"These Questions are Kind of Weird": Bilingual Learners' Experiences with Large-scale, Standardized, Science, Technology, and Engineering Items

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# Boston College

# Lynch Graduate School of Education

Department of Teacher Education, Special Education, and Curriculum and Instruction

## Curriculum and Instruction

# "THESE QUESTIONS ARE KIND OF WEIRD": BILINGUAL LEARNERS' EXPERIENCES WITH LARGE-SCALE, STANDARDIZED, SCIENCE, TECHNOLOGY, AND ENGINEERING ITEMS

### Dissertation

by

# STEPHANI A. BURTON

submitted in partial fulfillment of the requirements

for the degree of

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### Abstract

The nation's rapidly increasing bilingual student population has heightened the urgency behind longstanding policies and initiatives established to address systemically marginalizing education practices across academic fields, often through the use of standardized assessments. This qualitative case study explores the role of language in six fifth-grade BLs' experiences interacting with large-scale, standardized, science, technology, and engineering (STE) open response items from a state assessment administered in English. Using student and teacher interviews, this study examines the opportunities available for BLs to display their science, technology, and engineering content knowledge when limited and specific modes of communication are validated as acceptable responses.

This study draws on sociocultural theoretical research to understand the languagecentered context of a state STE assessment and uses this perspective to examine the assessment as a language-based, "communicative tool" (Albert, 2000, p.2 or "communicative event" (Shaw, Geaney, & Bunch, 2010, p.914). The findings show that the assessment's linguistic structures complicate bilingual learners' interpretations of the open response text and ultimately reveal why these standardized measures fail to measure what bilingual learners actually know.

# DEDICATION

To the "Burton Bunch" and the forerunners.

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# CHAPTER ONE INTRODUCTION Statement of the Problem

The U.S. Department of Education (USDOE) has instituted education policies and initiatives to monitor the academic disparities existing between bilingual learners (BLs) and their monolingual peers from dominant cultural backgrounds. The nation's rapidly increasing bilingual student population has heightened the urgency behind longstanding policies like The Elementary and Secondary Education Act (ESEA), established to address systemically marginalizing education practices across academic fields, often through the use of standardized assessments.

In a recent report, the USDOE expressed the specific need to "broaden participation" among those who are historically and substantially underrepresented in the science, technology, engineering, and mathematics (STEM) fields (Holdren, Marrett, & Suresh, 2013). The department relies, in large part, on standardized STEM test score data to inform the call for broadened participation among marginalized groups. Arguably, while there is urgency for the call, the use of test score data to substantiate it may prove problematic because many states struggle to administer standardized STEM assessments that accurately measure BLs' STEM content knowledge. A growing body of literature documents this dilemma and describes some of the ways STEM assessment data can misrepresent BLs academic knowledge and abilities (Bunch, Shaw, & Geaney, 2010a; Kachchaf, 2014a; R. J. Kopriva, Emick, Hipolito-Delgado, & Cameron, 2007; R. J. Kopriva, Wiley, & Emick, 2007; Noble et al., 2012a; Noble, Rosebery, Suarez, Warren, & O'Connor, 2014; Shaw, Bunch, & Geaney, 2010a; Winter, Kopriva, Chen, & Emick, 2006; Wolf, Kim, & Kao, 2012a).

At first glance, "test score gaps" (Noble et al., 2014) found between bilingual and monolingual learners seem to suggest that BLs are less proficