy as an ability to understand science content and scientific practices and the potential to use the knowledge to participate in a global science community (NRC, 1996). Krajcik and Sutherland (2010) interpret this definition of scientific literacy as the ability to “read, write, and communicate effectively to make decisions as informed citizens and engage in the critical thinking that active science learning requires” (p. 456). These national science organizations also assert that it is crucial for all Americans to be scientifically literate, including ethnic minorities (Lee, 1996).
To better support ELL students’ engagement in science, Lee (1996) identifies abilities those students need to acquire through the development of scientific literacy including knowing science (a body of knowledge and vocabulary), doing science (inquiry and process skills), and talking science (discourse and communication). These abilities are also evident in the Next Generation Science Standards (NGSS) that place stress on the importance of developing students’ competencies in grasping the nature of evidence, attending to precision and detail in their explanations, making and assessing arguments, synthesizing complex information, and following detailed procedures and accounts of events (NGSS, 2013). These standards also correspond with the Common Core State Standards (CCSS) for Literacy that highlight developing the abilities of scientific inquiry and efficient communication in science through literacy practices (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

To prepare adolescents to meet these standards, science educators are being called upon to engage students in the activities that real scientists do, such as conducting scientific inquiry, collaborating on science projects, crafting arguments in writing, and using multiple modalities to express ideas (Bunch, Kibler, & Pimentel, 2013; Lee & Buxton, 2010; Wilcox & Yu, 2017). However, these practices and activities in Western science classrooms can be quite different from what ELLs are exposed to in their home countries. As discussed earlier, students in China are not required or taught to write argumentative essays, to engage in classroom discussions, or to deliver oral presentations in public. They also need to acquire the vocabulary and grammar rules of English scientific discourse which are the prerequisites for learning the content. These dissonances may hinder Chinese adolescents’ development of scientific discourse in their new learning environments.
Positionality. Positionality is a term that captures the idea that people are defined by their networks and relationships with others as well as where they stand with respect to power, as “dominant/subordinate, marginal/center, empowered/powerless” (Takacs, 2002, p.169). Bucholtz and Hall (2005) describe positionality as an interactional position and defines it as “temporary and interactionally specific stance and participant role” such as evaluator, engaged listener, and joke teller (p. 592).

In a trajectory of second language (L2) socialization, a novice ELL’s positionality would be expected to constantly change depending on his or her resources and interactions with other community members. As Morita argues, “the co-construction of learner agency and positionality is not always a peaceful, collaborative process, but is often a struggle involving a web of power relations and competing agendas” (2004, p. 597).

In this study, I draw upon the idea of positionality to describe Chinese adolescents’ developing identities, which are shaped by themselves as well as by other members such as their parents, teachers, and peers. Chinese adolescents’ roles and positionalities can be inferred from their social acts and expressed stances, as Ochs explains (1993, p. 288):

“Social acts” means any socially recognized, goal-directed behavior, such as making a request, contradicting another person, or interrupting someone. “Stance” means a display of a socially recognized point of view or attitude. Stance includes displays of epistemic attitudes, such as how certain or uncertain a speaker is about some proposition, and displays of affective attitudes, such as intensity of emotion or kind of emotion about some referent or proposition.

According to Ochs (1993), other interlocutors’ social acts and stances play a crucial role in a person’s positionality development through comments, expectations, requirements, feelings
and opinions towards that person. To investigate “positionality” defined in such a way, one would need to identify how participants in a community are represented and what is expected of them by others, which in turn would be expected to affect their self-perceptions and positioning in that community.

In Western classrooms, Chinese students are often positioned as hard workers and reticent learners who are good at rote learning and lack capabilities of higher-order thinking such as problem-solving skills or critical thinking abilities (Chan, 1999; Cheng & Wan, 2016; Lim, 2007; Murphy, 1987). Paradoxically, they are also perceived as model minority students who excel not only in discipline but academic performance with little extra support from their teachers (Lee, 1994, 1996; Li, 2005; McKay & Wong, 1996). In this study, I investigated Chinese students’ positionalities in their science classrooms attempting to unpack the paradox.
CHAPTER 2: LANGUAGE SOCIALIZATION THEORY

This study draws upon language socialization theory (Ochs & Schieffelin, 2014), which explains the process of how a novice gains communicative competence, membership, and legitimacy in a discourse community through interactions with experienced group members. A successful socialization does not simply mean that a novice learner is able to “use semiotic forms of a discourse correctly” (Ochs & Schieffelin, 1986, p. 163). Rather, it indicates the participant’s expertise in grasping unique cultural and linguistic features of different discourse communities.

This chapter provides an overview of three components of language socialization, providing a framing for the investigation of Chinese adolescents’ learning experiences with a focus on semiotic resources, socializing practices, and positionality in U.S. science classroom contexts.

Three Foci of Language Socialization Theory

Ochs and Schieffelin (2014) discuss three foci of language socialization theory: semiotic resources for socialization, language socializing practices, and speech communities. Semiotic resources are explained as the linguistic signs (e.g., speech, writing, images, etc.) and tacit knowledge embedded in such linguistic signs (e.g., bodies of knowledge, moralities, ideologies, etc.). A salient feature of semiotic resources for academic language socialization is that academic context is often “multimodal, multilingual, and highly intertextual” (Duff, 2010, p. 172). This is a double-edged sword for young ELL science leaners. On the one hand, it offers ELL novices a variety of linguistic sources delivered in multiple modes such as verbal, visual, mathematical, and actional (Lemke, 1990), which may facilitate their acquisition of content as well as academic language. On the other hand, the semiotic forms that are different from ELL’s prior experiences may cause resistance and contestation in their socializing process (Talmy, 2008).
Ochs and Schieffelin (2014) describe socializing practices as the explicit and implicit semiotically mediated practices that novices participate in for the purpose of socialization. Duff (2010) identifies oral and written practices as two major socializing practices in academic contexts. Duff (2010) describes some commonly used oral practices to engage students in academic discourse including initiation-response-evaluation (IRE) and initiation-response-feedback (IRF) exchanges, presentations, mini-lectures, classroom discussions, and group project work. Specifically, in science, Lemke (1990) argues that “talking science” actually means “doing science through the medium of language” to create a scientific community in which people share beliefs and values (p. ix). The co-construction of such a community works through a variety of activity structures like triadic dialogues, ordinary question-and-answer, lectures, or summary monologues.

The third foci of interest in language socialization theory is that of speech communities. In a speech community, a novice learner’s agency, positioning, and self-investment are fluid and continuously shifted by feedback from other community interlocutors as well as the learner’s perception of his old and new learning contexts (Duff, 2002, 2004; Morita, 2004; Morita & Kobayashi, 2008; Wang, 2010). As an integral part of identity development, self-positioning relates to how an individual perceives and positions herself or himself in relation to the context (i.e., speech community). A novice learner’s self-positioning has significant effects on his or her access to social networks, language learning opportunities, and desire to use the target language (Wang, 2010). The learner may also reposition himself or herself depending on his or her engagement in learning and interactions with experienced members in the community (Chen, 2010).
Figure 1 represents a simplified model of language socialization with just the three foci highlighted. The dotted arrow from semiotic resources to novice indicates that linguistic resources as language input are provided to novice learners who enter the target cultures and communities through being engaged in socializing practices.

**Figure 1. Three Foci Highlighted in Language Socialization**

**Language Socialization Research**

As early as the 1980’s (Ochs & Schieffelin, 1984; Wertsch, 1985), language socialization research emerged to consider sociocultural aspects of children’s learning of language and cultural conventions through “ordinary day-to-day social practices” (Ochs, 1990, p. 287). According to Ochs and Schieffelin (1986), children are socialized into a community “to use language” and construct a sense of reality through “the use of language” (p. 163). Language is not only a symbolic system that encodes conventions and values but a tool that facilitates a novice learner’s entering into a particular discourse community.

Ochs (1990) differentiates two processes of novice learners’ socializing into a community: explicit socialization and implicit socialization. In the former, a community member explicitly directs a novice to repeat behaviors when engaging in socialization activities, and at the same time, points out information concerning social norms, values, and beliefs conveyed in
these activities. However, the majority of language socialization practices fall into the latter type and may not provide a high degree of scaffolding for novice learners. Most sociocultural information on acts and activities, identities and relationships, feelings and beliefs, and other domains must be inferred by learners themselves through actively engaging, observing, and reflecting.

As language socialization is often an implicit process, novices cannot be simply passive receptors of assigned cultural meanings. Rather, they have to choose socialization based on available resources. With an emphasis on a novice’s agency, Ochs (1990) asserts a bidirectional transformation of knowledge and meaning between members and novices. In other words, novice learners are highly active in language socialization and have potential to impact social activities and sociocultural knowledge jointly with members.

Compared to L1 socialization, novices’ agency and self-investment become even more apparent in L2 socialization, and the impact is more significant (Duff, 2014). Contemporary scholarship has identified a variety of factors that influence the novices’ actual attainment of a second language, such as the age at which they start to learn the language, the residence time, intensity and effectiveness of instruction, and their motivation and opportunities to practice (Casanave, 1992; Duff, 1996, 2007; Harklau, 2003; Kim & Duff, 2012; Tseng, 2013). The learners’ self-investment and agency play a significant role in socialization, as learners may seek different levels of expertise in the L2 (Duff, 2014, p. 4). Meanwhile, L2 learners’ complex histories of prior language exposure, learning experience, and multiple identities may become a challenge for their socialization into a new discourse community. These prior experiences and learning contexts can be quite different from and even contradict what is valued in the target language and culture.
An important direction of research on L2 socialization is to explore novice learners’ socialization into academic discourse. According to Duff (2010), this process often involves issues of learners’ different levels of investment and agency, negotiation of power and identities, and important personal transformations for participants. Novice learners are not only being socialized but are active agents in their socialization process (Bayley & Schecter, 2003). Moreover, some relatively experienced novices have been found to socialize other novices in academic settings (Bayley & Langman, 2011). As Duff (2007, p.3) explains:

Whereas academic texts might previously have been seen as a static set of established rhetorical, generic or discursive conventions, now they are viewed more as a social construction by individuals based on their own histories and social context, their learning communities and power relations within them, and their audience and goals. These social constructions then also evolve as the disciplines, genres, and participants themselves undergo changes.

A number of scholars have contributed to an understanding of these issues by in-depth ethnographic case studies on individual learners’ negotiation of the academic requirements and their own learning processes and struggles with their interlocutors (Duff, 2007). Most of these studies exploring the sociocultural aspects of ELLs’ academic learning experiences are at the postsecondary level, both undergraduate and graduate (see Casanave, 1992; McKay & Wong, 1996; Nam and Beckett, 2011; Spack, 1997; Tseng, 2013). With a synthesis of studies on L2 socialization into academic discourse, Duff (2007) identified five issues that need more investigation, and they are: (1) ELLs’ challenge to understand and acquire the pop-cultura-laden language in the academic discourse, (2) ELLs’ interactions with other experienced but non-native speakers of English, (3) ELLs’ acquisition of multiple modes of academic language other
than writing language, (4) the affordances and constraints that academic tasks provide to ELL students, and (5) ELLs’ trajectories for afterlife discourse socialization for academic or professional purpose.

**Use of Language Socialization Theory in this Study**

To fill the gap in research regarding L2 socialization at the secondary level and respond to Duff’s (2007) call regarding the five important issues that lack sufficient investigation, this study, situated in language socialization theory, explores the specific affordances and constraints to learning that Chinese adolescents’ experience in their science classrooms. I structured my research questions in language socialization theory highlighting the three foci: (1) what semiotic resources, (2) what language socializing practices, and (3) what positionalities within the speech community of the science classroom are afforded to Chinese adolescents.

In contrast to L1 socialization, Chinese adolescents have prior experiences with science classroom contexts before entering American high schools. Rather than blank slates, these Chinese students bring their experiences in a different discourse community with different semiotic resources and socializing practices gained in Chinese science classrooms to their new academic discourse community. A growing body of research has emphasized the importance of minority students’ “funds of knowledge” suggesting that these students, with their rich prior experiences, are not just knowledge receivers and the ones being encultured, but also contributors to the new discourse community that undergoes transformation as newcomers join in (Bunch, Kibler, & Pimentel, 2012; Buxton and Lee, 2010; Gonzales, Moll & Amanti, 2005; Kirshner, Sanchez & Hidreth, 2016; Morita, 2004).

Figure 2 shows an overlap between Chinese and English scientific discourse (CH scientific discourse & EN scientific discourse) regarding semiotic resources and socializing
practices, as some components (e.g., integration of mathematics and graphics) and practices (e.g., taking notes, doing homework) are widely accepted and used in both communities. With their “funds of knowledge”, Chinese students depart from the community of Chinese scientific discourse and enter into the community of English scientific discourse, bringing linguistic resources and socializing practices they gained in the old community to the new one.

Figure 2. Language Socialization of Chinese Science Learners
CHAPTER 3. CHINESE ADOLESCENTS’ EXPERIENCES OF SCIENCE LEARNING

As mentioned in Chapter one, the context of science education is quite different between China and the U.S. In this Chapter, I provide a literature review on the features of science education in China and their significant effects on learning resources, practices, as well as learners’ positionalities in Chinese science classrooms. I also discuss Chinese students’ experiences of science learning in the U.S. at K-12 as well as in postsecondary settings.

Students’ Engagement in Science Classrooms in Mainland China

Compared with science education in the U.S., science education in China has three unique features, and these are a centralized education system, an extreme emphasis on high-stakes standardized examination, and a mandatory and intensive training for all students including those who do not plan to major in science subjects. In China, the Ministry of Education (MOE) is in charge of most teaching and learning activities which leaves little flexibility and autonomy for teachers in science and other content classrooms. For example, the course syllabus, teaching objectives, topics to be taught, and even teaching hours allocated to each unit are stipulated by the MOE. Moreover, the MOE also selects and approves textbooks for all subjects from elementary through post-secondary institutions. When students graduate from high school, they have to take a nationally unified college entrance examination which covers core school subjects conducted by a testing agency directly affiliated to the MOE (Liang, Liue, & Fulmer, 2017).

The second feature of education in China is a great emphasis on standardized examinations, especially the national college entrance examination (Gaokao in Chinese). As a high-stakes examination, Gaokao can make or break the future of a young person whose test score is the sole factor of college admission. To many Chinese students and their families,
especially the less privileged ones, success in Gaokao means a prestigious career with security and a high income and a chance for upward social mobility (Gao, 1998). As a result, Chinese students, with encouragement and support from their parents and teachers, are willing to make every effort to succeed in this single examination even at the cost of their other interests, and physical and emotional health.

Finally, the Chinese government has placed a great emphasis on science education to prepare human resources to fulfill the national objectives of modernization and economic development since the country was founded. Typically, Chinese students have nine years of “compulsory education” with six years elementary, three years middle, and three years high school education (Liang, Liue, & Fulmer, 2017, p. 1). Students are required to take a science class for at least 45 minutes a week in grades 1-2, and 90-135 minutes a week in grades 3-6 (MOE, 2017). A wide range of topics are covered including physics, biology, earth science, and technology. When they progress to middle school, students need to take three consecutive years of physics courses from 8th grade, two consecutive years of chemistry courses from 9th grade, and one year of biology courses in 10th grade (Liang, Liue, & Fulmer, 2017). For those who plan to major in a STEM subject, they need to take all three subjects through 12th grade and then take the college entrance examination on these subjects. Even though Chinese students vary in their interest and motivation to study and pursue a career in science, most of them are prepared with a strong science background through the mandatory and intensive training and learning.

The three above-referenced features of science education in China substantially affect Chinese students’ learning experiences in their science classrooms in terms of learning resources, classroom practices, and their positioning toward science learning. As described above, textbooks are the sole official learning resources chosen by the MOE and legitimately reflects
content in examinations. That explains why science teachers and students in China emphasize the value of textbooks and use them as the main resource for learning without criticism. However, most of the scientific terms used in textbooks are translated from Western texts, and some translations may cause misunderstanding for students (Gao, 1998). For example, the word “crocodile” is translated to “e yu” in Chinese, which is associated with the word “fish.” Students can easily take it that a crocodile is a fish from this translation if no further clarification is provided (Cheng, 2011).

Another type of learning resource common in Chinese science classrooms is teachers’ lectures. In China, it is commonly believed that knowledge is transmitted from a teacher who is an authority figure to students who are passive receivers (Ginsberg, cited in Cheng & Wan, 2016). In a study on 96 Mainland Chinese adolescents, Zhao and Thomas (2016) found that more than one-third of the students (35%) reported that they were expected to be attentive, obedient, and respectful to their teachers without conditions. Gao (1998) asserts that teachers are perceived as “models of good conduct and learning” for students in the Chinese tradition. Unfortunately, science teachers in China, as one of the two main learning resources, seem not as qualified as their counterparts in Western countries. According to Postlethwaite and Wiley (1992), science teachers in China have the lowest number of years of postsecondary education (1.5 years) among 23 countries. In another study on Chinese high school science teachers, Ma (2009) argues that most of the participant teachers often overlook the social aspects in natural science and seldom review current scientific knowledge with a critical attitude.

With a centralized learning context and limited learning resources, science learners in China may not have as many opportunities to engage in scientific activities as their counterparts in the U.S. In a study on 4,115 ninth-graders from two cities in Mainland China (Urumqi City &
Shanghai), Yeung and Li (2017) present that students in both places have insufficient amounts of many types of science-related experiences such as hands-on activities and laboratory practice, as compared with their counterparts in developed Western countries like Finland and Greece. By the same token, Zhao and Thomas (2016) report that students in some regions in China (e.g., Shandong province) are not provided enough opportunities to do experiments as required in the nation-wide syllabus (Postlethwaite & Wiley, 1992). As a result, these students have to memorize the procedures and conclusions of experiments so that they can pass the examinations. Other classroom practices which are widely used in Western science classrooms like engaging in argumentation verbally or in writing are not valued or taught in many science classrooms in China (Xie & So, 2012).

Additionally, Chinese students are not encouraged to interact with their teachers in class in part because of the limited instructional time needed to cover test-related content (Wei, 2009). Nevertheless, Chinese students are very likely to seek one-on-one interaction with their teachers as soon as the class is over (Biggs, cited in Cheng & Wan, 2016).

In such a learning environment, teachers and students’ perceptions of science teaching and learning are developed, which can be quite distinctive from those of their U.S. peers. In a study comparing Chinese and U.S. science teachers’ autonomy and motivation, Robertson and Jones (2013) found that the participant teachers in China were less motivated than their peers in the U.S., and that was partially attributed to a feeling of constraint by the authoritarian curriculum and standardized testing administrated by the MOE.

Moreover, Chinese students intend to work hard and spend a long time on science learning to achieve success in examinations, even though their interest in science varies greatly (Cheng & Wan, 2016). According to Postlethwaite and Wiley (1992), Chinese students at junior
secondary level spend 7.6 hours a week on homework of which two-thirds are on science. That is the most among 23 countries. Gao’s study (1998) on the cultural context of science teaching and learning in China confirms this point and further identifies that Chinese students are more likely to learn with “achieving strategies”, namely strategies to “maximize cost-effectiveness of time and effort” such as maintaining neat and systematic work habits, planning well in doing tasks, taking clear notes, and searching for clues to understand and do well on examinations (p. 8).

Despite the unproductive learning context, fierce competition, and long study hours, Chinese students are still able to sustain their learning motivation in natural science. They make every effort to achieve academic success to meet their parents’ high expectations as well as their goals of earning an upward social class mobility and a prestigious career, or in other words, a promising future (Liang, Liue, & Fulmer, 2017; Zhou, 2014).

**Chinese Students’ Experience of Science Learning in the U.S.**

Chinese students are believed to perform well in science and math and are more likely to choose science subjects as their college majors and future professions (Lee, 1996; Lu, 2015). Nevertheless, like other ethnic student cohorts, Chinese students also suffer from the “inequitable learning opportunities” when being socialized into the Western scientific discourse due to linguistic and cultural discontinuity and lack of academic support (Lee, 2005, p. 493). As literature on Chinese students’ engagement in Western science classrooms is relatively scant, this section provides a literature review on Chinese students’ learning experiences of science as well as factors that affect their learning. Although most studies focus on college and graduate levels, they still offer valuable insights and understanding of what Chinese students have experienced in U.S. science classrooms.
International studies and government reports (Lee, 1996; Lu, 2015; Ma & Wang, 2014) such as National Assessment of Educational Progress (NAEP), Trends in International Mathematics and Science Study (TIMSS) (National Center for Education Statistics, 2011), and Program for International Student Assessment (PISA) test results (Barshay, 2013) reveal that Asian countries including China dominate the top 10 in the subjects of math, reading, and science. Also, according to the World Education Services report, 40% of Chinese international students major in science- and math-related subjects, which are the most popular majors among Chinese undergraduates and graduates (Lu, 2015).

However, Chinese students’ high achievement in math and science does not mean that they can succeed with no support as the model minority myth depicts. Studies on ELLs’ engagement in science classrooms have reported that language is a major obstacle for their learning (de Oliveria, 2010; Fang, 2005, 2006). In a study of Chinese graduate students majoring in Engineering, Zhang (2011) found the major concern for the Chinese doctoral engineering students was the rigorous evaluation of language in the manuscripts of journal articles, even if “they were confident with their novel ideas in the papers” (p. 47). Additionally, the syntax and logic of writing of the English language, which is quite different from that of Chinese, was another obstacle for their socializing into the professional science community.

In addition to the language obstacle, Chinese students majoring in a STEM field may also suffer from emotional difficulties due to a dissatisfaction of their learning experiences in the U.S. In a study of six Chinese doctoral students studying in a U.S. university, Zhou (2014) found that these students, despite their initial intrinsic interest in research, encountered similar demotivation conditions, such as overwhelming workload, fierce competition in publication, and mismatched interests or working style with their advisors. Nevertheless, they still managed to sustain their
motivation in obtaining their degree in a STEM field for more utilitarian reasons, such as high value of a U.S.-trained Ph.D. degree and the high social cost of quitting. Zhou (2014) attribute the participant Chinese students’ persistent motivation in learning in a STEM field to their Confucian cultural heritage that believes in “malleability, the importance of effort, interdependent self, and filial piety” (p. 186).

Despite their language and emotional challenges, Chinese science learners seem not to receive sufficient and effective support from their schools and universities. The Chinese engineering students in Zhang’s study (2011) critiqued the writing support programs provided by their universities for too general and superficial guidance on language issues. Like other ethnic minority students, Chinese students are not provided adequate resources or explicitly taught to take advantage of those resources (Nam & Beckett, 2011). At the secondary level, Chinese students’ learning needs are invisible to some teachers, especially in science and math subjects that are perceived as disciplines with less language and culture load (Lee, 1994; Li, 2005; McKay & Wong, 1996). Meanwhile, academic support for Chinese, as well as other ELL students, places more emphasis on improving their general English proficiency, sometimes at the cost of their development of content knowledge and cognitive competence (de Oliveria, 2010; McKay & Wong, 1996).

A common observation about Chinese students in American classrooms is their silence, which is perceived as the result of the students’ lack of communicative competence compatible to their NES counterparts (Liu, 2010; Wang, 2010; Zhou, Knoke, Sakamoto, 2005). However, Zhou and his colleagues (Zhou, Knoke, Sakamoto, 2005) found that Chinese students’ silence in Western institutions was not merely from the dissonances between their prior cultural and linguistic experiences and the target ones. Rather, an imbalanced power relation was identified in
classrooms, as Chinese students’ sharing of indigenous knowledge was not valued and accepted by their instructors and NES peers. By the same token, Wang (2010) reflected her own learning experience in Britain and attributed her in-class silence to her resistance to the stereotype and misconceptions about China that dominate the knowledge system and pedagogies in the classroom. In a study comparing in-class participation of Chinese and NES students, Duff (2002) asserts that the Chinese students’ opportunities to speak in the class were deprived of their NES peers who showed obvious disdain of Asian students’ accented English and reticent identity.

To compensate for the inadequate support provided by school, Chinese parents, who are well-known for great investment in their children’s education, are more likely to help their children to learn science than American parents do. In a study of 185 Chinese, 39 Chinese-American, and 140 American families, Chen (2011) compare parents’ attitudes and expectations toward their children’s science education. Results show that both Chinese parents and students have more positive attitudes toward science education, and Chinese parents place greater emphasis on their children’s self-improvement and set higher standards for their children’s science learning. This is consonant with Li’s studies on Chinese parents’ involvement in their children’s school work, showing that Chinese parents expect their children to have more homework and academic activities to achieve success (Li, 2006, 2007).

As a result of insufficient school support, pressure from parents, inaccurate stereotype (e.g., model minority), and discontinuity of language and culture, Chinese students are undergoing multiple-identity struggles that may cause conflict when they are socialized into the community of science (Huang, 2004; Wang, 2011). In Wang’s study (2011) on Chinese graduate students in science majors, the participant Chinese students struggled with identity issues that were also evident among other ELL ethnical groups. Wang (2011) argues that some Chinese
ELLs tend to produce “less-Western” writing, not because of their lacking competence to socialize into a new academic discourse. Rather, it may indicate their desire to keep or manifest their unique writing styles that are intimately bound up with their cultural backgrounds. Wang suggests that teachers should value various ways that Asian students, including Chinese students, present their writing and should use alternative criteria to assess their writing products.
CHAPTER 4: METHODOLOGY

In this chapter, I describe the study design, research sites, and participant characteristics. A total of five Mainland Chinese students were recruited from two public high schools located in a northeastern state. Multiple sources of data were collected including 15 student and teacher interviews, 14 weeks of classroom observations, and 142 pieces of student writing samples. A grounded theory method was employed for data analysis.

**Study Design: Ethnographic Multiple Case Study**

I adopted an ethnographic multiple case study as the research method in this study. As the outcome of L2 socialization can be quite unpredictable (Duff, 2004), a variety of factors can affect Chinese adolescents’ socialization in their science classrooms, such as their prior learning experiences, their interactions with teachers and peers, and their parent’s involvement. A multiple case study method offers an effective approach to explore the socializing process from multiple perspectives (Baxter & Jack, 2008; Yin, 2009). Also, an ethnographic approach is recommended when investigating phenomena through a language socialization lens (Ochs & Schieffelin, 2011) as it affords attention to how such things as semiotic resources, socializing practices, and participation in speech communities relates to how individuals develop within different social and cultural contexts.

Another feature of this study is an emphasis on participants’ views and feelings of their socialization process. Some language socialization researchers have argued that learners’ perspectives provide invaluable data that cannot be obtained through observation (Morita, 2004; Wang, 2010). Learners’ documentation, reflections, and recounts of what they experience are crucial to understand their L2 socialization, and these are always neglected in current language socialization research (Morita, 2004).
This study was designed in light of the findings from a pilot study I conducted investigating Chinese adolescents’ writing experiences in secondary math and science classes (2015). Three Mainland Chinese adolescents participated in the pilot study and findings suggested that: 1) students’ past learning experiences in China played a significant role in their learning of math and science subjects in their U.S. secondary school; 2) students experienced writing tasks that were both mechanical (e.g., fill-in-blank exercises) and informational (e.g., notes, lab reports) depending on their level of English proficiency, which held implications for their preparation for post-secondary study in STEM fields; and 3) students’ self-positioning towards classroom math and scientific discourse were highly associated with their real competence and motivation to learn science. These findings recommended (1) expansion of the data collection to other activities beyond writing and (2) investigation of science specifically as math and science experiences were quite variable.

**Contexts and Participants**

**Contexts.** Participants for this study were recruited from two public high schools in a northeastern state. Due to the rising demand of international employees by a global high-technology company, many Chinese families had moved to this area leading to an increased enrollment of Chinese students in local public schools. Nevertheless, Chinese students were still underrepresented in this area, and that was the major reason that I selected two sites (Springmarsh High School\(^3\) and Pinewood High School) to ensure enough participants. Both schools are large public schools located in suburban areas with expanding Chinese populations. The increasing number of Chinese families and students in the two areas is consistent with the

---

\(^3\) Pseudonyms were used to ensure the anonymity of schools.
national trend of Chinese population growth. Also, both schools are high achieving schools in the state with typical Asian enrollment rates\(^4\) (10-15%) compared to the state’s average.

As one of the top 15 states with the highest density of ELLs, the state has mandated regulations to provide resources and accommodations to support ELL students’ academic success (Ruiz Soto, Hooker & Batalova, cited in Wilcox, Gregory, Yu, & Leo, 2017). For example, Part 154 of the Commissioner’s Regulations (CR) put forth a number of requirements, such as engaging ELL students in content classrooms, arranging content and ESL teachers to collaborate, and providing ELL parents orientations and information about ELL programming and other support services (Wilcox, Gregory, Yu, & Leo, 2017). Both schools participating in this study complied with the requirements and provided resources to better serve their ELLs including those with Chinese backgrounds.

*Springmarsh High School.* Springmarsh High School is located in an affluent area. As one of the best performing schools in its region, Springmarsh High School has received several national rewards for its academic excellence. This school serves students from 9\(^{th}\) to 12\(^{th}\) grades with 80-85% Whites, 10-15% Asians, 0-5% African Americans, and 0-5% other ethnicities (state website, 2016).

Table 1
Demographics of Springmarsh High School\(^5\)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whites</td>
<td>Asians</td>
<td>African Americans</td>
<td>Other ethnicities</td>
</tr>
<tr>
<td>80-85%</td>
<td>10-15%</td>
<td>0-5%</td>
<td>0-5%</td>
</tr>
</tbody>
</table>

\(^4\) Ranges are provided so as to avoid deductive disclosure.

\(^5\) Same as above
Springmarsh High School offers a variety of programs including Honors and AP classes, interdisciplinary learning projects, and a broad range of electives such as nanoscale science. In addition to the academic programs, a large number of extracurricular clubs are provided to students including a Chinese club, created at the time of this study. An ESL program is provided in this high school, and a full-time teacher is responsible to help ELL students with their homework, searching translators for state examinations, and communicating with content teachers.

Additionally, two special programs were newly launched in Springmarsh High School when the study was conducted. One is an International Scholars program aiming to attract international students worldwide. These students are offered one year F-1 Visas for their study at the Springmarsh High School and stay in a host family rigorously selected by the school administrators. Some international students choose to study at 12th grade, as they can study legitimately for only one year with their F-1 Visas according to the U.S. Department of Homeland Security. Many, however, stay longer because their green cards are in process while they are enrolled in this program. These students often stay with their parents who have already obtained green cards and reside in the State. The three focal students recruited from Springmarsh High School all belonged to this type.

Another program was the Chinese language program, which was started no more than a month at the time of this study. A new Chinese teacher is in charge of this program and the Chinese club mentioned above. Although the Chinese teacher is not officially required to teach or advise Chinese students, she maintains a close relationship with all Chinese students as well as their parents. She also volunteers to serve as a liaison between the Chinese students and their NES peers by providing opportunities for them to communicate and hang out together. Most of
the Chinese students at this school are members of the Chinese club where their cultural knowledge and background are highly valued.

**Pinewood High School.** Pinewood High School is a large suburban school located in a diverse area. As for Springmarsh High School, the serving population of Pinewood High School are students at 9th grade through 12th grade. The demographics are 75% Whites, 12% Asians, 7% African Americans, 3% Hispanics, and 3% other ethnicities, as shown in Table 2 (state website, 2016). The graduation rate in 2016 was 90-95%, and 60-65% students continued their education in a four-year college after graduation.

Table 2
Demographics of Pinewood High School

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whites</td>
<td>Asians</td>
<td>African Americans</td>
<td>Hispanics</td>
<td>Other ethnicities</td>
</tr>
<tr>
<td>75-80%</td>
<td>10-15%</td>
<td>5-10%</td>
<td>0-5%</td>
<td>0-5%</td>
</tr>
</tbody>
</table>

A mission of Pinewood High School is to prepare students to be college and career ready. To achieve this goal, Pinewood High School offers a variety of academic and extracurricular programs including AP courses, electives, independent study, and more than 70 after school clubs.

Due to the racial diversity in this area, Pinewood High School place great emphasis on ESL education. Students who are non-native speakers of English have to take a State Identification Test for English Language Learners before enrolling in Pinewood High School. Students identified as ELLs are expected to enroll in a ESL program under the Department of Foreign Language and receive language and academic support services from a full-time ESL teacher. They also have opportunities to receive stand-alone ESL classes and integrated instruction in content area courses to develop their language and content knowledge.
Moreover, content teachers are encouraged to attain ESL certification and offered professional development on ESL education to better serve their ELL students. Although the two teachers participated in the study did not attain ESL certification, they actively sought resources to support their ELL students through professional development and collaboration with the ESL teacher. For example, one participant was enrolled in a research project of a local university which aimed to enhance in-service ESL and science and math educators’ expertise in teaching ELL students.

Participants. Students were selected based on the goal of this study, and that is to explore Mainland Chinese students’ learning experiences in their science classrooms. Therefore, participants were required to be native Chinese speakers and identified or formerly identified as ELL students by their schools. According to prior studies on second language acquisition, it can take eight years for ELLs of all age to achieve academic English proficiency as their NES peers (Collier, 1987; Hakuta, Butler, & Witt, 2000). To ensure their language proficiency at non-native level, participants had to study in the U.S. for no more than eight years.

Participants prior schooling experiences in China were also required, as students with little or no education background in their home country may not have had sufficient experiences of science learning, and thus were not able to compare and contrast their learning experiences in China and in the U.S. As mentioned earlier, taking science class(es) is mandatory in China from elementary school through secondary. Therefore, participants who had been formally educated in China during elementary or secondary school should have had science learning experiences in their Chinese schools. However, the types of schools (e.g., public school, private school) that participants were previously enrolled were not taken into consideration, as the information was
not directly related to school performance and teacher quality, and did not indicate students’
family socioeconomic status (SES) in China.

With the criteria above, I started to recruit participants in the fall of 2015. I contacted
district superintendents, school principals, and ESL teachers, and made a brief introduction of the
project through phone or email. I also reached out to local Chinese organizations such as
churches.

In the end, I received consent and assent from five Mainland Chinese students and their
parents following Institutional Review Board- approved procedures. These students, despite their
same ethnic background, varied in terms of their English proficiencies, residence length in the
U.S., family SES, and past learning experiences, as presented in Table 3.

Table 3
Participant Demographics

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Grade</th>
<th>Years of Residence</th>
<th>School</th>
<th>Science Course(s)</th>
<th>Teacher(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jie</td>
<td>Female</td>
<td>15</td>
<td>9th</td>
<td>2 (months)</td>
<td>Pinewood HS</td>
<td>Biology Regents</td>
<td>Ms. Phi</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>grade</td>
<td></td>
<td></td>
<td>Biology Lab</td>
<td>Ms. Brown</td>
</tr>
<tr>
<td>Xuan</td>
<td>Female</td>
<td>17</td>
<td>11th</td>
<td>2</td>
<td>Springmarsh HS</td>
<td>Chemistry Regents</td>
<td>Ms. Park</td>
</tr>
<tr>
<td>Wei</td>
<td>Female</td>
<td>15</td>
<td>10th</td>
<td>3</td>
<td>Springmarsh HS</td>
<td>Chemistry Honors</td>
<td>Ms. Park</td>
</tr>
</tbody>
</table>

6 Pseudonyms were used to ensure the anonymity of participants.
<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Grade</th>
<th>School</th>
<th>Subject</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wen</td>
<td>Female</td>
<td>15</td>
<td>10th</td>
<td>Springmarsh</td>
<td>Chemistry Honors</td>
<td>Mr. Del</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HS</td>
<td>Biology Honors</td>
<td>Mr. Bell</td>
</tr>
<tr>
<td>Hei-li</td>
<td>Male</td>
<td>17</td>
<td>12th</td>
<td>Pinewood</td>
<td>AP Environmental Selective</td>
<td>Mr. Rode</td>
</tr>
</tbody>
</table>

Table 3 provides general characteristics of the focal students. I intentionally integrated a more detailed description of students and their teachers’ characteristics and experiences in the findings chapters that follow, as these characteristics were closely related to the participants’ socialization experiences in science classrooms.

There was only one male student out of the five focal students. This was not by design but due to the composition of the ESL and the International Scholar program as well as the students’ attitudes towards extracurricular activities. I found that some Chinese students, especially the ones who excelled at academics were not very likely to participate in extracurricular activities that did not offer them academic credits. This impression was later confirmed by the Chinese teacher at Springmarsh High School.

**Data Collection**

Multiple sources of data were collected in one academic semester from September to December 2016. Primary data sources were two interviews with the focal students, as the first one focused on their general experiences of science learning in China and the U.S., while the
second one focused on their experience of a specific unit/lesson/activity in the semester when the study was conducted (see Appendices A & B). To obtain a thorough perspective of the students’ learning experiences, I also interviewed their science teachers with a focus on the focal students’ engagement in class and the types of resources and practices these teachers used (see Appendix C). Interview protocols were modified from the ones employed in the pilot study to elicit pertinent data (Yu, 2015). I used semi-structured protocols to capture the participants’ individual perspectives and allow for a rich description (Drever, 1995). The focal students were offered opportunities to speak either in English or Chinese, as this was helpful to enhance clarity, communication, and rapport between the researcher and the participants (Creswell, 2013). All interviews were conducted face-to-face, and all were audio-recorded with permission. The majority of the interviews lasted between 30 minutes to one hour. All interviews took place in the classroom or the library of the participants’ schools.

Immediately prior to an interview, I administered a background questionnaire to the student and was on hand to answer any questions the student had about this project. This questionnaire was designed to collect information about the student’s educational background, length of residence in the U.S., and parents’ careers and involvement in their science learning (Appendix D).

In addition, I conducted weekly classroom observations of the students’ registered science classes for 10 and 14 weeks in Pinewood High School and Springmarsh High School, respectively. I used an observation protocol for all observations with a focus on semiotic resources, classroom practices, and the focal students’ interactions with their peers and teachers (see Appendix E). I also debriefed with the students and their teachers after class with 26 “debrief” memos.
When I conducted interviews and classroom observations, I attended to the data related to the semiotic resources, socializing practices, and their positionalities within the context of the science classroom. Although the Chinese students in this study displayed multiple identities, I focused on their roles and responsibilities as high school students and science learners, and was primarily concerned with their coursework and everyday classroom practices. I asked myself the following questions as guidelines to collect pertinent data with regard to the Chinese students’ positionalities: What are the Chinese students’ social acts/behaviors in their science classrooms? What are their attitudes/stances towards science learning? How do their social acts and attitudes shape and affect their positionalities in their science classrooms? How do other community members’ (e.g., teachers, peers, parents) acts, attitudes, expectations, and requirements reinforce or contradict their positionalities and identities as science learners?

I also collected the participants’ writing assignments for their science classes (e.g., homework assignments, quizzes, lab reports) as a source for triangulation with other data sources.

Table 4 summarizes the sources of data in relation to each research question.
Table 4
Research Question and Data Source Matrix

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Related to theory</th>
<th>Main data source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student survey</td>
<td>Student interview #1</td>
</tr>
<tr>
<td>What semiotic resources (e.g., textual, oral, multimodal) are provided to Chinese adolescents in their science classrooms, and how do these resources affect their learning?</td>
<td>Semiotic resources for language socialization</td>
<td>5</td>
</tr>
</tbody>
</table>


| What types of tasks (e.g., oral presentation, written arguments) are provided to Chinese adolescents in their science classrooms and how do these tasks affect their learning? | Socializing practices that facilitate socialization |
| How are Chinese adolescents’ positionalities in their science classrooms shaped and perceived by others and by themselves? | Novices’ positionalities within a speech community |
Data Analysis

All interviews were transcribed and translated into English if they were conducted in Chinese. Translations were checked by another native speaker of Chinese with a Ph.D. degree and 11 years’ experiences of academic research. I sent all transcripts and translations to focal students to solicit their feedback (i.e., member checked). I also offered to present my findings to my participants as well as other students and teachers at the two schools where I conducted the research. I applied these strategies to increase the accuracy of my data and credibility of my findings (Creswell, 2013).

All sources of data were analyzed (i.e., triangulated) to identify patterns (Creswell, 2013). I used a grounded theory method using a four-stage procedure to analyze interviews and classroom observations (Charmaz, 2006). I first loaded all interview and observation data in the qualitative software program NVivo and applied 28 provisional codes such as accommodation to ELLs, teacher collaboration, affordance of learning resources, constraints of learning resources, and so forth. (see Appendix F). During this stage, I used a constant comparative method (i.e., modification of codes based upon new and any discrepant data) and memo-writing to check and re-check the coherence of these provisional codes (Glaser & Strauss, 1967). Next, I used axial coding procedures in order to collapse the initially generated provisional codes into seven major categories. These categories were: semiotic resource, socializing practice, student positionality, student background, school context, parents’ involvement, and ethnic/gender ideology. Finally, I mapped the relationships between the seven major categories in the theoretical coding phase and identified patterns of each student’s socialization as described in the finding sections (Miles, Huberman, & Saldana, 2013).
To analyze the students’ written samples, I adopted definitions of arguments and informative/explanatory texts listed and highlighted in the CCSS across 9-12 grades, as the two types of writing were commonly required in high school science classrooms. I also included two other categories identified by Lemke (1994, 2003) - mathematical expressions and illustrations. These specific forms of symbols and visual representations are also emphasized in the CCSS, as they embody unique cultural and scientific meanings (Oliveira & Weinburgh, 2017). The last category I used in this study was mechanical writing (e.g., fill in the blank, multiple choice), which was used to categorize writing by Applebee and Langer (2011) in the National Study of Writing Instruction. According to Applebee and Langer (2011), mechanical writing made up the majority of high school writing. To summarize, the categories that I used to analyze students’ written samples for this study were arguments, informative/explanatory texts, mathematics, visual representations, and mechanical writing (Appendix G).

When I completed the analysis of individual student datasets, I engaged in a cross-case analysis using the following typical cross-case procedures (Yin, 2013). I created a matrix to display the data from individual students according to the seven major themes (Miles, Huberman, & Saldana, 2013). Then I used the matrix to identify similarities and differences among the focal students and looked for patterns across cases in relation to each of the three research questions.
CHAPTER 5: Major Patterns

Based on a cross-case analysis, this chapter presents a summary of major patterns across the five participants’ learning experiences in their science classrooms in response to the three research questions guiding this study. As a preview to these findings, and in relation to the first research question (What semiotic resources are provided to Chinese adolescents in their science classrooms, and how do these resources affect their learning?), I found that the Chinese adolescents were offered multimodal learning resources (e.g., illustrations, videos, realia) and teachers’ one-on-one tutoring in addition to the traditional textual ones (e.g., textbooks, student workbooks). While some of those resources provided affordances to the Chinese adolescents’ learning of science, others caused obstacles, mainly depending on how teachers guided and scaffolded the use of the resources.

To answer the second research question (What types of tasks are provided to Chinese adolescents in their science classrooms and how do these tasks affect their learning?), I found that the Chinese adolescents in this study had more opportunities to engage in hands-on activities such as laboratory practices and science projects in the U.S. than in China. On the one hand, these practices enhanced their understanding of the science content and gave them a chance to practice scientific literacy skills (e.g., observing, collecting data, interpreting results). On the other hand, the Chinese students sometimes lacked background knowledge or did not understand the directions, and that undermined the benefits they gained from carrying on these practices. The Chinese adolescents also experienced difficulties in collaborative learning and expository writing.

Regarding the third research question (How are Chinese adolescents’ positionalities shaped and perceived by others and by themselves in their science classrooms?), four types of
positionalities emerged from my analysis: positioning as science learners, positioning as ELLs, positioning as Chinese students, and positioning as first-generation students. Although the four types of positionality seemed self-evident (e.g., positioning as Chinese students), their meanings were “constantly renegotiated and reshaped” by the Chinese adolescents and other community members (Harklau, 2000, p. 37).

**Semiotic Resource**

Based on the five adolescents’ reports, I found that there were more semiotic resources provided in their U.S. science classrooms than in the Chinese ones. According to the adolescents, the major semiotic resources in Chinese science classrooms were teachers’ lectures, textbooks, and student workbooks, which all aimed for test preparation. In contrast, multimodal learning resources were available in U.S. science classrooms in textual (e.g., worksheets, handouts, and articles), auditory (e.g., teachers’ lecture), visual (e.g., illustrations, videos, realia, etc.), and actional modes (e.g., experimentation). Moreover, science teachers in the U.S. were more likely to draw upon authentic information from students’ daily lives to their classrooms, and find a way to connect it to the learning contents. Finally, teachers’ guidance out of class such as one-on-one tutoring was another essential resource for the Chinese students, which was not always available in China.

Those semiotic resources had various impacts on the Chinese adolescents’ learning, depending on their academic language proficiency, learning style, and their teachers’ teaching approach. Without appropriate scaffolding, some of those resources had even impeded the Chinese adolescents’ comprehension of content and reduced their motivation. According to the participants, three types of semiotic resources had the most considerable impacts on their learning: textual resources, teachers’ lectures, and teachers’ guidance after class.
Textual resources in this study referred to PowerPoint slides, class notes, handouts, textbooks, and science articles. According to the participants, the note packets provided by their teachers with essential concepts and terms listed in bullet points were helpful, particularly for test preparation. For newcomers (e.g., Jie), note packets served as resources for them to review the content and vocabulary that was missed in class. For example, Jie reported that note packets were the most helpful learning resources for her because if she “missed something in class, she could always refer back to the notes and learn by herself” (Jie, interview 1, October 26, 2016). For learners who had studied in U.S. schools for years (e.g., Xuan, Wei, and Wen), the note packets were the most effective tools for them to prepare for exams because those notes were provided by their teachers and highlighted all key points that would appear on exams.

Despite the advantage of class notes as a review tool, some Chinese students in this study encountered challenges when reading or taking those notes, mainly because of their developing academic language competence. For example, Jie as a newcomer was struggling to figure out the meaning of her teacher’s directions and prompts on lab reports because of her unfamiliarity of the academic requirements (e.g., writing conclusions), and difficulty in understanding the dense vocabulary. Even for students who had no difficulty in reading, they still found it was challenging to take notes and attend to the teacher’s lecture, simultaneously. “There’s no way I can take notes and listen to the lecture at the same time,” reported by Xuan (interview 2, December 1, 2016). Those kinds of dictation tasks required strong language skills as well as content knowledge, none of which were fully acquired by those Chinese science learners.

This study also found textbooks, which were extensively used in the science classrooms in China, were seldom used by the Chinese students in their U.S. science classrooms. The dense vocabulary and long paragraphs made textbooks hard to read for both ELLs and NESs. Also,
some of the content in the textbooks was too advanced and discursive, and thus, was not taught in class. Instead of textbooks, the Chinese students and their science teachers relied more heavily on handouts and worksheets with concentrated content and in concise language.

To promote Chinese ELLs’ learning, some of the science teachers in this study provided extra scaffolding and resources on language, especially on vocabulary, including glossaries in both English and Chinese, explicit explanation of new terms, specific examples of scientific concepts, and vocabulary exercises and games. Those extra resources not only facilitated newcomers to figure out the meaning of new words (e.g., Jie) but enhanced advanced learners’ understandings of the content (e.g., Wei, Hei-li). For example, Jie’s biology teacher provided glossaries in ELLs’ native language and explicitly taught strategies to understand and memorize terms. These resources effectively facilitated Jie’s acquisition of both language and content.

In addition to textual resources, teachers in this study employed a variety of multimodal resources including symbols, numbers, illustrations, videos, realia, and experimentation, even though they did not intentionally incorporate these resources for the sake of scaffolding for ELL students. Those multimodal resources provided the Chinese students a non-linguistic medium to understand the content as well as an alternative way to express their thoughts. However, this study found that the Chinese students’ preference for non-linguistic resources was not necessarily attributed to their inadequate academic English proficiency. It was also influenced by students’ various learning styles (e.g., Hei-li).

Teachers’ lectures were another major semiotic resource in both U.S. and Chinese science classrooms, but the lecture styles in these two contexts were quite different. According to the Chinese students, the lectures in their science classrooms in China were monotonous and
teacher-centered. Teachers repeated the content in textbooks and did not encourage conversation with students.

In contrast, teachers in the U.S. science classrooms gave more vivid and engaging lectures, attempting to create triadic dialogues which involved everybody in the classrooms. Three features of teachers’ lectures which promoted the Chinese students’ motivation and understanding of scientific discourse were identified in this study.

First, teachers offered many examples to explain a new concept. They were also willing to clarify multiple times if needed. Moreover, teachers applied diagrams (e.g., photos, T-charts), gestures, and changes in pitch to supplement their lectures and make the content more accessible to students. Meanwhile, teachers endeavored to connect the target learning content to what students had previously learned as well as students’ personal life experiences. This teaching approach was particularly valued by the Chinese students in this study, as they could build up a knowledge network based on their “funds of knowledge” (Gonzalez, Moll, & Amanti, 2005).

Finally, teachers in this study constantly checked students’ understanding in class. Although most Chinese students in this study did not ask questions when their teachers checked for understanding, they learned from their peers’ conversations with teachers and appreciated their teachers’ patience and consideration, which made them less intimidated to ask questions after class.

The last major semiotic resource reported by these five Chinese students in this study was the guidance of other experienced community members, namely their teachers, siblings, and friends. Although the Chinese students in this study were quiet in class, they actively sought help from their teachers during break or after class, especially at one-on-one tutoring sessions.

Compared with science teachers in China, the teachers of these five Chinese students were more
willing to provide extra support and placed more emphasis on students’ hard-working attitude than their academic performance. Even for advanced learners like Hei-li, the teacher’s one-on-one tutoring after class helped him to learn and be socialized into the new academic discourse, especially in the transition period. Hei-li said, “when I first came here, I stayed after every day with my teachers to learn” (Hei-li, interview 1, November 15, 2016).

In addition to communicating with teachers, when they encountered difficulties some of the Chinese students sought help from their siblings who were more advanced in academic English and schoolwork. Extra support and guidance from other community members provided these Chinese adolescents an alternative means of acquiring an understanding of U.S. academic expectations, especially during their transition periods.

**Socializing Practice**

Regarding socializing practices, Chinese adolescents had more opportunities to engage in hands-on activities such as doing labs or carrying out science projects in their U.S. science classrooms than in their Chinese ones. In Chinese classrooms, even those students located in the affluent and metropolitan areas (e.g., Beijing or Shanghai) had few chances to conduct experiments and had to observe their teachers’ demonstration of experiments instead.

In contrast to what they experienced in their Chinese classrooms, the students in this study were required to complete a certain number of labs and science projects in their U.S. classrooms as well as tasks related to hands-on activities such as group work and writing assignments. These tasks provided both affordances and constraints to their learning of science.

On the one hand, the Chinese students found that doing labs helped them to understand some scientific concepts, especially the abstract ones. For example, in Wen’s chemistry class, she was guided to do a lab test to find out if the colored coating from a M&M could dissolve in
From doing this lab, Wen was able to understand target concepts such as dissolvability and polar and non-polar molecules. These concepts would be too abstract for Wen to understand if they were only explained in words, especially in English, a language that she was still learning.

Additionally, by carrying out science projects, the Chinese students experienced exploring their inquiries or repeating a discovery process. This not only enhanced their understanding of the science content, but gave them a chance to practice their scientific literacy skills such as observing, collecting and recording data, and interpreting results, as reported by the Chinese students in this study.

On the other hand, the Chinese students were sometimes unclear about the purposes, lacked background knowledge, or did not understand the directions of experiments or science projects, and that undermined the benefits they gained from carrying out these projects. The Chinese students’ vague understanding was partially attributed to language, especially when the directions involved many new and difficult words. Teachers’ lack of clarification on the lab purposes and directions was another reason for this issue. For example, although Xuan was able to complete her lab requirement by following her cookbook lab procedure, she was unclear about the lab purpose and had a hard time writing the lab report. In the interview, Xuan complained “I didn’t understand the point [of the lab], even though I completed it by myself” (Xuan, interview 2, December 1, 2016).

The engagement in carrying out labs and science projects also provided the Chinese students opportunities to communicate with their peers, as group work was always required in these hands-on activities. Although cooperative learning has been proven to effectively promote Chinese students’ development of content knowledge as well as language and social skills (Tang, 1996; Zhu, 2012), it was challenging for some Chinese students, even the experienced learners in
this study. A reason for this, as reported by the Chinese students, was that they preferred to work individually. Some Chinese students in this study perceived collaborative learning as “talking about something unrelated with their friends” (Wen, interview 2, November 7, 2016), and believed it was more effective to work by themselves. Some students reported that they had unpleasant experiences working with their NES peers, who might “say something mean,” merely because they were ELLs (Wei, informal conversation, November 4, 2016). These unsuccessful communication experiences made them feel intimidated about interacting with their NES peers, even when they were quite capable of communicating in English.

Nevertheless, this does not mean that Chinese students are not able to collaborate with their peers and complete task requirements. To the contrary, the students in this study were observed or reported to enjoy working with their peers and even sought opportunities to do so in some situations. One of these moments was when Jie worked with a Taiwanese student who shared the same culture and native language as her. As Jie reported, she would ask that student to explain the biology lab directions in Chinese whenever she was confused. Also, Wei also attempted to manipulate her NES peers to ask the teacher questions for her, as she was uncomfortable interacting with her teacher in class. When the Chinese students were grouped with their friends, both NESs and other ELLs, they would not refuse cooperative learning opportunities.

To elicit the Chinese students’ active participation, teachers’ use of triadic dialogue seemed to work effectively, though the teachers were unaware of this fact. Students answered a question or comment together from their seats in lieu of standing up and speaking individually. Through this less intimidating way, the Chinese students were able to speak up in class with no worry about losing face.
Another type of socializing practice that was used differently in Chinese and U.S. science classrooms was writing. In the U.S. school setting, the Chinese students were required to complete a variety of writing tasks for their science classes such as lab reports, essays, and arguments. Most of them had little experience in scientific writing, as the majority of writing in Chinese science classrooms was in the form of math exercises such as calculations. Lack of experience in the traditional genres of the Western scientific writing challenged the Chinese students in this study. For example, Wen spent hours completing her lab reports for her chemistry class while the teacher’s intended completion time was “no more than 15 minutes” (Mr. Del, interview, October 6, 2016).

To compensate for their lack of experience, the Chinese students sought alternative means to present their learning such as performing mathematics problems. Unfortunately, their science teachers were not aware of their math strengths and did not alter the curriculum or their instruction to tap into this resource.

Writing practices with the ESL teacher’s supervision were provided to the Chinese students when they were enrolled in the ESL program, as reported by two students (Wei & Heili) in this study. However, both students indicated that these practices, that placed a heavy emphasis on lexicon and grammar, were helpful when they were beginners, yet became less impactful as they progressed to advanced language proficiency.

**Positionality in Science Classroom**

This study found that positionalities of the five Chinese adolescents varied greatly and were continuously recreated through their social acts and stances as well as the other community members’. I found four types of positionalities emerged from my analysis, and these were: positioning as science learners, positioning as ELLs, positioning as Chinese students, and
positioning as first-generation students. Although the four types of positionality seemed self-evident (e.g., positioning as Chinese students), their meanings were “constantly renegotiated and reshaped” by themselves and other community members (Harklau, 2000, p. 37). The Chinese students’ positionalities noticeably affected their investment and motivation in science learning.

**Positioning as Science Learners.** The Chinese students’ positioning as science learners seemed to switch from the center to marginal when they transitioned into the U.S. science classrooms. Some of them were among the top range of students and took the responsibility to tutor other students when they were in China; while in the U.S. science classrooms, they repositioned themselves as help receivers because of their low self-positioning and perception as lacking abilities and skills (e.g., Jie). For example, Jie reported herself as the “student monitor” in her biology class in China, while she positioned herself as a student who needed extra help from her classmates in the U.S. classroom (Jie, interview 1, October 26, 2016).

A manifestation of the Chinese students’ loss of power and confidence in the U.S. science classrooms was their intentional silence in class. Regardless of their active interaction with their teachers after class, most of the Chinese students were unwilling to publicly speak or communicate with their teachers and peers in class. A reason for that, as described by one of the Chinese students, Jie, was they attributed their confusion about content and new words to their inadequate English facility. Jie believed she was not supposed to bother her teachers and NES peers to attend to these language-related questions.

One exception was Hei-li who had studied in the U.S. for eight years. As a “non-traditional learner” who learned from visual resources rather than textual resources (Hei-li,
interview 2, December 14, 2016), Hei-li actually switched his positionality from the marginal in his Chinese science classrooms to the center in his U.S. science classrooms. In his environmental science classroom which was more student-centered than his Chinese one, Hei-li seemed to gain power from sharing authority with his teacher rather than losing it as other Chinese students in this study.

Although the Chinese students positioned themselves as legitimate peripheral learners, they were able to manifest their “old timer” positionality as science learners in some specific circumstances. For example, Jie had an opportunity to show her outstanding knowledge of biochemistry in class because she had already learned it in China.

*Positioning as ELLs.* All of the five students except Jie had been tested out of the ESL program and were not official ELLs at the time of the study. However, their experiences as ELLs still had impact on their engagement in scientific discourse due to their developing academic language and a lack of experience with some academic and linguistic demands such as writing lab report or working in groups. For example, experienced learners such as Wei and Wen reported that they experienced difficulties in collaborative learning and expository writing, even if they were quite competent in taking standardized exams.

Their teachers were also aware of these constraints, and explicitly expressed their concerns about the students’ class participation, writing, or comprehension of scientific terms. For example, Xuan’s teacher explicitly expressed her concerns of Xuan’s lack of ability to fully comprehend her test questions (Ms. Park, interview, October 24, 2016). Ironically, they did not provide extra support or adapt their instruction to meet the Chinese ELLs’ learning needs because these students were officially tested out and not expected to receive help. Meanwhile, the teachers repeatedly emphasized their equal treatment of the Chinese students, as they
discerned no difference between local students and students coming from other countries. With
their colorblind perception, the teachers did not recognize the Chinese students’ strength in
mathematics and tap into it as a resource to promote the Chinese students’ learning of science.

It is worth noting that Ms. Phi was the only science teacher who noticed the particular
learning needs of Jie and other ELL students in her classroom, and provided extra semiotic
resources (e.g., glossaries, translations of exam questions), support (e.g., explicit instruction on
vocabulary), and accommodations (e.g., collaboration with the ESL teacher, test
accommodation).

*Positioning as a Chinese Student.* In this study, all five students positioned themselves as
Chinese regardless of their language proficiency and immigrant status. I found that their
affiliation to China and Chinese culture resulted from three factors. First, all of them exclusively
spoke Chinese language at home in order to effectively communicate with their parents who had
low English facility or did not prefer speaking English at home. Some students (e.g., Wei, Wen,
and Hei-li) even had to translate their performance report to their parents who spoke little
English.

Regardless of their limited English facility and a lack of schooling experience in the U.S.,
those Chinese parents behaved consonantly to the “tiger mom” stereotype regarding their high
expectations on their children’s academic success. They were intensively involved in their
children’s schoolwork and made decisions for their children’s future careers. Most of them
decided to have their children major in a STEM subject.

Second, all of the Chinese adolescents encountered many challenges and struggled to
adapt themselves to the U.S. education system in their transition period. Most of these challenges
were related to academic and linguistic demands (e.g., Jie, Hei-li), while others were about their
difficulty in social interaction with their NES peers who held hostile attitudes towards them (e.g., Wei).

Finally, the Chinese students were aware of the model minority stereotype and associated themselves with that stereotype consciously or unconsciously. All of them except Hei-li indicated their competence in mathematics and perceived it as an expectation from their teachers and peers. Meanwhile, they resisted the downside of the stereotype which described Chinese students as “over-conformist, lacking in individuality and initiative, emotionally repressed, socially inept, and physically unattractive” (McKay & Wong, 1996). For example, Xuan explicitly showed her lack of interest in STEM subjects (Xuan, interview 1, September 16, 2016), and Hei-li repeatedly emphasized his athletic talent (Hei-li, interview 2, December 14, 2016). Both of them endeavored to refuse their association with a nerdy and socially awkward image.

*Positioning as First-generation Students.* In this study, all Chinese students’ parents received secondary or even higher education, but none of them were educated in the U.S. or were familiar with the U.S. education system. As a result, the Chinese adolescents were unlikely to obtain assistance for their assignments and schooling experiences from their parents. When they were challenged at school, these Chinese adolescents did not seek help from their parents. Rather, they relied upon their siblings, who shared similar experiences with them, for academic and emotional support. For example, both Wei and Hei-li repeatedly emphasized their initial challenges and frustrations when they started learning in U.S. schools, but none of their parents was aware of these difficulties or were able to provide support. In the case of Hei-li, he communicated with his elder sister who was more knowledgeable about the academic expectations and school climate in the U.S.
I found that the Chinese adolescents’ learning experiences in U.S. schools were comparable to those of many first-generation college students who suffer from a lack of basic knowledge about the education culture, have fewer interactions and socialization with their peers, and receive a lower level of family support (Inkelas, Daver, Vogt, & Leonard, 2007; London, 1992; Pascarella, Pierson, Wolniak, & Terenzini, 2004). As first-generation high school students, the Chinese adolescents played a role as mediators between their school and family, responsible for helping their parents understand their engagement at schools through translating performance report and explaining school activities.

In the following chapters (5, 6, 7, 8, and 9), I provide an in-depth description of each participants’ experiences and perceptions of their experiences in order of their length of residence in the U.S. Although the time of belonging in a community is only one aspect of a learner’s identity, the entrance point plays an important role in the learner’s later socialization process in terms of his or her competence, motivation, and self-investment. (Duff, 2003). Other aspects of the Chinese adolescents’ roles and positionalities are discussed in the finding chapters that follow. The chapters for each of the five participants are ordered as follows:

- Jie: a newcomer who had resided in the U.S. for only three months
- Xuan: an insider with two years of learning experience in the U.S.
- Wei: a competent learner with three years of learning experience in the U.S.
- Wen: an experienced learner with three years of learning experience in the U.S.
- Hei-li: an advanced learner with a sense of belonging who had studied and lived in the U.S. for more than eight years.
CHAPTER 6: JIE: A NEWCOMER

Introduction

Jie had just started her 9th grade at Pinewood High School two months prior to the study was conducted. She was born in Canada and moved back to China when she was two years old. She completed her elementary and middle school education in Shanghai, a metropolitan city with diverse cultures, a vibrant economy, and rich educational resources. Jie’s parents are both well-educated and work for their own company. They provided Jie a relatively privileged life when she was in China, with high SES and rich educational and intercultural experiences. As Jie said:

My father sent me to learn English when I was only three years old, and I started to communicate with native English speakers since then (Jie, interview 1, October 26, 2016).

我三岁我爸就送我去上外教课。从小英语就不怕了。

Although Jie resided in the U.S. with her mother for only two months, she was able to communicate fluently with her teachers and classmates at Pinewood High School. With a positive attitude, Jie enjoyed living and studying in the new country. “I’m not afraid of making mistakes,” said Jie (Jie, interview 1, October 26, 2016).

Although Jie resided in the U.S. with her mother for only two months, she was able to communicate fluently with her teachers and classmates at Pinewood High School. With a positive attitude, Jie enjoyed living and studying in the new country. “I’m not afraid of making mistakes,” said Jie (Jie, interview 1, October 26, 2016).

The science classes that Jie was taking when the study was conducted were biology and biology lab (see Table 3). Ms. Phi, Jie’s biology teacher, was also a graduate student in science education at a local university and a participant in a national research project on promoting collaboration between content and ESL teachers. Although she decided not to continue in the research project due to personal reasons, what she learned from the program and project still played a role in her teaching style and instructional practices, as was observed in her classroom as well as an interview with her.
Semiotic Resource

During the period of learning at Pinewood, Jie found a significant difference between her new biology class and the class she had attended in China, in terms of teachers’ expectations and instructional environment. According to Jie, teachers in China were authoritative and emphasized standardized tests, whereas teachers in the U.S. were more likely to apply a student-centered approach. They also expected academic success from their students, yet at the same time paid attention to work ethic:

Teachers in China tend to keep an eye on you or force you to do a lot of things. American teachers aren’t like this. They will remind you of your study, but won’t push you like most Chinese teachers do. Chinese teachers may blame their students for incapability and ask them to stay after school. My biology teacher [Ms. Phi] will be happy, as long as I take her course seriously and work hard (Jie, interview 1, October 26, 2016).

国内的老师不是逼你, 就是盯着你。这边的老师不管。老师有时候会提醒，但不会一直像中国老师那样催你：怎么这个还不会，下课到我办公室。不会这样。

Biology 的老师我觉得还是希望态度要好。要有上进心，要她看出你很努力，就可以了。

Interestingly, Chinese teachers’ high expectations and requirements were exclusively for the major subjects that were included in the national exams in China. Chinese teachers intentionally cut down on the time that students spent on minor subjects or elective courses. As a biology lover, Jie was disappointed at the removal of her biology class to increase instructional time for other major subjects when she was in China. She complained:

In the middle school, only Chinese literature, English, math, physics, and chemistry are major subjects, and all other subjects are minors and considered not important. Biology is
a minor, so no one takes it seriously. We always do our homework or take a nap in the biology class (Jie, interview 1, October 26, 2016).

我们中学是语，数，英，物理，化学五门主科。其他都是副科。能混就混。生物课就是用来做做作业；实在困得不行了，也可以眯一会。考试也是混混就过去了。

After the graduation exam, biology was removed from our daily schedule, and that time would be used by teachers of major subjects. I’m happy it will never happen here (Jie, interview 2, December 6, 2016).

会考完了，生物课从此就没有了，全部都被主科占到了。这里就不会这样，我很开心。

Table 5
Semiotic Resources in Jie’s Science Classrooms

<table>
<thead>
<tr>
<th>Semiotic Resources</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s lectures</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Community members’ guidance (e.g., teacher’s clarification after class)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>PowerPoint slides</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reading articles</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Class notes</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Worksheets (e.g., lab reports, math problems)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Videos or other visuals</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

Note: Y = yes; N = no
As shown in Table 5, a variety of semiotic resources, both textual and visual were used in Jie’s biology class at Pinewood High School. Among all these semiotic resources, Jie perceived the note packets as the most helpful learning resource, which she could always refer back to:

I think the note packet and worksheets are very helpful. If I miss something in class, I can always refer back to my notes and learn by myself (Jie, interview 1, October 26, 2016).

Consonant with Jie’s perception, Ms. Phi also noticed Jie’s extensive use of her class notes and encouraged her to review them often:

I've noticed she uses her notes a lot. That's good, that's one of the things I orally encouraged them to do. Sometimes I write something on the board, and she’d ask if she can take a picture of it. So I think she's using visual things to help study or to help remember (Ms. Phi, interview, November 15, 2016).

Although the review function of class notes promoted Jie’s learning of biology, other types of language-intensive textual resources were not very helpful or even hindered Jie’s comprehension. For instance, Jie had difficulty in understanding lab directions in her biology lab class because of the complex vocabulary and a lack of clarification. Although her biology lab teacher asked students to read aloud directions before carrying out a lab, it did not make the content more accessible to her:

The lab teacher gives us some handouts listing the procedure. She asks someone to read the directions in class. I hate that. I don’t understand them when I read by myself, and it doesn’t help to have somebody else read them again. I’m sure all my American
classmates can read and understand them without listening to them again. She just let us
do the lab by ourselves and doesn’t take care of it. She leaves the classroom right after
when the bell rings (Jie, interview 1, October 26, 2016).

Lab 老师就是发下去, 告诉你要干嘛干嘛。找人读一下 direction。我最烦找人读
direction。看不懂就是看不懂，为什么找人读。美国人又不可能看不懂。我们就自
己做完，她也不管。下课就走了，也不会有别的。

The language barrier in Jie’s lab class also occurred in her biology class, especially when
she was required to read textbooks or science articles. In contrast to the frustrating experience in
her lab class, Jie found it was possible for her to comprehend those textbooks and science articles
regardless of the complex terms and deep content. A reason for that was Ms. Phi’s integration of
visual aids and demonstrations, as she acknowledged the advantage of multimodal resources
with ESL students:

One of the things I’ve found was that picture resources or diagrams, sometimes helps
students to really understand things. I actually found it helped all students, but especially
English language learners (Ms. Phi, interview, November 15, 2016).

In addition to the visual aids, Ms. Phi also provided glossaries and vocabulary practices
to the five ESL students in her class, as she claims:

State Educational Department provides the dictionaries or the glossaries that have the
vocabulary, so I've printed off the living environment vocabulary for students if it seems
like that would help (Ms. Phi, interview, November 15, 2016).

When introducing new scientific concepts, Ms. Phi also offered explicit explanations and
taught students strategies to memorize related terms, as Jie noticed:
Ms. Phi teaches us some strategies to memorize terms. For example, when she introduced the words hypertonic and hypotonic, she compared the “hypo-” to “hippo”. That helps me to understand “hypotonic” means “getting bigger,” so the cell inflates. Her explanation makes it easy and fun (Jie, interview 2, December 6, 2016).

老师上课会讲一些特殊的记忆方法。比如说一个是 hyper-tonic, 和 hypo-tonic, hypo 就是 hippo, 变大，所以是吸收水分，这样比较好记，也很好玩。

**Socializing Practice**

Table 6

Socializing Practice in Jie’s Science Classrooms

<table>
<thead>
<tr>
<th>Socializing Practice</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussions/ activities</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Triadic dialogues</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Presentations</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Science lab/ hands-on activities</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Science project</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reading science articles/ textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Taking notes</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Types of writing**

<table>
<thead>
<tr>
<th>% of writing (classroom in U.S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explanatory/ informative</td>
</tr>
<tr>
<td>Argument</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Symbolic representations (e.g., figures, tables)</td>
</tr>
</tbody>
</table>
As shown in Table 6, Jie was engaged in various types of classroom tasks in both her science classrooms in the U.S. and China, such as group discussions, laboratory practices, science projects, and other hands-on activities. Regardless of her outstanding lab skills gained in China, Jie still experienced difficulty in conducting experiments in her biology lab class because of the language barriers, as she said:

I can’t understand what I’m supposed to do for the labs, even if I ask my classmates. I can’t understand them neither. I have a friend from Taiwan, with whom I can talk in Chinese, but we’re not in the same table in my bio lab class. Whenever I’m confused, I go to her table and ask her for clarification (Jie, interview 1, October 26, 2016).

In addition to the obstacle in comprehension, Jie also suffered from writing lab reports, which was not required in her biology class in China:

I don’t really like the biology lab class. I think those labs are very boring, even if my teacher thinks they are interesting. We have to write conclusions. I think biology labs are all about writing, and I don’t know how to do it (Jie, interview 1, October 26, 2016).

It is noticeable that Jie was also required to complete labs or other hands-on activities in her biology class, in which she was more motivated and engaged. For example, in one class, a
Krebs cycle diagram was required to be completed by the students in groups. A representative was selected randomly by Ms. Phi from each group (to ensure everyone’s participation) to present the completed diagram. Afterwards, Ms. Phi turned on the projector and reviewed the Krebs cycle diagram with the whole class. It was observed that Jie constantly communicated with her team members and actively participated in this activity.

In this activity, Ms. Phi offered explicit instructions and clarifications before and after the activity, which helped Jie to understand the directions. She also placed less emphasis on vocabulary, as she said, “The activities aren't so heavy on vocab, and it's supposed to be more about understanding the concept” (Ms. Phi, interview, November 15, 2016).

Ms. Phi also noticed Jie’s active communication with her peers in the Krebs cycle activity, which promoted her comprehension of the learning content, as she commented:

I think the group activities help when Jie is talking with other students, and she's working on things like the activity we did today. I could see her group was discussing what happens in the Krebs cycle and I could see them discussing what each step was and I think that seems to help her understand (Ms. Phi, interview, November 15, 2016).

In addition to peer discussion, triadic dialogue was another dominant interaction format in Jie’s biology class, which initiated sequences of whole class discussion and participation. In the class vignette below, Ms. Phi engaged students in a “millionaire” question game to prepare them for a classroom test.

Ms. Phi showed a review pack to students and gave some tips on how to prepare for the test on Thursday. Jie listened carefully and took notes. Students were required to write down their names on a piece of paper to prepare for the “millionaire” game. Ms. Phi collected and mixed them in a box. After collecting all name papers, Ms. Phi introduced
the rules of the game: She would randomly pick up a student’s name card and that student
needed to answer a multiple-choice question shown on the PowerPoint. Students could
choose the difficulty level and value of the question, the harder the level, the higher the
value. Students would work in groups, and their correct answers would gain points for
their groups. The group with the highest score won the game.

Sometimes, Ms. Phi further explained students’ answers even if they were correct. A
student had difficulty answering a question, and some students helped her but got it
wrong. Then, Ms. Phi asked all students to discuss with their team members for a while,
and then raise their hands to choose the correct answer. Jie and some other students chose
the wrong one. Ms. Phi stopped the game and further explained it. Afterwards, she asked
a follow-up question to the whole class to ensure students thoroughly understood it. Jie
listened and took out her note packets for review (classroom observation, November 17,
2016).

Through the “millionaire” game, Ms. Phi initiated an inquiry and made the sequence
move by asking follow-up questions. She effectively engaged the whole class, including Jie in a
triadic dialogue and elicited their contribution on co-construct understanding, as Jie commented
later:

We have a game for every review class. Students compete with each other and answer
questions. I’m aggressive in the game and really want to win, so I spend a lot of time on
reviewing before that class. I always do a good job and win the points. If we can win as a
team, we will get bonus points for the test (Jie, interview 2, December 6, 2016).
Regarding writing tasks, Jie was required to complete a relatively large amount of explanatory/informative writing and argument (47.5% of all writing tasks), with which she had little experience. The lack of experience made her struggle with those types of writing tasks, and she attributed it to her inadequate language proficiency:

I think it’s the language issue. Writing is hard. I got a headache whenever I was required to write an essay. I have to spend a whole week on a piece of writing that only take my classmates an hour (Jie, interview 1, October 26, 2016).

还有些是语言的问题。写东西很困难。每次写 essay 都是让我头大的事情。别人花一两节课就写完了，我经常花一个星期。

A strategy that Jie used to address her language issue was translation. She sometimes wrote down Chinese translations on her worksheets as references. Figure 3 shows Jie’s Chinese translations for the new terms in the Unit of Organic Compounds.
Figure 3. Jie’s Chinese Translations for New Terms

Moreover, Jie was offered test accommodations which permitted ESL students longer time to complete tests or other assignments. Although Jie did not need that accommodation by the end of the semester, she still appreciated it and believed that it made her transition easier:

I was not able to finish my tests in class for several times. Ms. Phi gave me more time and allowed me to finish it in the ESL room. It would never happen in a classroom in China. I felt sorry about it and apologized to Ms. Phi, but she said it’s all right. She’s super nice and I really like her (Jie, interview 1, October 26, 2016).
Positionality in Science Classroom

In response to the last research question, this study found that Jie’s positionalities in her biology class in China were different and even contradictory to those at Pinewood High School. Jie’s positionalities were constructed and maintained by herself as well as the expectations and perceptions of her parents, teachers, and classmates. From Jie’s description, she was a confident and competent student who often offered assistance to her peers in China. She was also the student monitor for her biology class:

I was one of the top student in my biology class and the class monitor. I was very active and liked to speak up in class. I didn’t mind giving a wrong answer. When my classmates had some questions, they would come to me and ask for help (Jie, interview 1, October 26, 2016).

Jie’s interest and motivation in learning biology was developed from her career goal to be a veterinary physician. Although she maintained her career goal and showed interest in biology, she switched her identity from a confident help giver to an unconfident help receiver in her new biology classroom at Pinewood High School, regardless of her good performance on standardized tests. Jie described her challenges in learning biochemistry:

Now we are learning biochemistry, and it’s extremely hard for me. I liked chemistry when I was in Shanghai, but that’s too hard for me to learn in English. For example, I
need to say the chemistry formulas in English. We say “lvhuana” (sodium chloride) for NaCl in Shanghai, but how to say it in English? ... My American classmates are very nice. They always help me and answer my questions (Jie, interview 1, October 26, 2016).

In contrast to an active speaker in China, Jie intended to keep silent and avoid speaking in public. Although she was good at asking questions as described by Ms. Phi, she never did so in class unless she was required. She attributed her reluctance to speak in class to her lack of English facility, as she said:

I won’t ask her [Ms. Phi] questions in class because I’m afraid it’s my language problem. My question can be something related to grammar or vocabulary, and I may find the answer in a dictionary. I’m afraid it’s not a problem for other students, and I don’t want to waste their time listening to my question in class. I’ll ask Ms. Phi after class (Jie, interview 2, December 6, 2016).

有些问题，我还是不太敢问上课问。我怕是因为我语言不通，自己查字典就可以解决的问题。可能是 grammar或者生词的问题。我担心别人没有这个问题，我就浪费了时间，还不如下课自己去问。
Despite the disadvantage of language, Jie was able to manifest her characteristics as a top student and an “old timer” science learner in some specific moments. Jie described her outperformance in a unit of biochemistry because she had learned the content in China:

I sometimes think faster than my classmates in the biology class. At these moments, I think I am not that bad…. One day when we learned about biochemistry, the teacher asked what NaCl is, nobody responded to her, but I did. They [classmates] didn’t know it. I learned chemistry in Shanghai, so I thought it’s easy. I think I’m pretty good at that moment (Jie, interview 2, December 6, 2016).

The quote above was from the second interview with Jie. After learning for a semester, Jie was able to tap into her past learning experiences as resources to support her learning in the new environment. Language seemed not a primary obstacle to Jie’s academic achievement in science anymore, even for the biochemistry unit that she previously perceived as challenging.

Ms. Phi’s comments on Jie supported her self-description as a brilliant student and biology lover when she was in China. Ms. Phi complimented her as “one of the top student in class”:

She’s a very strong student, and she works really hard, so there's nothing that we've done that she really hasn't done well with from what I've seen so far…. She's definitely in the upper level, and she really understands the biology curriculum, so she's definitely one of the top in the class (Ms. Phi, interview, November 15, 2016).
With self-awareness of her incompetence (though conflicting with Ms. Phi’s description and Jie’s outperformance in some situations), Jie worked very hard and was willing to spend more time on study in order to meet her high self-expectations. It was noticeable that Jie’s high self-expectations did not fully stem from her own academic goal or her teacher and parents’ requirements. Rather, it was reinforced by Jie’s understanding of how she was supposed to be as described in the model minority representation, as she said:

I’ve been learning in Pinewood for 70 days, and my score is still far from satisfaction. I only get 80 for my biology class, never over 90. I hope I can get 90. I’m from China, a country well-known for outstanding achiever and high scorer, but the highest score I can get is 80 – that’s not acceptable (Jie, interview 1, October 26, 2016).

Ms. Phi and Jie’s mother supported her commitment to academic success without placing extra pressure on her. For example, Jie’s mother showed understanding of Jie’s difficulty with the transition and provided emotional and intellectual support. Jie described:

I tell my mom everything happens at school and my test scores for all subjects. She totally understands me. She says I will be fine after being adapted to the new environment and I should give myself some time. Everyone has their own strengths and weaknesses, and everyone needs time for adaptation (Jie, interview 1, October 26, 2016).
Jie’s mother also worked with Jie on her homework and sometimes translated and explained vocabulary words to her in Chinese.

Moreover, Ms. Phi also played an important role in Jie’s socialization, as she would provide accommodation and extra scaffolding when it was necessary, yet without overdoing it. She was aware of Jie’s ELL identity and recognized her developing language proficiency, but she never perceived that as a deficiency, as she commented on Jie’s writing ability:

It's actually been very good. For the most part very good. It shows that she really understands the curriculum. Sometimes grammar is off a little bit, but I don't grade for that, I'm looking for the content so that's been very good. She can definitely express her ideas, you know, other than grammar which even native language learners don't always do perfectly (Ms. Phi, interview, November 15, 2016).

Summary: Barriers, Supports, and Successful Socialization

Overall, Jie’s socialization into her biology class at Pinewood High School was successful and relatively enjoyable, if compared with other adolescents’ experiences in this study. Indeed, like all novice learners, Jie had encountered many challenges when she attempted to engage in her new school community, and language was one of the biggest barriers. The “language issue,” as Jie described, limited her potential to read, write, and carry out laboratory practices effectively. With carefully planned linguistic resources and classroom practices, Jie successfully overcame these challenges and was able to engage in learning and fulfill her high self-expectations without stressing herself too much. These resources and practices embodied visual aids, vocabulary practices, teacher’s detailed clarifications on terms and concepts, group activities, and triadic dialogues in class. At the end of this study, Jie had reconstructed her confidence in learning biology and intended to register for some AP courses in the next semester.
CHAPTER 7: XUAN: An Insider

Introduction

Xuan’s parents had immigrated to the U.S. with their children and resided in the Capital Region Area for two years when this study was conducted. Unlike most Chinese parents, they did not expect their daughter to achieve academic success in science subjects, and they were supportive of Xuan’s interest in humanities. Xuan was a girl with a low-key personality, easygoing and relaxed. As the only girl in her middle-class family, Xuan was beloved by her parents and elder brother and exhibited a less-competitive attitude.

Xuan completed her elementary and middle school education in China. She took biology and earth science classes during her two-year learning at Springmarsh High School. When this study was conducted, Xuan was in the Regents Chemistry class, which was the last science class she was required to take before her graduation. Ms. Park, Xuan’s chemistry teacher, was a supportive and warm-hearted teacher with sixteen years of teaching experience.

Semiotic Resource

Xuan described her science class in China as “not fun” and extremely test-driven. The resources provided to students were solely in textual mode (e.g., textbook, workbook) which were used to prepare students for exams. Xuan attributed the test-driven learning environment to the teacher’s aspiration of personal profit:

The teacher required us to stay after school for exam preparation because our performance was related to his wage (Xuan, interview 1, September 16, 2016).

在美国我们放学就走，也不会留下来做题，因为成绩也不会关系到老师的工资。

Compared with the monotonous instructional context in China, the science classrooms in Springmarsh High School were more flexible and student-centered. Xuan believed teachers’
attitudes and teaching goals determined how they taught and structured the class. She compared her Chinese and American science teachers’ expectations on students’ academic performance, and explicitly showed her favor to the American ones, as she said:

In China, if you can get high score, you can do everything in class; if you get low score, the teacher will say something mean. My teacher always compares students’ scores and humiliate the poorly achieved ones. Your score is everything. It’s nonsense (Xuan, interview 1, September 16, 2016).

在国内，要是分数高，在课上怎么闹，老师也不管。要是遇到你分数不好的科目，老师就会说一些尖酸刻薄的话。尤其是我们的生物老师。老师会比平均分：你看别人考多少多少分；你是我带过的最差的一届。主要就是按分数来。就是很无聊。

According to Xuan, teachers at Springmarsh High School were willing to offer help to anyone who wanted to learn. She said:

[At Springmarsh High School.] teachers don’t have unrealistic expectations on students’ score. Of course, the higher, the better, but you can always retake the exam if you fail for the first time. As long as you care about what you’re doing, they are very willing to help you even if you’re not smart (Xuan, interview 1, September 16, 2016).

他们对分数没有要求，当然越高越好，但是考试没过的话，第二年再考。如果你态度好，很认真，就算你成绩不好，他还是很愿意帮助你。

Xuan was motivated by the multiple modes of semiotic resources incorporated into her science classes at Springmarsh (see Table 7). For instance, Xuan was motivated by her earth science teacher’s videos showing students how to do experiments:
My earth science teacher played some fun videos on YouTube, about how people do experiments. He also did some experiments at home, like making a rocket, and then recorded and played them for us in class (Xuan, interview 1, September 16, 2016).

我们 earth science 的老师有的时候会给我们看视频。在 YouTube 上给我们看比较好玩的视频。看看别人做的实验。他自己有时候做火箭啊什么的，他会录下来，给我们看。

Xuan also mentioned that her biology teacher created a storyline in her lab assignment to make the content more engaging:

We did a lab on gene. We had to use our knowledge learned from the biology class to track a murder suspect. The teacher told us a story first and then guided us to read the genetic samples and find out the murderer. It’s fun (Xuan, interview 1, September 16, 2016).

生物课就是做实验，还有关于基因什么的，比如追踪犯人，挺好玩的。老师给我们编了一个故事，然后让我们对基因样本，找出来谁是凶手，这样的话比较有趣味。

Table 7
Semiotic Resources in Xuan’s Science Classrooms

<table>
<thead>
<tr>
<th>Semiotic Resources</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s lectures</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Community members’ guidance (e.g.,</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>teacher’s clarification after class)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint slides</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

72
Aside from visual and imagery components, textual materials such as PowerPoint slides, textbooks, worksheets, and note packets were still the major semiotic resources in Xuan’s science classroom at Springmarsh High School. Although language did not obstruct Xuan’s comprehension of textual content, it was challenging for her to take notes and listen to the teacher’s lecture simultaneously. Xuan said:

Ms. Park asked us to take notes and listen to her at the same time. There’s no way I can do them at the same time. Native speakers should be able to do it. If I listen, I will write very slowly and miss some points on my class notes (Xuan, interview 2, December 1, 2016).

她一边说话，一边让我记笔记。我的话只能要么听她说话，要么记笔记，不能两件事一起做，一边听一边写。美国学生可能可以吧。让我听她说的，我可能记笔记思路就特别慢，会拉下一些。

Xuan reported that the review sheets printed and provided by her teacher were more helpful, as she could concentrate on her teacher’s explanations in class and have a reference for review later:

I think the most helpful resources are review sheets with all key points summarized by the teacher. Everything that will appear in a test is listed on the review sheets, very
straightforward. It makes things easier for me (Xuan, interview 1, September 16, 2016).

最有用的就是快考试的时后给你一个突击的、整理出来的 review sheet,那个挺有用的。我比较喜欢看那个，因为它比较直白，不会给你绕圈子。就是把所有你要考试的东西列出来，这样的话简单一点。

Textbooks, one of the major semiotic resources in Xuan’s science classroom in China, were seldom used in her science classroom in the U.S., as Xuan said:

We use PowerPoints, but not the textbook. We seldom use it. The textbook is very thick, and the content is deep and dense, unrelated to our exams (Xuan, interview 1, September 16, 2016).

我们有 PPT，但是书都不怎么看。Textbook 基本就没用。Textbook 很厚，写到后面都是特别深的东西，和考试无关。

Likewise, Ms. Park was aware of the ineffectiveness of the textbook as a learning resource because of the dense vocabulary and challenging content. She commented:

The textbook, I don't know if it is a great resource because there are a lot of words. Very wordy. Some of the information is above and beyond both levels. I have to pick and choose what to read when I give them assignments in it. I think especially at the Regents level, with Xuan's class, it might be confusing for them (Ms. Park, interview, October 24, 2016).

Socializing Practice

Table 8

Socializing Practices in Xuan’s Science Classrooms

<table>
<thead>
<tr>
<th>Socializing Practice</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

74
Compared with her learning experience in China, Xuan was offered more opportunities to read and write for her science class at Springmarsh, as shown in Table 8. Aside from reading textbooks and doing math exercises, which were the main literacy activities in China, Xuan was engaged in a variety of writing tasks in the U.S. such as writing lab reports. However, the majority of her writing tasks was mechanical writing (e.g., multiple-choice, fill-in-the-blank questions) which made up 54.8% of all writing assignments. Even for explanatory/informative writing that required some composition, little cognitive demand was involved.

Figure 4 is a piece of explanatory/informative writing in the form of short-answer questions for Xuan’s chemistry class. Although Xuan wrote a paragraph to describe Dalton’s Model of the Atom, its composition did not require any scientific thinking skills such as inquiry
or inference. “You can copy the answers directly from the textbook and articles,” commented Xuan (Xuan, interview 1, September 16, 2016).

Figure 4. A Sample of Xuan’s Explanatory/Informative Writing
In addition to the writing tasks, Xuan was engaged in lab activities and science projects at least once a week, as Ms. Park, her chemistry teacher, believed students were involved in active learning through hands-on activities:

I do think that the hands-on is a great way to enforce what we've been doing. Because they get to figure it out themselves without me standing up front saying, “This is the answer! This is what it is; this is the definition.” They're actually figuring it out (Ms. Park, interview, October 24, 2016).

Despite Ms. Park’s positive attitude towards hands-on and laboratory practices, Xuan took up a complex attitude towards them. On the one hand, observation, peer interaction, and investigation helped her to visualize some science concepts that could not be fully explained in words. For instance, Xuan did not understand the structure of an atom until she did a lab to simulate atomic particles by two marble balls, as she described:

I think the “hitting ball” experiment was helpful. We were given two marble balls to simulate atomic particles. We flicked the balls to get a feeling of the distance between atoms. It’s very far. Atoms are very small, and you cannot see it, but in this way, you can see if they could hit each other. Ms. Park said there is only two electrons in a big atom, and they are very far away from each other. It helps us to visualize something we can’t see (Xuan, interview 2, December 1, 2016).

我觉得比较有帮助的，就是弹球的那个。给我们两个弹珠，让我们弹，去测试原子里面的距离，很远。原子太小，你看不见，用这种方式，老师让我们弹弹球，看你能不能弹到两个。我们弹不到，老师就会说，这么大的原子里只有两个这个电子，所以它们是非常分散的。就把一个不能肉眼看到的东西展示一下。
On the other hand, the purpose of a lab investigation was not always clearly clarified, and that would confuse Xuan’s understanding of the target learning content, though she was still able to complete the lab activity with step by step “cookbook” instructions. Shown below is Xuan’s understanding of a “flame lab” activity which was not well explained or guided:

There is one lab very fun. We watched some materials burn into flames, and observed the color of these flames. That lab work was engaging, but until now I still do not understand what that was for. I didn’t understand the point behind, even though I completed it by myself (Xuan, interview 2, December 1, 2016).

Moreover, Xuan had minimal communication with her classmates while carrying out lab activities in a group. In the class vignette below, Xuan had difficulty finding a partner when she was required to do so for a lab activity.

Ms. Park demonstrated to students how to draw a coordinate grid, and asked students to draw one from their data reference table. She divided students into two groups with different tasks. Students were assigned into a group by blindly picking a card with the group name; then they had to find a partner from the other group. Students stood up and moved around to find a partner. Xuan was walking around and did not interact with anyone. Finally, she was paired up with a male student with Ms. Park’s help (classroom observation, November 18th, 2016).
When Xuan worked with her partner, both of them worked individually and had little interaction. Finally, Xuan’s partner started to discuss with someone else from another group on the lab work.

In contrast to Xuan’s reluctance to speak in class, she was confident with math exercises which were “the most important thing” for a science class in China (Xuan, interview 1, September 16, 2016). However, she was not offered many opportunities to show her strength in math, as the mathematical component was “not the focus in a Regents class” (Ms. Park, interview, October 24, 2016).

**Positionality in Science Classroom**

I like humanities. Everyone believes that Chinese kids are good at math and science, and they are born to learn STEM. Everyone believes that Chinese students only know rote learning and never play. Chinese kids….always sit there quietly, heading down and studying, with a pair of big glasses. I’m not like that. I may choose humanities in college, like law. I also love learning language, you know, and that helps me to know the world better (Xuan, interview 1, September 16, 2016).

Contradictory to what is described in the model minority stereotype, Xuan explicitly indicated her lack of interest in learning science. This attitude was developed when she was in China, and was enhanced through her new learning experience in Springmarsh. Xuan said:
When I took the physics class in China, I knew I definitely wouldn’t go for STEM major in college….I am not able to do it (Xuan, interview 1, September 16, 2016).

在国内学学物理的时候，我就誓死不学理科。。。。。我不行。

As Xuan indicated above, her lack of interest in learning science was related to her lack of skills and abilities in these subjects. Such feelings of incompetence was even stronger in her chemistry class at Springmarsh High School:

I feel it is more interesting and easier to learn Chemistry in China than the U.S. Learning in the U.S., I feel much less achieved. For example, if the teacher asks me to derive a principle, I will have no idea how to do it (Xuan, interview 2, December 1, 2016).

中国上的化学课，我会觉得有趣些，比较容易。这边的化学，学不下来。比如她会让你反过来去证明一个东西。我不知道该怎么做。

Xuan’s low confidence in science learning was consistent with Ms. Park’s description of her as an “average student” in her Regents Chemistry class (Ms. Park, interview, October 24, 2016). Ms. Park pointed out Xuan’s challenges in writing and class participation:

Xuan, I think struggles a little bit. Now and then, when I read her responses, they're very short. I wonder if it is because possible language…. She doesn't ever ask me for questions or clarification or anything like that. She is very quiet there (Ms. Park, interview, October 24, 2016).

Ms. Park attributed Xuan’s silence and average performance to her confusion about some scientific terms and question prompts on tests. Ms. Park commented:

It shocks me that her test was a little bit lower. I just graded a unit test and it was lower than what I thought it would be. There were a few labs, where she got a few wrong where I'm like, "She knows that answer I'm pretty sure." I think with Xuan, it could be possibly
understanding the directions or maybe slight words here and there (Ms. Park, interview, October 24, 2016).

Nevertheless, Ms. Park did not provide extra support or accommodation to Xuan because she had already been “tested out from the ESL class” and had “no accent in English” (Ms. Park, interview, October 24, 2016). Ms. Park indicated her willingness to help Xuan if she felt Xuan was “struggling with the language” (Ms. Park, interview, October 24, 2016).

In contrast to her average performance on writing and class participation, Xuan showed strong confidence in math, which made up the major classroom practices in her Chinese science classrooms. Interestingly, although Xuan resisted the model minority stereotype, she related herself to it with little self-consciousness:

The only moment I feel good is when I’m doing math exercises. I don’t even need a calculator. I don’t like math, no, but I will shame the Chinese group if I am not good at it (Xuan, interview 2, December 1, 2016).

Xuan did not have a chance to demonstrate her outstanding math knowledge and skills because these were not the foci in a Regents chemistry class, as Ms. Park said:

We have not done too much math yet. What have we done? One simple heat calculation. Simple algebra and she's been fine. She won't see much more than that in Regents (Ms. Park, interview, October 24, 2016).
Summary: No Interest, No Extra Support, No Science Anymore

To sum it up, Xuan was engaged in a variety of semiotic resources and socializing practices in her chemistry class, but only a few of them (e.g., videos, note packets) supported her learning effectively. With two years of learning experience in the U.S. and fluent spoken English proficiency, Xuan still had difficulty in completing some tasks which are commonly used in Western science classrooms such as writing lab reports, doing laboratory practices, and engaging in group activity. Meanwhile, Xuan’s advantage in doing math was not acknowledged by Ms. Park who believed math was not supposed to be the focus at Xuan’s level of learning. Xuan’s relatively lower achievement in her chemistry class (if compared to other focal students in this study) enhanced her apathetic attitude toward science learning and constrained her potential to be a scientist in her future career path. Unfortunately, Ms. Park, regardless of her caring and enthusiastic characteristics as a teacher in general, was not aware of Xuan’s struggles in learning and rarely provided accommodations or extra support because Xuan had been tested out from the ESL class and seemed to have no difficulty in communication, even though she seldom did so in class.

Another salient feature of Xuan’s socialization was her strong resistance to the model minority image, and she surely had some characteristics that were contradictory to this stereotype such as low interest in academic success, especially in science subjects. Interestingly, Xuan was still being associated with this stereotype by herself and Ms. Park, as she was silent in class discussion and assiduous in learning.
CHAPTER 8: WEI: A COMPETENT LEARNER

Introduction

Wei and Wen are twin sisters, Wei being the younger one. They had been residing in the U.S. for three years with their parents when they participated in this study. They started studying at Springmarsh High School when they were twelve years old. Wei was an outgoing, confident, and self-determined girl. As the twin sisters studied at the same grade levels, they discussed a lot of their learning content and experiences. For example, Wen sometimes helped Wei to prepare for her upcoming quizzes. Wei described:

I read my notes and then play around. Sometimes Wen asks me, “Won’t you have a test tomorrow?” Then she will give me a fake test, and I can answer all questions correctly (Wei, interview 2, November 9, 2016).

Wei and Wen’s father was a doctor of traditional Chinese medicine, and their mother was a housewife. Neither of them spoke English. The mother was highly involved in her daughters’ school activities with extremely high expectations.

Wei was educated in China until 6th grade and then started her secondary education in the U.S. The only science class that Wei attended in China was earth science. The science class that Wei was taking at Springmarsh High School was Chemistry Honors, and her teacher was Ms. Park, who was also Xuan’s teacher for Chemistry Regents. Wei was the only ELL student in her chemistry class, though she was tested out of the ESL class at the time of this study.

Semiotic Resource

In Wei’s opinion, her science class in China was authoritarian and teacher-centered, as
the teachers’ lecture was the primary learning resource. In such learning context, students’ obedience was highly valued and expected, as Wei pointed out:

Chinese teachers don’t care if you learn well or not, as long as you are obedient. In their eyes, obedience means smart (Wei, interview 1, September 29, 2016).

中国老师认为，你很乖，就觉得你聪明。不需要那门功课好。

Compared with her science class in China, Wei’s Chemistry Honors class at Springmarsh High School was more flexible and student-centered, and more types of semiotic resources were integrated such as videos and worksheets (see Table 9). Moreover, the teacher encouraged students to develop an ownership of their learning by offering them opportunities to gain bonus points, as Wei described:

Ms. Park gives us some bonus questions in a test. If you can answer these questions, then you get the bonus credits. If your grade is too low, she will ask you to do some extra work and give you some credits for it (Wei, interview 1, September 29, 2016).

Ms. Park 会给extra credit。比如在考试时给你bonus，做出来，就给你分。或者你分数太低。有时候老师会给，让你做一个东西，给你多些分。

Table 9
Semiotic Resources in Wei’s Science Classrooms

<table>
<thead>
<tr>
<th>Semiotic Resources</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s lectures</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Community members’ guidance (e.g.,</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>teacher’s clarification after class)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint slides</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
In both science classrooms in the U.S. and in China, teachers’ lectures were the most essential learning resources for Wei. Nevertheless, the lecture styles varied significantly, as teachers in China “give lectures without careful plan and do not explain well”, whereas her chemistry teacher in the U.S., Ms. Park, “always checks if students understand and is ready to clarify again” (Wei, interview 1, September 29, 2016). Another feature of Ms. Park’s lecture was to connect the new learning content with what students had previously learned, which effectively helped Wei to construct her knowledge, as she commented:

The teacher refers to the content in the old unit we have learned when we learn something new. I think all these are useful (Wei, interview 2, November 9, 2016).

老师教了一个unit，再讲下一个unit的时候都会用到我们以前学的，在refer过去，再加一些东西。我觉得都还挺有用的。

To support students’ comprehension, Ms. Park also integrated colloquial words and names of everyday items used in their daily life when introducing new science concepts. For example, when lecturing on different phases of matter, Ms. Park asked students to identify the phases of everyday materials such as toothpaste and jello, as a way to monitor their understanding of the concept.

In addition to the different ways of lecturing, American teachers were more tolerant and
willing to help those students who were unable to learn independently, as Wei observed:

Teachers in the U.S. are more responsible. If I have some questions, I can always stay after school and ask them. It doesn’t work in this way in China. Teachers don’t like you to do so. Students who stay after school in China are perceived as the slow ones in Chinese teachers’ eyes (Wei, interview 1, September 29, 2016).

美国的老师更负责。这边我有什么不懂，都可以stay after，中国就不行。老师不喜欢。一般stay after的学生，在他们眼里都是不聪明的。

According to Wei, the Chinese and American teachers’ different lecture styles made a prominent difference in students’ motivation and investment on science learning. According to Wei, teachers at Springmarsh High School were more attentive to students’ learning needs and were willing to build up a connection between the target learning content and students’ prior experiences and knowledge, whereas science teachers in China placed more emphasis on students’ achievements in exams.

**Socializing Practice**

Table 10 shows the socializing practices that Wei experienced in her science classrooms. Compared with classroom practices in China, Wei was engaged in inquiry science projects and lab activities at Springmarsh High School. At the time of this study, students were required to complete a water testing project, which aimed to help them understand the chemical components (e.g., pH, dissolved oxygen) in a local body of water. In this project, students went for a field trip and used chemical test kits to test the water of a local pond. Then students worked together in groups and presented their research and findings.
Table 10
Socializing Practices in Wei’s Science Classrooms

<table>
<thead>
<tr>
<th>Socializing Practice</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussion/activity</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Triadic dialogue</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Science lab/ hands-on activities</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Science project</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Reading science articles/ textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Taking notes</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Types of writing</td>
<td></td>
<td>% of writing (classroom in U.S.)</td>
</tr>
<tr>
<td>Explanatory/informative</td>
<td></td>
<td>26.5</td>
</tr>
<tr>
<td>Argument</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
<td>33.8</td>
</tr>
<tr>
<td>Figures/tables</td>
<td></td>
<td>7.3</td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
<td>32.4</td>
</tr>
</tbody>
</table>

In the biology class that Wei attended in another semester, she was engaged in three inquiry-based projects, and these projects gave Wei opportunities to investigate problems, search for possible solutions, make observations, record data, and write final reports, as she described:

We went to a forest and looked for something by ourselves. We needed to find a tree and observe bugs and animals living on it. I always went to the forest when there were few people, a quiet place, far from the main street so that people wouldn’t see me. Sometimes I had to find bugs, yucky! I had to take notes of it. If I didn’t know the name of some animals because of their strange looking, I had to search them online. I usually spent half
an hour on it. We were required to write about 10 to 20 small animals including their names, common names, scientific names, habitus, and where it came from in the U.S. (Wei, interview 1, September 29, 2016).

我们要去一个森林里自己找。我们要找一棵树，观察上面的虫子，或者动物。我是在没人的时候，离路挺远的，别人都看不见。有时候要去找虫子，我觉得特恶心。还得写，有时候我不知道什么动物，长得很怪，我还得上网去找。我可能要花半个小时。还要写二十个，还是十个小动物，要知道他们的名字，common name, scientific name, 还有生活作息，还有大部分的 population 在美国的那个地方。第一个学期是这个。

In addition to the science projects, Wei was also engaged in laboratory practices in both her biology and chemistry classes. These hands-on activities effectively promoted Wei’s motivation and comprehension by providing her opportunities to explore science and repeat the processes by which scientists discovered and proved scientific principles and rules, as shown in our conversation below:

Wei: I think it’s very interesting when we do the atom lab. I can see how the atom rule is discovered.

I: Why do you think it’s interesting?

Wei: Because I never thought of those problems myself. Scientists thought about them and found the answers. It’s very interesting to me.

I: Is it helpful to repeat the discovery process?

Wei: Yes. Take the atom lab, for example, they first found there were electronics, and then found the neutrons, and finally found the neutrons were not floating, but moving
around an orbit in a specific space. Now I know they didn’t find out the composition of an atom all of a sudden. They gradually discovered it step by step.

I: Do you like to explore and prove a principle?

Wei: Yes. It makes me understand how things are discovered. It’s just like what is said in the textbook. It’s very interesting and helps me to understand (Wei, interview 2, November 9, 2016).

Wei: 可能是在做 atom，是怎么一步一步推导出来的。我会觉得真有趣。

Interviewer: 你为什么觉得这个有趣?

Wei: 我觉得我从来没想过这些，科学家能想到这些，还能得出这个结论，我觉得 interesting。

Interviewer: 你觉得推导的过程 helpful 吗?

Wei: 有帮助。比如 atom，他们先知道里面有 electronics，最后发现里面有个 neutrons, 后来又发现 neutrons 不是在外面 float，其实是有个 orbit，而是有一个 specific 的地方。我能明白原来他们不是一下子就知道原子是由什么组成，而是一步一步发现的。

Interviewer: 你喜欢 explore 和推导的过程吗?

Wei: 对。能让我知道怎么发现的。原来真的跟书上说的一样。更 interesting，印象也更深刻。

Another advantage for Wei to do hands-on activities was she had a chance to work with peers who not only discussed and exchanged ideas with her but helped her to communicate with Ms. Park, as Wei said:
I prefer working with others. I may get lost when working by myself. I don’t have a friend to talk with in that class, and I’m afraid of asking teachers. Sometimes I ask my lab partner, “do you know how to do it?”, and I know he doesn’t, but he will reach out to Ms. Park. That’s exactly what I want (Wei, interview 2, November 9, 2016).

我还是喜欢和别人做lab，因为我自已做着做着就晕了，课上也没什么人可以说话。但我又不敢问老师。有时候我就会跟我的lab partner说，“你知道怎么做吗？”一般情况他都不知道，所以就会说“I will go ask.” 其实我知道他不知道，我就想让他去问。

Despite Wei’s achievement and motivation in hands-on activities, she still faced some challenges to complete these cognitive-demanding tasks, especially when she was required to produce language outputs such as giving a presentation or writing an essay. She complained about her relatively low grade in her presentation on the water testing project and had to “get a higher score on the next exam to raise up her GPA” (Wei, interview 2, November 9, 2016). She also complained the laboratory practices in her biology class were time-consuming because of the related writing tasks:

We also do a lot of labs. Sometimes I can’t understand because it’s so complicated. I have to figure it out by myself and answer questions like “why it’s like this,” “why we have to choose leaves but not flowers for labs on these kinds of plant.” We are also required to write an analysis paper in my biology class. After we complete the lab, we have to write “what do you think will happen,” lab purpose, conclusion, and analysis. That’s hard (Wei, interview 1, September 29, 2016).

我们做很多lab。有时候我也看不懂，因为有时候特别复杂。我们要去自己理解，“为什么是这样的”，“为什么这样的植物是选择做leave，而不是花”。Bio 让我们写
Regarding writing practices in Wei’s Chemistry Honors class, math exercise was the primary task which made up 33.8% of all writing tasks (see Table 10). As Ms. Park said, she placed much emphasis on math in her Honors class, as these tasks were perceived as cognitive-demanding:

They'll do logarithm in here with Honors kids. Much more difficult math. Regents, no
(Ms. Park, interview, October 24, 2016).

Wei enjoyed learning through doing math exercises and showed confidence when she was required to do so, as she said:

I think my chemistry teacher is pretty good. She sometimes asks us to do math exercises. I think math is pretty easy for me. Sometimes, she asks us to repeat doing many exercises of the same type and on the same topic. I really like it. Yesterday we did some practices on unit conversion, and it helped me a lot! (Wei, interview 1, September 29, 2016).

Consonant with what Wei said in the interview, Wei’s strength in math was observed when she did metric conversions in class. She did not use a calculator for math problems, even if most of her peers were not able to complete the task without it (Classroom observation, September 30, 2016).
Positionality in Science Classroom

Like many Chinese students, Wei took her scores in class very seriously. She was motivated to learn and endeavored to get higher scores in all classes, as she described:

I am always trying my best to get higher scores. I take every single quiz very seriously and work hard to complete assignments (Wei, interview 1, September 29, 2016).

我总是试着得很高的分，考试都很认真的复习，做作业也很努力地做。

In Wei’s opinion, “learning” means “gaining a high score,” and she repeatedly mentioned “score,” “grade,” and “performance” when I asked her questions about her learning interest, ability, and teachers’ expectations. For example, she felt capable only when she “got a very high score after taking an exam” (Wei, interview 2, November 9, 2016). She also indicated her lack of motivation to present in class because she “lost many points on it” (Wei, interview 2, November 9, 2016).

Although Wei really cared about her academic performance, she was not confident in it. Wei attributed her “displeasing” performance in the Honors class to the inadequate time she spent on learning, as she said:

I always spend two hours on writing homework and then play around for a few minutes, but I will go back and finish it. I don’t work very hard (Wei, interview 2, November 9, 2016).

我可能写两个小时候的作业，就玩几分钟。然后意识到要写作业了，再去写。

Interestingly, there was a gap between Wei and her chemistry teacher, Ms. Park’s perceptions regarding Wei’s performance and work ethic, as Ms. Park recognized Wei as a capable student as well as a hard worker for her class:
I think Wei is most definitely hard working. Very hard working. We haven't had too many grades yet because it's only the first quarter, but so far, she is definitely doing a very good job. I don't think she is the top student in here by….like, if you were to rank them, I don't think she's the top, but she's up there (Ms. Park, interview, October 24, 2016).

A potential reason for Wei’s lack of confidence in her academic performance was her mother’s extremely high expectations. Wei’s mother explicitly required her daughters (Wei and Wen) to take Honors level classes and to achieve A+ in all subjects, as Wei said:

My mother expects me to receive a score above 96 or 98 in all subjects, but I cannot make it. She has many friends whose children are unbelievably amazing. They just arrive in the U.S., totally new here, but their scores are super high. They also play instruments and join the state-level orchestra band. I can’t do that, but I will try my best to perform well on my school work (Wei, interview 1, September 29, 2016).

Wei’s mother’s expectations also impacted Wei’s choice for her future major and career. Although Wei showed an interest in arts, she was reluctant to choose a career in that field because “there’re not a lot of jobs for arts” and her mother “won’t allow her to do so.” Wei described her mother as a “typical Asian mom” who helicoptered and made decisions for her children:

She is a typical Asian mom and wants me to be an engineer, or a doctor, or a lawyer. My mom says I should be an engineer, and that’s fine with me, even though I don’t know
what an engineer does every day. Maybe, a chemistry engineer? I don’t know, but it will be something related to science (Wei, interview 2, November 9, 2016).

她是一个 typical Asian mom, 会让我当一个 engineer, or doctor, or lawyer.

后来我妈跟我说做个 engineer。我说 okay，虽然我不知道 engineer 是干什么。也有可能是 chemistry, like chemistry engineer? 不知道，应该是 science 的。

Regardless of Wei’s mother’s high expectations, she was not able provide her daughter with sufficient support on the schoolwork because of her little schooling in the U.S. This led to Wei’s tendency to rely upon herself rather than seeking help from her mother when she encountered challenges. For example, Wei told me about her struggles with English and her classmates’ hostility when she started to study at Springmarsh High School at 12 years old. Nevertheless, she never revealed that to her parents (Wei, informal conversation, November 4, 2016).

Wei’s ability to solve problems by herself did not mean that she refused help from others. Actually, Wei received much support mentally and academically from Wen, her twin sister. As mentioned earlier, Wen always helped Wei to prepare for exams. They also discussed what they learned at school and attempted to solve problems together. Although Wen and Wei’s counselors intentionally placed them into different classes, the twins still went to school and participated in extracurricular activities together, as Ms. Park noticed:

Wei chit chats with her friends in here and her lab partners and interacts with them more. Where Xuan doesn’t quite interact as much with the other kids. Because Wei has her twin sister, too. They probably have more friends (Ms. Park, interview, October 24, 2016).

Regarding interaction with the teacher, Wei was willing to ask Ms. Park for help, but only after class, as Wei said:
I don’t want to raise my hands and speak in class. I’d like to figure it out by myself or have my lab partners ask and get the answer. I’ll also go to ask Ms. Park after class (Wei, interview 2, November 9, 2016).

上课我不明白不是很想举手问，就想自己学，或者让别人去问再告诉我。下课我会找她问。

Ms. Park also noticed that Wei was more active after class than in class, even if she would have liked Wei to be more confident in front of others, as she said:

Wei, though, I think, she might not raise her hand regularly during discussions or answering questions, but she's not afraid to approach me, ever. Like I said, she does ask clarifying questions every day. I mentioned I wish she was a little bit more active in front of everybody because the questions she asks me on her own for clarifying are very good. If she were to ask those in front of other people, other people would benefit as well (Ms. Park, interview, October 24, 2016).

Summary: A Community Insider with Conflicting Features

To sum up, Wei’s science classrooms in the U.S. were more flexible and student-oriented, when compared with the Chinese ones. According to Wei, one of the most distinctive features of science teachers in the U.S. was their willingness to connect emergent learning content to students’ daily lives. This teaching technique is beneficial to all students, yet especially to ELLs, as it helps them to learn on their already gained knowledge and skills with the teachers’ acknowledgment of their backgrounds and past experiences (Quinn, Lee, & Valdes, 2012).

Moreover, Wei was provided many opportunities to explore science through engaging in projects and other hands-on activities, such as laboratory practices. However, like many Chinese
students, Wei faced difficulties in some Western classroom practices such as oral presentation, class participation, and writing. Wei’s parents had extremely high expectations of their daughter’s academic achievement, whereas her chemistry teacher placed more emphasis on students’ good working attitude.

In conclusion, Wei was an insider in her chemistry class, as she was able to complete most of the tasks well and effortlessly. Meanwhile, she retained many features of a stereotypical Chinese learner, such as having mathematics advantages and holding unrealistically high expectations on academic success.
CHAPTER 9: WEN: AN EXPERIENCED LEARNER

Introduction

As for Wei, Wen had resided with her family in the U.S. for three years when this study was conducted, but different from Wei’s outgoing and confident character, Wen was quiet and obedient, as she described:

Wei’s test scores are always higher than mine. Sometimes, my parents ask me, “Why does your younger sister get higher scores?” .... Sometimes, Wei hears that and jokes with me, “Because I’m smarter than you” (Wen, interview 1, September 27, 2016).

Wei 总是比我分数高，他们就会说, “为什么你妹妹能比你的分数高？”。。。。妹妹跟我开玩笑, “我比你聪明啊”。

The science classes that Wen took in China were biology and earth science at elementary level, and Wen said that she forgot most of the content. Wen took her studies very seriously and was quite anxious before exams, as she said:

I’m not good at biology, so I have to work hard in every single class…I think my score on the last exam should be good, but I may be wrong. Every time when I think I’m good, the result turns out the opposite. I should double check my answers before submitting (Wen, interview 2, November 7, 2016).

生物我本身就不是很好。我每节课都要仔细听。。。。我感觉考得挺好的。但是好像每次我觉得考得挺好的时候，都不太好。我感觉很后悔，没有再仔细检查一遍，

As described in the last chapter, Wen’s mother had high aspirations for the twin sisters’ academic achievements, as Wen said:
I need to get good grades on tests. My mother explicitly requires me to do that. If I got an A, she would ask why I didn’t get an A+ (Wen, interview 1, September 27, 2016).

我的成绩必须要好。我妈明确的跟我说过。我要是得了 A，她会说为什么不得 A+。

Wen was taking Chemistry Honors and Biology Honors with Mr. Del and Mr. Bell as her teachers respectively. This was her first time taking an Honors level class in science. Although there were some Asian students in both classrooms, Wen was the only ELL.

**Semiotic Resource**

Table 11

<table>
<thead>
<tr>
<th>Semiotic Resources</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s lectures</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Community members’ guidance (e.g., teacher’s clarification after class)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>PowerPoint slides</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reading articles</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Class notes</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Worksheets (e.g., lab reports, math problems)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Videos or other visuals</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Internet resources (e.g., class website)</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
Like her younger sister, Wen described her science classrooms in China as monotonous and teacher-centered, and students learned mainly through the teacher’s lectures and textbooks (as shown in Table 11). She said:

The class was dull. The teacher just repeated what it said in the textbook and never gave any example to help us understand (Wen, interview 2, November 7, 2016).

国内的老师总是干巴巴的，把课本的内容讲给我们，也不怎么揉碎了让我们明白。

In contrast, Wen described her biology and chemistry classes at Springmarsh High School as vivid and engaging. Teachers integrated pictures, videos, and realia in class and always offered examples to clarify the points. She repeatedly mentioned that her chemistry teacher, Mr. Del, clarified concepts by connecting them to personal stories and used realia to demonstrate and explain:

I’m excited when he tells us his personal story. I remember he used a magnet to show us force attraction and how it worked on two particles. He compared that to husband and wife…. He has many knickknacks, simple items, which always give me an “aha” moment. That’s exciting (Wen, interview 2, November 7, 2016).

老师讲自己亲身经历的时候。我觉得很exciting。有的时候，化学老师会自己开玩笑。有一次我们做gas变成solid, 老师会用吸铁石给我们示范force attraction，如果force太大，两个particle会离开。。。。。老师有很多小玩意，很简单的东西，能让人一下就懂，非常exciting。　

Likewise, Wen was more engaged in her biology class, if her biology teacher, Mr. Bell, connected the learning content to his personal experiences. Wen believed that the intentional integration of personal stories made learning more approachable and vivid, as she said:

You can’t always lecture. You give examples, and students want to know something
unrelated (Wen, interview 2, November 7, 2016).

Moreover, multimodal instructions were widely used in Wen’s biology class, as Mr. Bell intentionally incorporated textual, visual, auditory, and mathematical resources into his class to fulfill his students’ different learning needs. He said:

I try to vary my PowerPoints, so it's not just words or just pictures….There're different modes of learning, so there're visual components, there're auditory components….Well, different kids learn in different ways. Some kids are very visual kids. Some kids are much more language based. Some kids are more math based. You know, some kids are auditory. They like to hear it, so I try to hit as many of those aspects of learning as I can in a session with kids (Mr. Bell, interview, September 29, 2016).

Although a variety of semiotic resources were offered to Wen, the main resources that she relied upon were the traditional textual ones such as note packets because these resources focused more on test preparation if compared to the others. Wen reported:

The teacher [Mr. Bell] gave us a note packet which contains some review sheets in the beginning of the semester and suggested we should use that to prepare for the final exam. I think it’s helpful….The review sheets list all the concepts and terms that will appear on the exams….The chemistry teacher doesn’t give us feedback, but he gives us notes. I review the notes before exams. They are very intuitive (Wen, interview 2, November 7, 2016).

老师在学期初的时候给我们一个packet, 里面有review sheets, 说final exam就拿这个复习，我觉得很有帮助。。。。。Review sheet会让我知道那些概念出现在考试里，还有词。。。。。化学老师不会给我们feedback，但是会给notes。我就复习
The textual resources (e.g., review sheets, note packets) served as two-edged swords for Wen’s learning of science. On the one hand, the clear purpose on exam preparation reduced Wen’s load to search for related information by herself. On the other hand, these texts were very language-intensive and contained many terms, which caused a barrier in Wen’s comprehension of the learning content. For example, Mr. Del was concerned about Wen’s learning of chemistry in the spring semester because “there’ll be more vocabulary” (Mr. Del, interview, October 6, 2016).

By the same token, Mr. Bell pointed out Wen’s difficulty in fully comprehending his speech and exam questions, as he said:

She [Wen] may be missing things when I'm teaching, and so now she's looking for an answer and searching for an answer, and she just doesn't have the words or….You know, it just is something that she missed because she didn't understand the words at the time (Mr. Bell, interview, September 29, 2016).

According to Mr. Bell, Wen not only faced challenges in understanding and using discipline-specific language but thinking and doing in the particular ways to learn biology, namely synthesizing the learning content and solving problems. Mr. Bell said:

Some of the things we do in Honors might not be helpful....We leave a lot to the student to learn….It's almost as if there's some missing pieces, and we expect them to fill in the gaps. That may be very hard for her….If the vocabulary over here isn't…. She doesn't make the connections here….Sometimes it's synthesis, you know, synthesizing the answers and taking the material we have and then having them solve the problem with it. The answer, no, it's not right in front of you. You might learn about something over here,
and then we ask you to apply it over here. That's kind of filling in the gap here when we
gave you the tools over here. You have to try to apply that, and there might be some
nuances in the words or in the way things are applied. That might make it really hard, 
where she might be capable of that kind of thinking, but when you throw that language 
on there, it might make it really hard. Those kinds of things I think might not be at this 
point helpful for her, you know. In our Regents curriculum, we don't do as much of that 
kind of stuff, and you know, it's much more rote I guess. Here's a vocabulary word, this is 
what it means. Here's another vocabulary word, here's what it means (Mr. Bell, interview, 
September 29, 2016).

Wen’s description of her challenges in learning biology seemed to prove what Mr. Bell 
identified, as she equaled learning biology to “memorizing concepts and vocabulary.” Wen commented:

Biology is hard for me. It’s all about terms and concepts which I have to memorize, like glucose and bacteria….I need to memorize all terms about function and structure (Wen, 
interview 1, September 27, 2016).

生物比较难。因为生物都是词，大部分都是背下来，concepts。有的是glucose，还有bacteria。。。。。我要记住function和structure。

To compensate for her disadvantages in vocabulary, Wen sought help from her sister, 
Wei, who took biology and could explain the content in Chinese, as Wen explained:

If I have some problems with my homework, I will go to Wei first. If she doesn’t know the answer, I will search online. Most of the time, she explains it clearly…In the beginning of this semester, we learned about cell theory. Wei took biology before, so she taught me these things. It’s so helpful! She explained very clearly. I understood her
explanation very well, and that made me confident in class (Wen, interview 2, November 7, 2016).

作业不会做的时候，我第一先问妹妹，如果她不会，我就上网查。她一般都讲得很清楚。。。。。在开始的时候，讲cell theory，妹妹已经给我讲过一些东西了，我就觉得很好。妹妹讲得特别仔细的，我能懂的那部分，我在课上就很confident。

Mr. Bell’s one-on-one clarifications and tutoring, often after class, were another way for Wen to enhance her understanding and prepare for exams. Wen said:

If I have something unknown, I will go to ask my teacher [Mr. Bell]….He will tell me the answer. I do this during my study hall when he is free. I use the entire mop for question and answer….He sometimes says things that seem unrelated, but those things will appear on exam. So you really have to listen to him carefully. He always explains one question and connects it to another one. He explains my questions very thoroughly (Wen, interview 2, November 7, 2016).

我有事不懂，会问老师。。。。。他告诉我答案。我会等他有free的时候，我也
有study hall，我再问他。整个mop都问问题。老师会告诉我。他经常会不经意说一
点，就出现在考试上。所以要认真听他讲的。他会经常给我讲一道题的时候，联系
另一道题，给我反过来讲。

Socializing Practice

A distinguishing feature of the socializing practices provided in Wen’s science classrooms at Springmarsh High School was an orientation for college preparation. For example, Mr. Bell purposely integrated university-level reading materials to support his students’ transition to college, as he said:
I try to get them to practice reading out of the text. I think it's a good skill, for university level. (Mr. Bell, interview, September 29, 2016)

Likewise, Mr. Del prepared his students to be familiar with the ways that students learn in a college. He said:

For labs [we have] a lot of it is, I'm trying something new this year where they're keeping their own lab notebook, just like you would in a college style. (Mr. Del, interview, October 6, 2016)

In such science classrooms, Wen had opportunities to engage in a variety of activities, such as science projects, laboratory practices, and literacy tasks (see Table 12). In my interviews, Mr. Del explicitly emphasized the importance of doing hands-on assignments and labs:

Tuesday they're going down to the river to do their water testing down there. So, content-driven, direct instruction, a lot of hands-on. Later on, in the year, once they get more lab skills down, a couple of the labs will be like more inquiry-based where they kind of design something on their own and they test it. Again, it's building those skills and getting to that point. (Mr. Del, interview, October 6, 2016)

Table 12
Socializing Practices in Wen’s Science Classrooms

<table>
<thead>
<tr>
<th>Socializing Practice</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Honors Biology</td>
<td>Honors Chemistry</td>
</tr>
<tr>
<td>Group discussion/activity</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Triadic dialogue</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Science lab/ hands-on activities</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Those labs and hands-on activities offered Wen another option to comprehend and learn through observing and investigating instead of solely listening and reading like what she did in her science classrooms in China. For instance, Wen reported that it was more intuitive for her to learn through doing experiments and observing than reading texts or listening to lectures:

We did some labs [in biology class]. We need to know the purpose of them. We have a big packet with directions on various experiments. Most often, we did something on glucose and cells. For example, we once dropped glucose indicator in a cell and observed the change. We had to answer why the cell changed its color…. For the candy lab, I got to know wax is not dissolvable in water, and that’s why these colors [from wax] didn’t mix…. I didn’t know that before doing the lab…. I’ll understand concepts much better if I can see and observe it…. (Wen, interview 1, September 27, 2016)
做了一些 labs。需要知道 lab 都做得什么。我们有一个很大的 packet，有不同的 experiments。做的最多的就是 glucose 和 cell。我们做了一个 cell，把它放进 glucose indicator，看变化。要讲为什么这个 cell 会变颜色，这是一个 lab。那个糖的实验，我知道 wax 不能 dissolve in water。这就是为什么开始很长时间，水的颜色不会混在一起。我开始不知道。那些东西观察一下，就会更明白这些 concept。

Nevertheless, Wen did not always know the purpose of a lab making her confused and unable to learn, as she described:

These labs help me when I understand what they are for. But if I don’t, you know, don’t know the purpose, I can’t answer questions after finishing it…. I understand most of them. We have learned four units. The middle two confused me. Numbers 2 and 3, about enzyme chemistry. Anything about enzymes confuses me, but I understand the first and the last one. (Wen, interview 2, November 7, 2016)

It was worth noting that Mr. Bell provided lab notes and planned to use them to help students understand the purpose of labs. Wen would have a clearer comprehension of the lab purposes if she read the notes ahead of time, and the laboratory practice would be more meaningful to her. However, Mr. Bell did not require students to read them ahead of time, as he
believed when they did it made no difference in their learning. The following excerpt showed how Mr. Bell implemented labs with notes:

I really work hard to make the labs connect to the notes, so I don't really do labs just for the sake of doing labs and giving them lab practice. I try to do a lab that supports the notes that we do in class and notes that support the labs in class to cement their understanding…. Sometimes it works better to do the lab first…. Like today's lecture they were learning about the structures of protein and the structures of fats and things, and they built those all in the lab yesterday using the modeling kits. The modeling kits are the individual atoms, and they saw the three-dimensional structures. I think today when I was doing the notes. It probably made a lot more sense to them because they did the hands-on first, hands-on stuff first…. Now, I mean, I think it would work equally as well to do the notes first, and then the lab would make more sense. I don't really have a preference of one versus the other. I think it can be really motivating when you read about something and then go experience it with your hands. (Mr. Bell, interview, September 29, 2016)

Students were also expected to write lab reports and work in groups to complete the hands-on practices. Wen found it was challenging for her to engage in those activities which were not demanded in her science classrooms in China. She complained:

We have a lot of homework for my chemistry class. Labs are very long, with multiple pages to write. Plus you have to write conclusion. There’re at least five questions in the conclusion part. And there’s analysis…. Too many writing. For chemistry, we also have three sections of math exercises. There’re a lot of questions in each section…. We have
to write a lot…. You also need to explain in your writing, and that’s tough (Wen, interview 1, September 27, 2016).

Despite Wen’s complaints of the demanding writing tasks, Mr. Del, her chemistry teacher told me that he expected students to complete all homework and writing assignments in “no more than 15 minutes”:

When I give homework, I tend not to give more than 10 or 15 minutes’ worth. In my opinion, it shouldn't be more than 10 or 15 minutes. (Mr. Del, interview, October 6, 2016)

Another challenge that Wen experienced was group work, and that was necessary when students carried out labs. Wen said:

There’s nothing to discuss. Math doesn’t need to discuss. Students sit with their friends and chat together. I don’t chat…. I don’t really know the people who work with me. For the Water Test Project, I said I would make cards and additional notes when I gave the presentation, but I forgot to do so. I just read the slides. I still remembered how Billy\textsuperscript{8} stared at me, like saying “you did not do what you said.” I think people in our group are not very nice…. I don’t have any friend to talk (Wen, interview 2, November 7, 2016).

\textsuperscript{8} Pseudonym is used to ensure confidentiality
没有什么讨论。数学不用讨论。有些人，有朋友的，他们就自己一起做，再聊天。我不聊天。一起做的那些人，我都不认识。我已经说了我要 make cards， additional notes，去做。那天晚上我忘了。我就直接读下来了。我记得 Brian 就看着我，好像说“你怎么说做 notes，为什么又没做”。我觉得我们那个组人不太好。我没有人说话。

Wen’s frustrating experience of collaborative learning was for two reasons, the first being when she did not see the purpose of peer discussion. She would rather complete her tasks individually than work with her peers. Second, Wen experienced some conflicts with her group members and had no friend there to support her. Although these experiences were quite common among teenagers, they made Wen more intimidated to socialize with other students and led her to become even more isolated later on.

In contrast to Wen’s challenges in writing and collaborative learning, she demonstrated a remarkable math advantage in her Honors Chemistry class. Doing math exercises not only helped her to learn new content but built up her confidence in chemistry, as she said:

We have a lot of math exercises in chemistry class, and those are pretty easy for me….We need to do math every day, and that helps me a lot. Math skills are build up on exercises. He [Mr. Del] gives us a worksheet of math exercises every day, and it’s super helpful!... In chemistry class, the only moment I think I’m great is when I’m doing math. I can do it very fast and count in my head. I don’t need a calculator (Wen, interview 2, November 7, 2016).

化学有很多数学，数学对我来说很简单。每天都会做一点数学题，我觉得很 helpful。数学需要练习才能做好。他每天给我们 worksheet，上面都是数学
Positionality in Science Classroom

Wen perceived herself as a diligent student and believed her hard work would pay off. From my interactions with, and observations of Wen, she was very serious about her performance on every single test, strived to do the best, and always stressed out before taking exams. She expressed her work ethic to me:

If I study hard, you know, study smart and hard, I’ll get a high score. If I’m lazy and don’t learn, or don’t pay attention in class, I’ll get low score….I’m happy with my performance on the last two exams. It’s a big relief for me when I am done the biology exam. I spent a lot time on learning for it. I got very stressed out because we had two exams on the same day. I learned extremely hard, and now I feel my hard work is paid off (Wen, interview 2, November 7, 2016).
如果我好好学，study smart, study hard，我的成绩会比较好。如果我总是拖延，不使劲学，不使劲听课，我的成绩就不好。。。。。上次考试应该两个都挺好的。
总的来说，我觉得考完生物以后就完全解放了。我学了很久。两个考试在同一天，我就非常 stress out。我就使劲学。最后觉得自己的 hard work pay off 了。

Wen’s diligence in her science classes did not necessarily mean she liked learning science. Actually, her interest in science learning varied depending on the subject. For instance, she explicitly expressed her interest in chemistry but held an apathetic attitude towards biology, as she said:

I really like chemistry because there’s math there. I’m confident. I’m afraid of biology. Every time when I pass by the biology classroom with my sister, I don’t even want to step in it. I am very worried when the biology teacher [Mr. Bell] asks me to answer questions in class. I don’t like biology. Mr. Del also asks me questions in class, but I can give him the right answers, even though I don’t like to speak in class. Biology intimidates me. I ask Mr. Bell a lot of questions before exams, and he may think I get his points, but not really….sometimes I do, but sometimes I don’t, not at all (Wen, interview 2, November 7, 2016).

我喜欢化学，因为有数学，我很 confident。我很恐惧生物。每次和妹妹一起走路的时候，特别不喜欢去上生物课。生物课总是怕老师上课叫我回答问题。我不喜欢生物。化学老师问问题，我都可以回答，但是我不想。生物，感觉比较害怕。在考试之前，我总是问问题，老师可能认为我都会了，但是。。。有的时候我能回答，能懂，有的时候我就不知道，完全不知道。
In my interview, Wen explained why she had these different attitudes. Wen liked learning chemistry because of the integrated math components which made her feel confident and capable. Her apathetic attitude towards biology was attributed to her lacking interest in memorization which was the major learning task in Wen’s understanding biology. Although Wen’s understanding of biology learning was inaccurate, these words indicated her lack of interest in rote learning and invalidated a pervasive yet incorrect stereotype of Chinese students who are believed to learn through mechanical memorization. Wen said:

Learning biology means memorizing concepts, such as glucose and bacteria. You have to remember their names and functions….I really like chemistry, and I think it’s much easier than biology. There’s not so much memorization in chemistry, just some equations. There’re too many things to memorize in biology, all about vocabulary….One word and another. If you don’t know the meaning of one word, then you don’t know the others (Wen, interview 2, November 7, 2016).

Wen’s understanding of the methods and goals of learning biology was completely contradictory to Mr. Bell’s emphasis and requirements on building up cognitive-demanding skills such as argumentation and synthesis. Ironically, this understanding gap led Mr. Bell to believe that Wen was only capable in rote learning, which was actually the last thing that Wen wanted to do.
Regardless of Wen’s lack of interest in learning biology, her parents required her to perform outstandingly across all subjects at the Honors level of rigor. As I described in the beginning of this chapter, Wen and her twin sister had to gain A+s for all classes; even an A was not acceptable. Moreover, Wen’s parents, like many Chinese parents, were highly involved in their children’s choice of major and career. They explicitly required Wen to choose a STEM subject for college. Wen said:

My mom says I should choose a STEM subject because it’s easier to find a job….My dad wants me to be a doctor, but I don’t want to….I think it’s so sad if you do a job that you don’t like. For example, I like chemistry. If it’s hard to find a job in chemistry, I can still do something small and related, and I’ll enjoy it (Wen, interview 2, November 7, 2016).

As the biology teacher, Mr. Bell knew Wen’s parents’ aspirations for their daughters’ education, even if they did not have any communication at the time of this study. In an informal conversation with Mr. Bell, he told me that Wen’s mother called to ask the school personnel what she could do to help Wen and her twin sister be admitted to Ivy League universities.

Although Mr. Bell was not explicitly against Wen’s mother’s extremely high expectations, he argued that the goal of learning was to enjoy it and prepare oneself to succeed in the future rather than to earn high scores:

I want to let them enjoy the class and be kids but get a taste of what the next level is going to be and practice so that when they get there, they have the tools to be
successful….I hope Wen gets to the point where she can enjoy the class, where she's not stressed about just the number and the letter that's assigned to her work (Mr. Bell, interview, September 29, 2016).

Likewise, Mr. Del held a similar opinion to Mr. Bell’s, as both of them endeavored to guide their students for mental and intellectual growth rather than merely outstanding academic performance. Mr. Del said the following enthusiastically:

We were actually just talking about in the meeting how it's always nice to set them high but be realistic when you know if they're not going to be happy with… I mean I told parents at back to school night some of the kids are going to struggle, but if they're doing the best they can and they're putting forth the time, then there's something to be said about that too…. High school is not all about learning the content; it's also about learning how do you learn, how do you study best, how do you manage your time and trying to get those skills down for moving onto that next level in college. In college, mom and dad's not going to be necessarily sitting right on top of you, “Did you study for that math test that you have today?” And stuff like that. So just kind of getting those self-efficacy skills down is a huge part of high school I think… Because anyone can just sit and memorize flashcards. But some of the kids that are the most successful ones are the ones that… You look at like Steve Jobs, he wasn't anything special in high school, but he learned those personal skills, and he learned how to think for himself. He knew what he could do, not what he had to do… You look at a lot of successful people, and they know their own limitations, and they know what they don't know, which is an important skill to have (Mr. Del, interview, October 6, 2016).
This conflict of expectations between Wen’s teachers and her parents finally led to a hard question for Wen. Both Mr. Del and Mr. Bell believed that Wen could learn better with less stress if she was moved to a Regent class. When Mr. Bell provided the option to Wen and asked for her opinion, Wen responded with a very upset look:

My mom would be very disappointed at me. I’m not sure if I would be happier in the regent class (Wen quoted by Mr. Bell, informal conversation, November 3rd, 2016).

Despite Mr. Del and Mr. Bell’s attention of Wen and good will to help, they overlooked Wen’s ELL status because she had already been tested out from the ESL program. For example, Mr. Del emphasized multiple times that he perceived and treated Wen as no different from other students in his class. When I asked him if Wen was the only non-native speaker in his class, Mr. Del responded:

As far as I know, no one has been brought to my attention or anything like that (Mr. Del, interview, October 6, 2016).

Mr. Del indicated that Wen was very quiet in class, but he did not attribute it to Wen’s ELL status. He said:

All in all, it's like she definitely seems like a normal kid as far as a lot of that goes. She's not the first one to be painfully shy in a class or anything like that...So there's that, but as far as like compared to anyone else, I wouldn't think. She seems to be right on par with a lot of them as far as struggling or having difficulty with certain things (Mr. Del, interview, October 6, 2016).

By the same token, Mr. Bell explicitly indicated his equal attitude and treatment to Wen and his willingness to provide extra support if she needed. Mr. Bell said:
I haven't done anything with her. I would say I probably wouldn't treat that any different than any other kid who needs help. She needs some help but for a different reason than another kid. You know because the language, so if she needs extra help, I'm more than, I mean, like the guy that just came in, I'm more than happy to meet with her and help her understand things and kind of reteach some things to her…So far I haven't provided extra help, but again, I try to treat her like I do every other student. If she comes and needs the help, absolutely, I'm there to help her which I would do that for any student (Mr. Bell, interview, September 29, 2016).

Summary: Disparities Under the Surface of “Model Minority”

Among the five participants, Wen behaved the most consistently with the model minority stereotype, as she worked hard, kept silent in class, set high expectations for herself, and never made any trouble. Nevertheless, from the narrative above, disparities were identified in Wen’s socializing experiences when she attempted to engage in the scientific discourse at Springmarsh High School.

Regarding Wen’s use of semiotic resources, she relied heavily on textual resources such as note packets, especially for exam preparation. Teachers’ use of multimodal resources and connections to personal life also effectively motivated and engaged her in the science classrooms. Meanwhile, both Wen and her teachers, Mr. Del and Mr. Bell, noticed the density of discipline-specific language and vocabulary caused a barrier to Wen’s comprehension of the learning content and a development of higher-order thinking skills. Unfortunately, no extra resources or scaffolding were provided to Wen, as she had been tested out from the ESL program. The strategies that Wen applied to deal with this barrier were discussing with her twin sister about the learning content in Chinese and seeking one-on-one tutoring after class.
Regarding classroom practices, Wen was engaged in a variety of hands-on activities such as science projects in her chemistry class and laboratory practices in her biology class. These hands-on experiences offered Wen an alternative way to learn, in addition to the note packets and worksheets. Nevertheless, the expository writing and collaborative learning required in hands-on activities challenged Wen, because for her, writing was more time-consuming than it should have been, and working in a group felt unnecessary and intimidating. Despite the challenges in writing and group learning, Wen showed strong background knowledge and skills in math, though her teachers did not take note of that.

Three disparities were identified regarding Wen’s positionality in her science classrooms, mainly due to a lack of effective communication. First, an understanding gap existed between Wen and Mr. Bell on the requirements and goals of learning biology, as Wen viewed learning biology as memorizing concepts and terms, whereas Mr. Bell highlighted the importance of developing higher-order thinking skills such as synthesizing and reasoning. Second, Wen’s parents’ high requirements on her academic performance conflicted with her teachers’ expectations of students to “enjoy the class with no pressure.” Both expectations affected Wen’s interest and self-investment on science learning. Third, Wen’s ESL status was blurred by her teachers who perceived and treated Wen “exactly the same” as her NES counterparts, and therefore, provided no extra support or scaffolding for her socialization into the new community of discourse.
CHAPTER 10: HEI-LI: AN ADVANCED LEARNER

Introduction

Hei-li was a 12th grade student studying at Pinewood High School. Although he was born in the U.S., he returned to China when he was three years old and no longer spoke English in his daily life. When he came back to the U.S. with his family in 4th grade, he spoke little English, as he said:

When I first came here, I have about almost zero English (Hei-li, interview 1, November 15, 2016).

At the time of this study, Hei-li had already resided in the U.S. for eight years and spoke both native-like English and Chinese languages. He was tested out of the ESL program in 9th grade and continued receiving support from the ESL teacher for another academic year until he proceeded to 10th grade.

Hei-li’s parents worked for a restaurant and had limited educational experience and relatively low English facility when compared to the parents of other Chinese adolescents in this study. As Chinese was the only language used at Hei-li’s home, he was able to speak this language quite fluently when I interviewed him. However, he still chose to be interviewed in English.

Hei-li was educated in a private elementary school in China, which was encompassed by an atmosphere of restriction and authoritarianism, as he described:

I went to a kind of private school, a private school in China, and the teachers there usually keep you up really late to do your homework and stuff, and sometimes they physically tell you to do stuff….They hit you and stuff….Back then a lot of boys just mess around and don't really do their homework, and they get held and stay after school
for two or three hours….The teacher, she pulled me to her dorm, to the teachers' dorm, where I did homework until like 12:00, and then I went back to my own dorm (Hei-li, interview 1, November 15, 2016).

In contrast to Hei-li’s classrooms in China, the Advanced Placement Environmental Science class that Hei-li took at Pinewood High School was quite flexible and student-centered. As a Non-Regents class, Mr. Rode, the teacher of this class could adjust the teaching content and pace to students’ learning needs with little exam stress. Mr. Rode said:

It's a twelfth-grade elective course….A lot of the stuff so far for the year, we are outside a good bit, so it's not very book intensive….It's not very fast-paced either, so I think that that's helpful because it's not a Regents course….We don't...If we don't cover what I wanted to cover for the year, it's fine.

With an outgoing personality, Hei-li was actively engaged in extracurricular activities such as playing football for his school team.

Semiotic Resource

A distinctive feature of the semiotic resources in Hei-li’s science classrooms at Pinewood High School was the teachers’ guidance and tutoring for individual students. In Hei-li’s opinion, teachers in the U.S. were more committed and tolerant of all students, including those who were not perceived as well-behaved. Hei-li commented:

They're [teachers in the U.S.] like a lot more committed. Teachers in China are committed too, but they're more committed towards students that want to read, ones that want to be good. Instead of kids that are here that don't want to be good, but they will still do anything to help….They say, "If you need any help, stay after; I'll help you," like almost every day….Like in China, if you're behind, you better copy a note from someone
else instead of telling me to grab notes because "I only write it on the board once. I'm not going to write it again." It's like that (Hei-li, interview 1, November 15, 2016).

Hei-li explained that his teachers at Pinewood High School, like Mr. Rode, shared their authority with students, respected their choices, and were willing to communicate with them:

If you don't really pay attention to the teacher, sometimes the teacher gets really mad, but in China it's a lot faster like you can see it a lot more than teachers in America because they're more towards communicating and telling them what to do instead of forcing them, like beating them….Teachers in America expect you to do your best, most of the time. And if you have any questions, just stay after and they can help you. The teachers in America, they give students a lot more chances than in China (Hei-li, interview 1, November 15, 2016).

In my interview, Hei-li recalled his transition experience to the U.S. school and explained how his teachers offered him extra support by providing one-on-one tutoring every day. He also mentioned the small amount of homework made him less stressful during the transition period:

I came here around fourth grade, where they just stopped giving help a lot of times like reading and writing. In first grade, second grade, and third grade, they teach you about pronunciation, all the basics, which I don't really have. Fourth grade is where they start letting go of the basics and they start pounding you with reading and writing and all that stuff….It was stressful trying communicating when I first came….Back then because when I first came here, I stayed after every day with my teachers….I didn't know what was going on because it was really bad; I didn't understand anything, so I have to stay after and learn….I've been through a lot. I've been through a decent amount of stuff….The teachers were a lot nicer because I was still in elementary school and teachers
didn't really put a lot of homework on, which helps a lot....I feel like there's just less stress on me, like, "Do homework. Oh, I have to do more homework," even though I didn't really do a lot because back then I kind of had to help out in the restaurant, so my parents would pick me up after school, I did homework in the restaurant and I'd get home late (Hei-li, interview 1, November 15, 2016).

Consonant with Hei-li’s description, teachers’ respect and adaption to individual students’ needs were observed in Mr. Rode’s class. For example, Mr. Rode was aware of Hei-li’s silence in class, but also recognized his active engagement in hands-on activities. He showed his understanding and respect to Hei-li, as he commented:

Hei-li is pretty out-going and…When we're out doing things, outside, hands-on stuff, he's frequently wanting to jump right in on that. But yes, he's been helpful in that respect. It's very different when he's outside. It's a very different dynamic….He doesn't seem to be as engaged inside when we're in here….We have other kids, like Gabrielle, is very quiet. She's quiet all the time but she's a junior. We have a couple kids that are eleventh graders and they typically are a little bit intimidated….I think they're just intimidated by the age difference. They don't want to stand out….But once the seniors leave then they develop (Mr. Rode, interview, November 9, 2016).

Mr. Rode’s flexibility was also reflected in an incorporation of multiple modes of semiotic resources into his class to meet students’ various learning styles. He said:

For each of the chapters they have a note packet, so we go through that. I try to show them examples of things that we're talking about. So we're learning about the model, and then we're kind of seeing it there so they can get a visual of it. That one last interview, the guy walked them right through that chart that they were labeling…...I like to throw a lot of
different things at them because I...They've chosen to be here; I don't want to bore them with a lot of finer details. We just want to expose them to a lot of different ideas (Mr. Rode, interview, November 9, 2016).

As shown in Table 13, Hei-li had a lot of opportunities to access visual resources and simulations from websites in Mr. Rode’s class. These opportunities not only motivated Hei-li but made it possible for him to learn, as he described himself as a non-traditional type of student who learned through visuals and hands-on activities:

I feel like now, as technology improves, it helps a lot of visual students to study instead of back in the days when it's usually writing and reading classes. I feel like the teachers or the students, almost all the students can learn instead of the student that only reads can learn. Like the student that can read, usually read and write note cards can learn on the subject. Do you know what I mean? It helped me a lot towards studying because I can never just sit down and write notes from the teacher and remember it….Texts are definitely not enough because I feel like showing me how it works or painting a picture in my head it's easier for me to remember, "Oh, we did this before."…I don't really usually like to read (Hei-li, interview 1, November 15, 2016).

Table 13

Semiotic Resources in Hei-li’s Science Classrooms

<table>
<thead>
<tr>
<th>Semiotic Resources</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s lectures</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Community members’ guidance (e.g., teacher’s clarification after class)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>PowerPoint slides</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Resource</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reading articles</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Class notes</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Worksheets (e.g., lab reports, math problems)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Videos or other visuals</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Internet resources (e.g., class website)</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

Mr. Rode’s intensive use of visuals and computer simulations did not mean an abandonment of traditional textual resources. Actually, Mr. Rode used handouts and PowerPoint quite frequently when he introduced the background knowledge and clarified the information in the videos and simulations. For example, when he taught the Unit of Eutrophication over several lessons, Mr. Rode first introduced some related concepts and terms through PowerPoint. He also showed where eutrophication was processed in the local area on Google Maps, and then demonstrated it through graphs and photos from websites. Finally, he played a video of the eutrophication problem in the Chesapeake Bay and occasionally stopped the video to provide explanations, ask guiding questions, and check students’ understanding. When the unit was completed, students were required to create a comic strip based on their understanding of eutrophication. Samples from prior classes were also provided as examples (see Figure 5). Below is a classroom vignette on one of the several lessons of eutrophication.

Mr. Rode talked about the recent presidential election for a while in the beginning of the class. He explained how the election result would affect climate change of the State. He also showed his concern for the environmental policy in this country.
Mr. Rode turned on the PowerPoint and talked about the plan for tomorrow’s field trip. All students had handouts of the same content on the PowerPoint slides. Some words were highlighted on the slides as key terms such as “eutrophication.” When he mentioned the word “nutrients,” Mr. Rode wrote down some examples like “sewage,” “farm staff,” and “fertilizers” for students’ reference. Hei-li wrote down these examples on his handouts. Mr. Rode further explained the key terms and concepts shown on the PowerPoint. He sometimes stopped and asked inquiry questions like “What will happen if you take out oxygen from the water?”

Mr. Rode opened Google Maps and showed students places where eutrophication was processed in the local area. He then described the eutrophication process by showing pictures and photos. Students, including Hei-li, were taking notes. Finally, Mr. Rode played a video on water pollution in the Chesapeake Bay and occasionally paused to give some comments or clarifications.

At the end of this class, Mr. Rode commented on the recent election again and repeatedly emphasized how the election result would impact the issue and solutions of water pollution (Classroom observation, November 9, 2016).
Mr. Rode’s integration of texts and authentic information from real life (e.g., connecting election results to environmental policy) supported Hei-li’s socialization from two perspectives. From a code-based perspective, Mr. Rode’s explicit explanations of vocabulary and concepts facilitated Hei-li’s acquisition of the “set of rules relating to both grammatical accuracy and sociolinguistic appropriateness,” which are necessary for effective communication in the
discipline of environmental science (McKay & Wong, 1996). From a process-oriented perspective that involves identity constitution, Hei-li developed his own attitudes and thoughts on the issue of environmental pollution, which signified his active engagement in, and contribution to, the field. For example, Hei-li chose the eutrophication unit as the most impressive unit throughout the semester and shared his thoughts on this topic in the interview. He remarked:

I would probably choose how nitrogen, how dead zone was created, and how much humans put in to create it. If human, is not there, dead zones would definitely not occur. I feel like the only reason why a lot of the environmental hazards become hazards, is because of human activities. And a lot of times when the public speaks up, they're already way too late. Because first, they’re gonna do it, and they're not going to notice that they did it, and then after they went through the cycle it comes back to bite them in the tail. They're gonna be like, "Why did this happen?" And then they're going to complain about it, but they're not gonna do anything about it….I truly know there's some reason why environmental hazard is really crucial part of Earth. A lot of times I notice this part…. This thing that happened is because of us. And sometimes I look around like, "Don't do this. Clean that up." And a lot of times when I see people protesting about stuff but didn't really do anything about it, I'm always trying to say, "You didn't do anything to help. All you did was talk about it instead of helping out" (Hei-li, interview 2, December 14, 2016).

Socializing Practice

As shown in Table 14, Hei-li was engaged in a variety of socializing practices in his environmental science classroom. Particularly, Mr. Rode placed an emphasis on hands-on
activities and self-conducted science projects, as he said, “We do some group work throughout the year, some of the lab work that we do in here, the hands-on activities and stuff like that” (interview, November 9, 2016). Throughout the semester, Hei-li was observed to participate in activities like using microscopes to observe bacterial, practicing to read a thermometer, and going on a field trip to test water pollution.

Table 14
Socializing Practices in Hei-li’s Science Classrooms

<table>
<thead>
<tr>
<th>Socializing Practice</th>
<th>Classroom in U.S.</th>
<th>Classroom in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussion/activity</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Triadic dialogue</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Science lab/ hands-on activities</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Science project</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Reading science articles/ textbooks</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Taking notes</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Types of writing % of writing (classroom in U.S.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explanatory/ informative</td>
<td>57.6</td>
<td></td>
</tr>
<tr>
<td>Argument</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Figures/tables</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>35.6</td>
<td></td>
</tr>
</tbody>
</table>

Those hands-on activities not only promoted Hei-li’s engagement in this class but facilitated his comprehension and acquisition of the target learning content such as ecology concepts or interactions among organisms and their environment (e.g., how human activities
affect water resources). It was reflected in Hei-li’s response to my interview question “What types of tasks help you to learn?”:

Definitely a lot of hands-on like more towards studying, using my hands, watching the video or listening to something instead of writing and reading, sitting there by myself type stuff. I'm definitely a hands-on person. When I go to study, I really like to look at what's going on and then see the process of how it moves. That really helps me learn stuff (Hei-li, interview 2, December 14, 2016)

Hei-li also developed an understanding of the relationship of human actions and environment protection through participating in those hands-on activities. He connected what he learned in class to what he experienced in his daily life, as he said:

We brought water in from Grey Creek⁹, and then we got that out from the creek, and we put fertilizers inside the water to see how much the algae grows and what would happen. And then we could definitely see how the water turned into blueish gray because of the copper and the hydrogen, and the nitrogen. All that together. But that really shows us what can fertilizers, and animal feces do to clean water.... I definitely learned something from this. Like how people are creating certain problems that they are complaining about. Like I definitely see why people are complaining about stuff, I can definitely see reasons why things are created. Like why the problem is there (Hei-li, interview 2, December 14, 2016).

In this class, hands-on activities were implemented as inquiry-based projects in lieu of “one-and-done” assignments. Before carrying out a hands-on activity, students were engaged in a series of topic-related tasks including notes taking, reading articles, and teacher-guided

---

⁹ Pseudonym is used to ensure confidentiality
discussion to prepare for background knowledge. Afterwards, students were also required to use writing or painting products to represent what they learned from this activity. Take the Water Pollution Project, for instance, the goal of this project was to have students test the water quality of a local creek and make them understand how human activities affect the environment. Before going on the field trip, Hei-li first copied key concepts and vocabularies from Mr. Rode’s PowerPoints and lectures. He also watched a video of the eutrophication problem in the Chesapeake Bay to obtain the background information. Then, some worksheets like a word puzzle game were provided to make Hei-li and other students familiar with the new words (see Figure 6). Hei-li said:

We did a crossword puzzle on it…. A part of it was really difficult because a lot of words are really long. (Hei-li, interview 2, December 14, 2016)
Once Hei-li had sufficient background information from a variety of resources, he was guided to experience using and reading a thermometer, which would be employed later to test water temperature (Classroom observation, December 5th, 2016). Another practice to prepare students for their field trip was to practice using microscopes to observe bacteria (Classroom observation, November 21st, 2016).
When students had adequate background knowledge and skills, they went to a local creek with Mr. Rode to test how fertilizer affected the water and cause pollution. Hei-li described what happened on the field trip:

When the weather is really nice, we usually go out and catch wasps and bees and all that stuff. A lot of people just sat there, but I caught a lot. Then when it got colder, we usually go out, and we went to the pond, little lake thing down there by Blue Creek. We started catching frogs and examined the water. Now we're testing how fertilizers, how nutrients affect water…. We put fertilizers in the water and left it over the break, and we're going to see how the bacteria and the stuff in the water eats away the fertilizers and how it damages the environment overall (Hei, interview 2, December 14, 2016).

Finally, Hei-li was encouraged to write an essay and draw a cartoon panel to describe how the fertilizers he put affected the water and to express his attitudes towards it. Hei-li explained:

We did a cartoon panel. And we wrote out how nitrogen and hydrogen when it's put into the water, and then how algae grow because of it, and then a large number of algae and a less amount of food for the algae, and the algae dies and decompose and decompose to algae, and the oxygen is taken away from the water which mean all the fish dies. And then everything dies. (Hei-li, interview 2, December 14, 2016)

In contrast to Mr. Rode’s class, Hei-li’s science classrooms in China were more text- and lecture-oriented with minimal student involvement in decision making, as Hei-li said:

In China, we were usually in the classroom with a textbook. Didn't really go out a lot. We would just stay in a room. Take more traditionalized filling out everything, taking tests. Not really going outside to see what's going on. We would do little projects, like figure
out what happens first, what happens second, and goes through it…. It was all boring.

Like you don't really do anything (Hei-li, interview 2, December 14, 2016).

Meanwhile, Hei-li’s science classrooms in China lacked communication and social interactions which were encouraged and essential in hands-on activities. When he was asked to compare the learning contexts in his Chinese and American science classrooms, Hei-li said:

It's [American classroom] more hands-on and they're [American teachers] communicating a lot more….Like teachers tell you to do stuff, tell you to raise your hand and answer a question, but back then when I was in China, usually the teachers keep on going. It's like a college in a way (Hei-li, interview 1, November 15, 2016).

Hei-li also emphasized the role of technology in American classrooms to support the communication between students and their teachers. He remarked:

It’s kind of a lot easier because now teachers can communicate with each other a lot easier, and student and teachers can talk to each other through email, so technology allows a student and teacher to bond, to communicate a lot easier than back then (Hei-li, interview 1, November 15, 2016).

In addition to the hands-on activities and science projects, Hei-li also reported that drawing helped him to organize his thoughts and represent what he learned from hands-on activities. Although figures and other visual representations made up a small percentage of all Hei-li’s writing tasks (1.7%), he perceived drawing as an insightful experience in his environmental science class. He said:

Definitely the comic strips and the water. That really pops out at me and tells me that this is what's going to happen if you don't stop it (Hei-li, interview 2, December 14, 2016).
He also positively commented on another drawing task he was required to complete on the water cycle unit:

It [drawing] definitely made me think about how to draw it because the symbols combined two different cycles together into one. Which really challenged me. I didn't really think about it yet (Hei-li, interview 2, December 14, 2016).

As Hei-li had learned at Pinewood High School for eight years and tested out of the ESL program, he was no longer perceived as an ELL student nor did he receive any support from the program. However, he still mentioned how writing assignments that focused on lexicons and semantics supported his development of English during his transition period. Hei-li said:

I feel like when I was doing my homework the easiest part was just matching words and stuff, like writing a sentence, like homework, like, "I blank dogs. I like dogs. Fill in all blanks," and stuff like, "Please write a sentence about how you feel," like a whole sentence. That's a lot harder for me (Hei-li, interview 1, November 15, 2016).

Positionality in Science Classroom

A variety of positionalities were identified in Hei-li’s environmental science classroom. Some of them were contradictory to one another because of Hei-li’s unique linguistic, cultural, and family backgrounds and experiences. This section discusses Hei-li’s roles as a science learner, an ESL student, and a Chinese studying at an American school.

According to both Mr. Rode and himself, Hei-li was a competent science learner with an excellent academic performance. For example, Hei-li confidently described himself as a capable learner in various science subjects, even if he did not really “pay attention”:

Earth science. That was a really easy class for me. I don't know why, but I just knew every single thing the teacher said. I was going through it really fast….We usually joke
around saying that even though I don't pay attention, I still get 100s. But that's about it. I get really high grades in that class even though I joke around in that class. Fool around like a lot (Hei-li, interview 2, December 14, 2016).

Consonantly, Mr. Rode perceived Hei-li as a very creative student who was able to perform well if he wanted to. In the interview, Mr. Rode mentioned the comic strip assignment of the eutrophication unit, as Hei-li’s drawing was much more creative and well-explained than his peers’.

Nevertheless, Hei-li’s competence in learning science did not mean that he was always interested in doing so. When Mr. Rode acknowledged Hei-li’s strong learning ability and creative thinking skill, he also pointed out Hei-li’s low motivation in completing assignments and getting high scores. Mr. Rode said:

He could be near the top; I think if he pushed harder. But again, I'm still just not sure as to whether it's a language thing or a motivation thing. I'm leaning more towards motivation, but I'm not decided yet in my mind….To me it looks like it's just not pushing as hard as he could push (Mr. Rode, interview, November 9, 2016).

Hei-li was also aware of his low motivation and attributed it to the less meaningful learning content. He criticized the water cycle unit as “repetitive” and refused to learn it, as he was already able to comprehend and apply the relevant knowledge quite well. Hei-li said:

Definitely I know what's going on. If someone asks me why is this happening? Why is the tree there? I definitely know. But if you really go in detail, I don't think it's going to be anything that I'm going to need later in life. Or like it's really important in education…. It's really repetitive. It's just how you draw them (Hei-li, interview 2, December 14, 2016).
In addition to his science learner role, Hei-li’s positionality as an ESL student was constantly changed and perceived differently by himself and others. In my opinion, Hei-li spoke near-native English with no accent and was able to communicate appropriately. Hei-li was the only one among five participants in this study comfortable to be interviewed in English. Meanwhile, Mr. Rode, as a NES, did not even notice Hei-li’s ELL background because of his fluent English facility. Mr. Rode said:

Actually, before you came in, I didn't realize that he was...you know, that he was bilingual at all or that he had maybe issues, struggles with English. I didn't perceive that, particularly in his speech (Mr. Rode, interview, November 9, 2016).

On the contrary, when he was asked about his self-positioning, Hei-li emphasized that he was an ESL student and English was not his first language, regardless of his native-like communication ability in English. Hei-li explained:

I was [an ESL student]. I tested out two or three years ago, but I was doing it for years, and this was the first year I ever moved out of ESL....I spoke English for a year, like in kindergarten. Then I moved back to China for five or six years....English is my first language, but not really because I barely learned anything in kindergarten (Hei-li, interview 1, November 15, 2016).

Moreover, Hei-li repeatedly mentioned his language difficulties in the transition period to Pinewood High School. Hei-li sought help from his elder sister who came to the U.S. earlier than him and had a more advanced English proficiency. Hei-li said:

It was stressful trying communicating when I first came. I've been through a lot. I've been through a decent amount of stuff....My sister definitely helped because she had a better base beginning English because she came here in third grade and she took third grade
again, so she had a better base than I do… She's going a lot faster in reading and writing and is better overall, but she's a girl. That kind of helps too….After like two years, around sixth grade, seventh grade, that's when I started saying, "Oh, it's getting a little better. It's getting a little better." Then it was a lot easier when I got to high school (Hei-li, interview 1, November 15, 2016).

When he talked about his family, Hei-li reported his parents did not even know about his struggles in the transition period because “My parents are usually working, so it's just most of the time me and my sister”. As Hei-li’s parents did not speak English, Chinese was the only language Hei-li used at home (“Chinese. All Chinese” in Hei-li’s words, interview 1, November 15, 2016).

Hei-li’s parents’ tight schedule and their limited English skills, did not reduce their aspirations in Hei-li’s education. According to Hei-li, his parents had fairly high expectations for his academic achievement and did not really know or care how he would achieve it. Hei-li said:

My parents really push on me hard….They want me to get a good education, but they don't really know what to do. I just see it. No, I just see it. When I'm not working hard, they're always like really stressed out and yell at me like a child….They don't really expect me to do anything, but they just want to see the grade. That's the only thing they want to see. They don't care how I got it; they just want to see the final grade (Hei-li, interview 1, November 15, 2016).

In my interview, Hei-li also pointed out his parents’ lack of ability to support him regardless of their high expectations. His elder sister was the major source providing him academic and emotional support. He said:
My parents used to influence me in grades, but this is just all me. My parents are not gonna do the homework for me. They're usually not home. Me and my sister. So usually I can do it myself or my sister's going to be there to help. Thank God, I'm not going to put a zero….They usually don’t help me on my schoolwork because they still can't really speak English that well. They moved here when they were around 20, but they never really speak English, and they work in a restaurant….I have to explain it to them, like translate it (Hei-li, interview 2, December 14, 2016).

Moreover, Hei-li was aware of his strong association to Chinese culture, language, and ideology, but he was sometimes hesitant to admit it. For example, he highlighted his non-traditional style of learning as well as his talent in athletics and outdoor activities, both of which differentiated him from “a lot of Asian kids”:

I'm more towards an outdoor person. But certain things I love being indoors too. I like extremes. I'm a lot different than a lot of Asian kids. A lot of Asian doesn't like to go outside. Usually stay inside….I can never just sit down and write notes from the teacher and remember it (Hei-li, interview 2, December 14, 2016).

When compared with his attitude towards his Chinese heritage, Hei-li seemed more associated with his American identity. He felt his learning experiences in the U.S. affected his choices for college and career, as he said:

American school affected me a lot more than the Chinese because I didn't really spend as much time in China, even though I did spend like six years, but I feel like it's not that long, when you think about it. I still have spent more than half of my life here seeing stuff and experiencing things a lot of Chinese kids haven't experienced (Hei-li, interview 1, November 15, 2016).
Summary: a Chinese, Chinese-American, or American?

As the one who had learned in the U.S. for the longest length of time, Hei-li was unique among the five participants regarding his near-native English proficiency, non-traditional learning style, critical attitude toward learning content, and complex positionalities as a science learner, an ELL, and a Chinese student.

On the one hand, Hei-li had strong ties with Chinese language and culture, as he had lived in China for years and exclusively spoke Chinese at home. Moreover, Hei-li’s parents, like many typical Chinese parents, had strong aspirations for their children’s academic success. Hei-li’s acknowledgment of his Chinese identity was reflected in his acceptance of his ESL identity, as English was not “really” his first language regardless of his near-native English facility. He also repeatedly mentioned the challenges and struggles in his transition to Pinewood High School, which were not experienced by most NES students. Finally, writing assignments on lexicons and semantics and one-on-one tutoring with teachers, both of which were helpful for many ESL students, promoted Hei-li’s acquisition of language skills and helped him to meet the academic requirements at the beginning of his learning at Pinewood High School.

On the other hand, Hei-li had some characteristics that indicated his Americanized identity. For example, Hei-li described himself as a “non-traditional” student who learned through hands-on and outdoor activities, both of which are widely used in Western science classrooms, but are not in typical Chinese classrooms. This was confirmed by Mr. Rode, who acknowledged Hei-li’s learning ability and thinking skills (e.g., creativity), yet also recognized Hei-li’s low motivation in certain learning materials and contents. Although Hei-li’s academic performance was not the best in his environmental science class, he was able to develop an attitude and contribute his original thoughts to this field. He also held a critical opinion to the
learning content. These skills are believed to be developed in Western learning contexts and are lacking in many Chinese students regardless of their high exam scores (Liu et al., 2009; cited in Mathias, Bruce, & Newton, 2013).
CHAPTER 11: DISCUSSION AND CONCLUSION

As an under researched group, Mainland Chinese students are easily associated with the model minority stereotype which holds that they can achieve academic success with little support. In science education, Chinese students’ unusually high performance enhances this stereotype (Barshay, 2013; Lee, 1996; Lu, 2015; Ma & Wang, 2014). A growing body of literature has attended to “the paradox of Chinese learners” indicating that Chinese students are able to succeed in mathematics and science even in classroom learning environments that are not particularly conducive to learning (e.g. those with large number of students and lacking opportunities for individualized instruction) (Biggs, 1994; Cheng & Wan, 2016, p.30; Zhou, 2014). A couple of reasons associated with their unusually high performance are that Chinese students have developed abilities to memorize information with understanding and are persistent in their studies (Cheng & Wan, 2016). However, little research, especially at secondary level, has investigated what affordances and constraints are offered to Chinese students and what impacts they have on their learning in U.S. science classrooms. Through the lens of language socialization theory, this study sheds light on the affordances of semiotic resources, socializing practices, and students’ positionality in a speech community (Ochs & Schieffelin, 2014).

Semiotic resources comprise the linguistic and non-linguistic signs through which community members communicate. In science disciplines, the semiotic resources are often delivered in multiple modes such as verbal, visual, mathematical, and actional (Lemke, 1990). Socializing practices refer to the meditated practices that novice learners participate in for the purpose of socialization (Ochs & Schieffelin, 2014). Oral and written practices are identified as the two main socializing practices in academic discourse, and in science specifically, these practices can be triadic dialogues, presentations, lectures, argumentations, lab reports, and
mathematics exercises (Duff, 2010; Lemke, 1990). Finally, a novice learner’s positionality describes how a novice learner is defined by himself or herself and his or her relationships with others in relation to a context (Duff, 2010; Ochs, 1993). In a trajectory of L2 socialization, a learner’s positionality not only involves his or her and other members’ social acts and stances but the learner’s positioning with respect to power (Morita, 2004; Takacs, 2002).

The literature has identified that a novice learner’s agency and self-investment play a crucial role in the socializing process in both L1 and L2 socialization (Ochs, 1990; Duff, 2014). The novice learner is not only being socialized into the target community but also being an active agent who may bring in new knowledge and norms and transform the target community (Bayley & Schecter, 2003). In academic contexts, a novice learner’s histories of prior language and content learning experiences can have a variety of impacts on his or her socialization in the new community. On the one hand, these past experiences and knowledge can be tapped into as valuable resources to increase motivation and promote learning. On the other hand, some of the experiences that contradict what is valued in the new speech community can cause a dissonance and affect the learner’s content learning trajectory and impede his or her socialization into the new community more generally.

A growing body of literature has investigated ELL students’ learning processes and struggles when they are socialized into academic contexts. However, most of the studies are at the postsecondary level and perceive ELLs as a homogeneous group without differentiating the unique challenges, advantages, and identity negotiations within one ethnic group, such as the Chinese group. Chinese students have been depicted as reticent learners, poor writers, and incapable presenters, regardless of their higher academic performance in natural science subjects in international examinations (Lee, 1996; Lu, 2015). Insufficient school support, high pressure
from their parents, and inaccurate stereotypes lead to struggles and conflicts for Chinese students when they are socialized into their new science classrooms (Huang, 2004; Wang, 2011).

Contribution of This Study

To gain a better understanding of Chinese adolescents’ experiences of science learning, this study investigated five Chinese adolescents’ engagement in their science classrooms, identifying the specific affordances and constraints to their learning and their positionalities. Framed in language socialization theory, I explored three research questions: (1) What semiotic resources (e.g., textual, oral, multimodal) are provided to Chinese adolescents in their science classrooms, and how do these resources affect their learning?; (2) What types of tasks (e.g., oral presentation, written arguments) are provided to Chinese adolescents in their science classrooms and how do these tasks affect their learning?; and (3) How are Chinese adolescents’ positionalities shaped and perceived by others and by themselves in their science classrooms?

I researched these questions in two public high schools located in a northeastern state with five Chinese students from Mainland China aging from 15 to 18 and their science teachers. The five Chinese students were selected because their L1 was Mandarin and they had uninterrupted science education in China. Despite their common cultural and educational experiences, the students varied in terms of gender, grade level, place of birth in China, and length of residence in the U.S. These variations helped me to avoid constraining my understanding on a certain group of Chinese students.

I collected multiple sources of data including student background questionnaires, ten student interviews, five science teacher interviews, 14 weeks of classroom observations, and 142 pieces of student writing samples. I also adopted open-ended interview questions to capture the participants’ individual perspectives. All interview data were recorded with permission and
translated into English if they were conducted in Chinese. I used NVivo 11 to open-code interview and observation data, and categorized student writing samples into arguments, informative/explanatory texts, mathematics, visual representations, and mechanical writing. When I completed the analysis of an individual student case, I conducted a cross-case analysis (Yin, 2013) to identify similarities and differences across students.

**Semiotic Resource**

According to the Chinese adolescents, the most effective semiotic resources in their science classrooms were class notes and handouts. For newcomers who was developing academic language like Jie, class notes and handouts provided them a guidance and reference of learning, especially when they did not catch up in class. For experienced learners who had studied in the U.S. for a while like Xuan, Wei, and Wen, the teacher-provided textual materials assisted them to prepare for examinations effectively.

Nevertheless, the intensive language and dense vocabulary of these textual materials impeded the Chinese students’ comprehension of content. This finding is consistent with previous studies on ELLs’ acquisition of scientific language. Scientific language can be challenging for all students because of its unique lexicon, grammar, and rhetorical structure that are quite distinctive from everyday language (Martin & Halliday, 1993). These challenges are even more acute for ELLs, as they may not have developed high levels of academic language competency before being mainstreamed (Buxton & Lee, 2014; Lee, Quinn, & Valdés, 2013; Wilcox & Yu, 2016). The difficulty in fully understanding scientific language caused a dilemma for the Chinese adolescents in this study, that they were not able to take maximum advantage of the class notes and handouts which were their main semiotic resources for learning.
An effective way to address this issue was teachers’ explicit explanations of new concepts and technical terms in the scientific texts. Specific examples and vocabulary practices were also reported helpful for all five Chinese students including Hei-li whose linguistic and cultural competency was comparable to NES. In previous studies, providing explicit instruction on language and metalanguage is also identified as a key in the genre-based pedagogy which is proposed by many scholars in science education (Martin & Halliday, 1993; de Oliveira & Lan, 2014; Hyland, 2007; Keys, 1999; O’Neil, 2001; Swanson, Bianchini, & Lee, 2014; Winsor, 2007; Wollman-Bonilla, 2000).

Provision of semiotic resources in multiple modes was also found as a means to compensate for the Chinese students’ lack of proficiency in language, even though most of the science teachers in this study were not aware of it. Visual aids such as pictures, teachers’ gestures, graphic organizers, and tables were used to convey the science content helping to explicate science vocabulary and connect science concepts to students’ daily life. Those multimodal semiotic resources provided comprehensible input for the Chinese students who did not have “equitable learning opportunities” compared with their NES peers, due to a dissonance in language and culture (Lee, 2005, p. 493; Wilcox & Yu, 2016).

Another main type of semiotic resources that provided affordances to the Chinese students’ learning of science was their one-on-one interaction with teachers. Although Chinese students were documented as silent learners in class (Chan, 1999; Cheng & Wan, 2016; Lim, 2007; Murphy, 1987), this study found that they actively asked questions and sought closer interaction with their teachers immediately after class. This finding supports an earlier argument on Chinese students that refute the perception of Chinese learners as silent and passive (Biggs, 1994; Chan, 2007; Zeng, 2006).
Socializing Practice

Consonant with previous work, this study found that the Chinese adolescents, including those from metropolitan cities, were lacking sufficient scientific experiences such as laboratory practices and inquiry projects in their home country (Wei, 2009; Yeung & Li, 2015). Nevertheless, this does not mean that they were not able to learn through “doing science” as required by the CCSS and NGSS. On the contrary, the Chinese students in this study were actively engaged in science projects and hands-on activities to build their understanding and scientific skills if they were carefully guided and provided sufficient resources.

However, without effective guidance, the Chinese students felt that doing laboratories did not enhance their scientific understanding, even if they were able to complete the practices with “cookbook” directions. The Chinese adolescents’ confusion about the objectives of laboratory investigations was attributed to a lack of effective scaffolding and guidance rather than their developing language abilities. Actually, even newcomers like Jie were able to learn through hands-on activities if scaffolding was provided. Lunetta and his colleagues (Lunetta, Hofstein, & Clough, 2007) have argued that manipulating materials in the laboratory without teachers’ guidance is not sufficient for learning contemporary scientific concepts and does not help to promote the desired scientific understanding. Likewise, Kirschner, Sweller, and Clark (2006) reveal that minimal guidance provided to students accounts for the failure of experiential and inquiry-based learning in a classroom.

The Chinese students in this study were also engaged in collaborative learning in their science classrooms. Despite the advantages of small group learning as suggested by literature (Moje et al., 2001; Swanson, Bianchini, & Lee, 2014), this study found that the Chinese students were beneficial from collaborative learning only when they were grouped with their friends who
were always their compatriots or other ELL students. This confirms Duff’s (2007) argument that novice learners are sometimes socialized through interacting with other relatively experienced novices who are perceived as more effective and approachable linguistic and cultural mentors in L2 socialization.

In addition to small group learning, interactions with teachers in the form of IRE or IRF seemed to promote the Chinese students’ in-class participation. “Triadic dialogue” (Lemke, 1990), though criticized in the past, has been perceived as an effective tool to create productive classroom participation, especially in the context of L2 learning (Haneda, 2005). It offers an opportunity for all students in the classroom to co-construct shared meanings of knowledge and display their intellectual initiative and creativity (Lemke, 1990; Heap, 1985, cited in Nassaji & Wells, 2000). This is beneficial for all students, especially for Chinese students who have been identified as reticent learners for multiple reasons.

Regarding writing tasks, the Chinese students, both the newcomers and the experienced learners, found it challenging and time-consuming to complete. A potential reason for this was their lack of experience in writing for discipline-specific genres such as argumentations and lab reports that are widely used in Western classrooms. Although writing practices on general English were provided to the Chinese adolescents when they were in the ESL program, these practices mainly focused on lexicon, grammar, and sentence structure rather than the norms and “hidden rules” of content writing (Prain, 2006, p. 182), and thus, lost its value when the Chinese adolescents were mainstreamed into the content classrooms.

The Chinese adolescents and their teachers had an apparent understanding gap of the mathematical component in science learning. The Chinese learners perceived doing math exercises as an easy task and an efficient way of learning, whereas the teachers believed math
was difficult and only for advanced students with more skills and content knowledge. As the teachers did not recognize the Chinese adolescents’ math advantage, they were not motivated to alter their curriculum or instruction to tap into these students’ strong mathematical knowledge and skills.

**Positionality in the Scientific Discourse**

Through analyzing the Chinese students’ use of semiotic resources and socializing practices, this study found a variety of positionalities that they created in their science classrooms. Except Hei-li, whose linguistic and cultural competency was comparable to his NES peers, all other Chinese students in this study positioned themselves as legitimate peripheral learners in their science classrooms. For example, Jie transformed her positionality from the center to the peripheral when she attempted to engage in her new scientific discourse, even if she was still able to manifest her identity as an experienced science learner in some situations. Such marginalized transformation of identity was attributed to a lack of experiences and abilities of the language and culture in the new community.

A manifestation of the Chinese students’ identity as peripheral learners was their silence in class and segregation in group work. Such segregation could be explained as “self-exposed segregation” (Miller, 2004, p. 97), as some of the Chinese adolescents preferred working alone. We cannot neglect the possibility that the Chinese students’ choice of working style might be affected by their prior unpleasant interactions with their NES peers (e.g., Wei). A loss of confidence in their ability was another reason for their silence in class (e.g., Jie). Despite their obvious silence in class, these Chinese adolescents actively participated in class through taking notes of their teachers’ lecture and attending to their peers’ talk (Morita, 2004; Liu, 2002).
With the increasing length of learning in the U.S., the Chinese adolescents gradually transformed their positionality from the peripheral to fuller participation with a growth of identity as well as linguistic and cultural competency (Young & Miller, 2004). Paradoxically, the gain of membership came along with a recession of their Chinese identity. In this study, Jie had the strongest association with her Chinese identity as she repeatedly mentioned her experience in China and constantly compared her learning contexts in China and the U.S. On the contrary, Hei-li’s Chinese identity was not as apparent as Jie’s, and was not even recognized by his teacher, even though he still maintained his Chinese language proficiency for the sake of communicating with his parents.

Prior work on straight-assimilation provided explanations for the waning of Hei-li’s Chinese identity (Gordon, 1964; Kao & Tienda, 1995). Gordon (1964) described how ethnic minorities will blend into the mainstream culture and become indistinguishable from the native populations with the increasing length of their residence in the target country. I found two potential reasons for the Chinese students’ straight-assimilation in their new academic settings. The first one was related to their resistance to the negative aspect of the model minority stereotype describing the Chinese population as “over-conformist, lacking in individuality and initiative, emotionally repressed, socially inept, and physically unattractive, or nerdy” (McKay & Wong, 1996). To disassociate themselves from this downside, the Chinese students endeavored to manifest the characteristics of mainstream adolescents, such as a lack of interest in science learning (e.g., Xuan) or an aspiration in athletics (e.g., Hei-li).

The second reason was that the Chinese students’ learning environment did not really encourage them to maintain their original identity. According to Miller (2004), when the first language of the ELL students goes unrecognized, untapped, and undeveloped, their identity
construction will be seriously affected and may cause a problem. The dominant use of English and Western-oriented resources and practices failed to acknowledge the value of Chinese language and the students’ past learning experiences. Moreover, the teachers’ color-blind perception and unawareness of the students’ strength, like math advantage, further enhanced this unbalanced power relationship.

Finally, this study found that the Chinese students faced many challenges common among first-generation students, such as a lack of basic knowledge about secondary education and lower level of family support (Pascarella, Pierson, Wolniak, & Terenzini, 2004). Despite the strong aspirations in their children’s education, the Chinese parents were not very likely to provide sufficient support to their children due to their lack of learning experience in the U.S. As a result, the Chinese students had to struggle and “depend on themselves” instead of seeking help from their parents when they encountered a challenge. In some cases, like Wei, Wen, and Hei-li, other family members such as siblings served as the advisor and counselor roles, as they had shared common experience with the participants in the new academic community. This evidence is supported by Xu’s (1999) study on literacy education in Chinese immigrant families suggesting that siblings sometimes play the role of parents to provide support for Chinese kindergarteners’ development of literacy ability.

Limitations

A limitation of this study was the composition of the participant students. Only one male student of the total five participants was included in this study due to the composition of the Chinese students at the two research sites. As gender plays an important role in a novice learner’s identity construction and transformation, a different group of Chinese students with
more male students may have a different socializing experience in their science classrooms from what is described in this paper.

Moreover, this study would be stronger if Chinese parents’ perspectives were included. Although multiple sources of data were analyzed and triangulated for the findings, the descriptions of Chinese parents from students and teachers were not validated by the Chinese parents themselves. Future research is needed to investigate Chinese parents’ views on their children’s science education.

The findings of this study are based on five students over a period of 10 and 14 weeks in two public schools. Due to the small sample and relatively short period of time, it is tentative to make generalizations. However, this study still sheds light on Chinese adolescents’ experiences of science learning with in-depth data and contributes to further explain language socialization theory and holds practical implications to meet Chinese students’ needs better and prepare them for success in science learning.

**Implications for Theory and Research**

This study has implications for language socialization theory in several ways. A growing body of literature has investigated how a novice learner progresses from a legitimate peripheral learner to an “old timer” with fuller participation in their L2 socialization. Nevertheless, what novice learners experience when they transform from their L1 community to their L2 community is seldom attended to. In this study, when the Chinese adolescents entered their new school science community, they were very likely to experience a transformation from the center of their L1 community to the periphery of their L2 community. This study calls upon researchers to explore what novice learners experience when they attempt to engage in L2 community and lose
their center positions in the L1 community. Suggestions to make such transformation less frustrating are also needed.

Second, it is important to note that the Chinese adolescents’ socialization in this study is not a bidirectional transformation as found in prior language socialization studies (Duff, 2007, 2010; Ochs, 1990). Without teachers’ acknowledgment of their past learning and cultural experience, the Chinese adolescents did not have a chance to pass the semiotic resources and socializing practices in the Chinese scientific discourse to their NES teachers and peers who were considered as experienced community members (see Figure 7). This unidirectional transformation makes Chinese adolescents lose a chance to tap into their prior knowledge and experiences (e.g., outstanding math skills) to support their current socialization into the new scientific discourse. Meanwhile, their NES counterparts lose a chance of learning and personal growth through cross-culture reflection, and the English scientific discourse remains relatively stable and cannot transform into a more diverse community which is created jointly by newcomers as well as old-timers (Lin & Schwartz, 2003).

\[\text{Figure 7. Language Socialization of Chinese Adolescents in Science Classrooms}\]
Third, it was found that a dilution of the Chinese adolescents’ original identity occurred in the process of gaining membership in the L2 community. The Chinese students underwent a straight-assimilation rather than gaining bilingual and bicultural expertise, which has been advocated for decades (Crawford, 1989; Hakuta, 1986). Numerous studies have reported that language learners’ academic and literacy skills in L1 afford their acquisition of L2, as those skills are transferable from L1 to L2 (Bulter & Hakuta, 2004). Meanwhile, learners’ development and use of L1 are highly affected by their attitudes towards their native language and maintenance of their original identity (Guardado, 2002; Hakuta & D’Andrea, 1992). In other words, the loss of language learners’ L1 identity can defer their L2 acquisition, especially academic L2 skills, which is one of the primary goals of academic L2 socialization. Further studies on how to maintain bilingual students’ expertise and identity in mainstream content classrooms are needed for the sake of a diverse and democratic society.

Finally, this study reaffirms Duff’s (2001, 2003) assumption that L2 socialization is a fluid and non-linear process. Instead of being nurtured by NESs in the community, the Chinese students’ socialization was more likely to be facilitated by other relatively experienced ELLs or their siblings who were considered as more approachable and efficient resources. Moreover, Chinese parents played a crucial role in their children’s socializing process, even though they were neither experts nor experienced learners in the community. For example, the Chinese parents in this study substantially influenced their children’s planning and choices of college majors. Particularly for Chinese students’ academic language socialization, interactions with non-community members such as their parents may need to be taken into consideration in future research. Topics include how Chinese parents impact their children’s preparation and transition into college and career and in what way.
Implications for Practice

This study explores the unique affordances and constraints to Chinese adolescents’ learning of science in the U.S. In contrast to the model minority stereotype, this study suggests that Chinese students cannot achieve academic success and emotional well-being by themselves, and do need extra attention and support from teachers and other school personnel to foster their engagement and success in their science classrooms. This study offers a number of implications on pedagogical interventions to better promote Chinese students’ learning of science in U.S. secondary school settings.

First, teachers need to be aware of the Chinese students’ funds of knowledge and tap into their past experiences and knowledge as learning resources. For example, teachers can allow Chinese students to learn science through doing math problems and share their math skills with other students in the classroom. This will also help Chinese students to value their own background knowledge and maintain aspects of their identities they may hold dear.

Second, teachers and NES students also need to understand that Chinese students’ in-class silence is not a representation of nonattendance and resistance. Rather, Chinese students actively participate in class in a variety of ways, even if they do not speak up. Teachers can volunteer to provide extra guidance and support to Chinese students after class through one-on-one interactions in case some Chinese students do not seek help when they encounter a challenge.

To promote in-class participation of Chinese students, teachers can create more opportunities for triadic dialogues. As a way to interact with the teacher as a whole class, triadic dialogue helps Chinese students to avoid the risk of “losing face” for their accented English. Also, teachers and administrators need to encourage Chinese students to participate in a variety
of extracurricular activities. With more opportunities to interact with both NES and NNES peers, Chinese adolescents will not only be more confident to speak and collaborate with others in their classrooms but face an easier socialization into colleges where more autonomy and social interactions will likely bode well for their academic and social success.

Moreover, explicit explanation on vocabulary and background information also helps to enhance Chinese students’ understanding of scientific concepts. When they implement laboratory activities, teachers should clarify the purposes, goals, and directions of these activities. This will benefit all students, but particularly ELLs who have lesser exposure to and resources of Western classroom practices.

It is important for both school administrators and teachers to have professional development opportunities on culturally-responsive instruction and practice. Co-teaching and planning meetings should be arranged for mainstream and ESL teachers to better support their ELL students’ learning needs.

Both school administrators and teachers need to be provided with opportunities for professional development on culturally-responsive instruction and practice. Co-teaching and planning meetings should be arranged for mainstream and ESL teachers to better support their ELL students’ learning needs.

As Chinese parents are intensively involved in their children’s learning, effective communications between school personnel and these parents are necessary. School personnel can offer orientations and workshops for Chinese parents to explain the educational system in the U.S. as well as their missions, goals, and expectations of students. Schools personnel can also contact and collaborate with local Chinese organizations such as Chinese churches to promote communications with Chinese parents and bridge the understanding gaps.
Appendix A. First Student Interview Protocol

Interviewee/Grade: _________________________               Date________________________

1. Tell me a little about yourself as a student
   a. How do you think your teachers perceive you – (a good student, bad student, etc.)?
   b. How long have you been studying in the U.S.?

2. What kinds of things does your teacher use (e.g. powerpoint, textbook, handouts, etc.) in your Chinese and American science classrooms? Do you notice any difference?
   a. What kinds of resources do you think are effective to help you learn? Can you give me an example?
   b. What kinds of resources do you think are not very helpful for you? Can you give me an example?

3. What kinds of things does your teacher do (e.g. lecture, student discussion, etc.) in your Chinese and American science classrooms? Do you notice any difference?

4. Tell me about the tasks (e.g. writing, hands-on activity, group discussion, collaborative project, etc.) you were required to complete in your Chinese science classroom. What is different in your American science classroom?

5. In your opinion, what kinds of tasks help you learn, and what kinds of tasks do not or even hinder your learning? Why?
   a. In your opinion, of those tasks you did in China, what helped you learn? Can you give me an example?
   b. In your opinion, of those tasks you did in China, what did not help you learn? Can you give me an example?
   c. In your opinion, of those tasks you did in America, what helped you learn? Can you give me an example?
   d. In your opinion, of those tasks you did in America, what did not help you learn? Can you give me an example?
6. What do you think you should and were expected to do as a student in your Chinese science classroom? What do you think you should and are expected to do as a student in your American science classroom?

7. Please describe what you will be interested in doing in your future. How has your experiences in your Chinese or American science classroom influenced your aspiration?

8. What do your parents expect at you with regard to your performance in science? How do you know that?

9. Is there any other things you would like to tell me about your experiences as a student in China and the U.S.
Appendix B. Second Student Interview Protocol

Interviewee/Grade: _________________________               Date________________________

1. If you had to choose a particular experience that helped you learn science – what would you choose? Please describe this experience

   a. What kinds of resources (e.g. handouts, writing prompt, feedback, etc.) were you provided?

      i. What was helpful about these resources with regard to learning science?

   b. What kinds of tasks were you required to complete?

      i. What was helpful about these tasks with regard to learning science?

   c. What things did your teacher do (e.g. lecture, ask you to work with your classmates, etc.)?

      i. What was helpful about what your teacher did with regard to learning science?

   d. What is similar or different about this experience and your experiences studying science in China?

2. If you had to choose a particular experience that did not help you learn science – what would you choose? Please describe this experience (What were you expected to do?)

   a. What kinds of resources (e.g. handouts, writing prompt, feedback, etc.) were you provided?

      i. What was not helpful about these resources with regard to learning science?

   b. What kinds of tasks were you required to complete?

      i. What was helpful about these tasks with regard to learning science?
c. What things did your teacher do (e.g. lecture, ask you to work with your classmates, etc.)?

   i. What was not helpful about what your teacher did with regard to learning science?

d. What is similar or different about this experience and your experiences studying science in China?

3. Tell me about a time you really enjoyed science class.

   a. What was enjoyable about it?

4. Tell me about a time when you felt really good about yourself as a learner in science class.

5. Is there any other things you would like to tell me?
Appendix C. Teacher Interview Protocol

Interviewee/Subject: _________________________               Date________________________

1. What is your name? What subject do you teach? How long have you been teaching <participant student>?

2. What kinds of resources (e.g. powerpoint, textbook, handouts, etc.) do you provide to students in your class? Anything special for [participant name]?

3. What modes of instruction or resources (e.g. textual, visual, audio, multimodal, etc.) do you provide to students in your class? Do you provide anything special to [participant name]?

4. What kinds of resources do you notice are effective to help [participant name] learn science, and what kinds of resources are not helpful?

5. Tell me about the tasks (e.g. writing, hands-on activity, group discussion, collaborative project, etc.) students are required to complete in your class. Is [participant name] required to complete anything different?

6. Do you notice any challenge that [participant name] experienced when completing these tasks, and what are they? What kinds of support and help do you offer to him/her?

7. What kinds of tasks do you notice help [participant name] learn?

   a. What kinds of tasks are not helpful for his/her learning? Why?

8. How do you perceive <participant student> as a student in your class (e.g. active participation)

9. What else have you noticed regarding his/her learning for your subject? Is there anything interesting to you?
Appendix D. Background Information Questionnaire

Name: ______________________________________

Age: ______________

Gender: Male ____ female ____

Residence in U.S.: _______ years/ months/ weeks

Contact information: ___________________________

What types of schools have you attended in the past?

- Pre-school/Kindergarten  Public ____ Private ____
- Elementary School  Public ____ Private ____
- Middle School  Public ____ Private ____
- High School  Public ____ Private ____

In what language(s) did you learn science in the past? __________________________

At what age did you start taking classes in science in China? ________

What science topics did you study in China?

- Biology  Yes ____  No ____
- Physics  Yes ____  No ____
- Chemistry  Yes ____  No ____
- Earth Science  Yes ____  No ____

At what age did you start taking classes in science in the United States? ________

What science topics have you studied in the United States?

- Biology  Yes ____  No ____
- Physics  Yes ____  No ____
- Chemistry  Yes ____  No ____
- Earth Science  Yes ____  No ____

Do your parents speak, understand, read, or write in English? Yes ____  No ____

What does your father do for his work? ________________________________

What does your mother do for her work? ________________________________

In what language(s) do your parents encourage you to read and write about science?

______________________________________________________________________
What language(s) do you speak, read, or write at home? _________________________

What language(s) do you use with your friends? _______________________________

When you read about science outside of school is it in English?
Yes ____  No ____  If another language which one(s) _________________________

How important to your parents is your science achievement?
Not very important _______  Somewhat important ____  Very important _____

How important do you think science is for your future work or college?
Not very important _______  Somewhat important ____  Very important _____
**Appendix E. Classroom Observation Protocol**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Teacher:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject:</td>
<td>Settings (grade level, topic, class size, noise level, lighting, etc.):</td>
</tr>
<tr>
<td>Class agenda</td>
<td>Focal student’s interactions (student-student/ student-teacher, pair/ group, group members):</td>
</tr>
<tr>
<td>Focal student’s use of scientific discourse:</td>
<td></td>
</tr>
<tr>
<td>Linguistic/ extralinguistic resources</td>
<td>Instructional practices</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Memo:
### Appendix F. Codebook

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student background</strong></td>
<td>Background information of Chinese students such as prior learning experiences, period of residence in the U.S., family SES, etc.</td>
</tr>
<tr>
<td><strong>ethnic stereotype</strong></td>
<td>Students’ and other community members’ stereotype of ethnical groups</td>
</tr>
<tr>
<td><strong>Parents involvement</strong></td>
<td>Parents’ involvement and investment on their children’s education, especially science education</td>
</tr>
<tr>
<td><strong>School contexts</strong></td>
<td></td>
</tr>
<tr>
<td>accommodation to ELLs</td>
<td>Extra support, services, and test accommodations provided to ELL students</td>
</tr>
<tr>
<td>curriculum.content</td>
<td>Content of the curriculum such as topics and projects</td>
</tr>
<tr>
<td>instructional practice</td>
<td>Instructional practices in science classroom</td>
</tr>
<tr>
<td>learning requirements</td>
<td>Expectations of students’ learning outcome</td>
</tr>
<tr>
<td>school environment</td>
<td>Teaching and learning climate of schools</td>
</tr>
<tr>
<td>st attitude towards learning context</td>
<td>Students’ perspectives on the teaching and learning climate of schools</td>
</tr>
<tr>
<td>teacher characteristics</td>
<td>Perspectives on the features and qualifications of teachers</td>
</tr>
<tr>
<td>teacher collaboration</td>
<td>Collaborative among faculty to support ELLs’ learning</td>
</tr>
<tr>
<td><strong>Semiotic resources</strong></td>
<td></td>
</tr>
<tr>
<td>affordance of learning resources</td>
<td>How do learning resources support Chinese students’ learning of science</td>
</tr>
<tr>
<td>constraints of learning resources</td>
<td>How do learning resources constrain Chinese students’ learning of science</td>
</tr>
<tr>
<td>difference between US and Chinese classrooms on resources</td>
<td>Difference between science teaching and learning in China and the U.S. regarding learning resources</td>
</tr>
<tr>
<td>learning resources</td>
<td>The types of learning resources provided in science classrooms</td>
</tr>
<tr>
<td>use of learning resources</td>
<td>How learning resources are used in classrooms (e.g., to clarify new vocabulary, to give examples)</td>
</tr>
<tr>
<td><strong>Socializing Practices</strong></td>
<td></td>
</tr>
<tr>
<td>affordance of tasks</td>
<td>How do classroom practices support Chinese students’ learning of science</td>
</tr>
<tr>
<td>classroom tasks.hw</td>
<td>The types of classrooms tasks and homework that Chinese students are engaged in</td>
</tr>
<tr>
<td>constraints of tasks</td>
<td>How do classroom practices constrain Chinese students’ learning of science</td>
</tr>
<tr>
<td>difference between US and Chinese classrooms on practices</td>
<td>Difference between science teaching and learning in China and the U.S. regarding classroom practices</td>
</tr>
<tr>
<td>Implementation of tasks</td>
<td>How do teachers implement tasks in science classroom (e.g., give writing tasks in a project)</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>Type of learning strategies that Chinese students employ to support their learning of science</td>
</tr>
<tr>
<td>Participation</td>
<td>Chinese students’ participation in science classrooms</td>
</tr>
<tr>
<td>Student positionality in community of school science</td>
<td></td>
</tr>
<tr>
<td>Student positionality in community of school science</td>
<td></td>
</tr>
<tr>
<td>Attitude toward science learning</td>
<td>Chinese students’ interest and motivation science learning</td>
</tr>
<tr>
<td>Interaction with others</td>
<td>Chinese students’ interaction with other community members within the context of science classroom</td>
</tr>
<tr>
<td>Positioning by teacher</td>
<td>How are Chinese students positioned by their science teachers as science learners</td>
</tr>
<tr>
<td>Self-positioning</td>
<td>How are Chinese students positioned by themselves as science learners</td>
</tr>
<tr>
<td>Student career goal</td>
<td>Students’ plan and preparation for college and career</td>
</tr>
</tbody>
</table>
Appendix G. Categories of Writing

The categories of function refer to the way the language is used in a piece of writing. Below are four main categories of function and a brief description of each based on the CCSS for literacy in history/social studies, science, and technical subjects, work of Lemke (1994), and work of Applebee (1981).

Arguments: Tasks that require students to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. To complete this type of tasks, students need to (a) introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence, (b) develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns, (c) use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims, (d) establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing, and (d) provide a concluding statement or section that follows from and supports the argument presented.

Informative/explanatory texts: Tasks that require to students to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. To complete this type of tasks, students need to (a) introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g.,
figures, tables), and multimedia when useful to aiding comprehension, (b) develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic, (c) use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts, (d) use precise language and domain-specific vocabulary to manage the complexity of the topic, (e) establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing, and (f) provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

**Mathematics**: Tasks that require students to use specialized mathematical symbolisms (e.g., diagrams, numbers, mathematical formulas, algebraic symbolisms) to make meanings about addition, subtraction, multiplication, and division; about numerical difference and equality; about geometrical relationships of parallelism, orthogonality, similarity, congruence, and tangency.

**Visual representations**: A variety of visuals and graphic components (e.g., tables, graphs, diagrams) to present, deliver, and explain scientific terminologies and concepts.

**Mechanical Writing**: Tasks which require written responses but that do not require the writer to organize text segments of more than a paragraph length. Subcategories include: Multiple-choice exercises, fill-in-the-blank exercises, short answer exercises, transcription from written material (copying) or oral material (dictation), translation.
References


Ochs & B. B. Schieffelin (Eds.), The handbook of language socialization (pp. 1-21).

literacies through images. In L. C. de Oliveira (Eds.), The Common Core State Standards
in literacy in history/social Studies, science and technical subjects for English language
learners: Grades 6-12 (pp. 91-106). MD: TESOL Press.

college students: Additional evidence on college experiences and outcomes. The Journal


of science teacher education, 25(2), 145-156.

Qin, W., & Uccelli, P. (2016). Same language, different functions: A cross-genre analysis of


Wilcox, K. C., & Yu, F. (2017). Writing to achieve the Common Core State Standards in science for ELLs. In L. C. de Oliveira (Eds.), *The Common Core State Standards in literacy in*
history/social Studies, science and technical subjects for English language learners:

Grades 6-12 (pp. 75-90). MD: TESOL Press.


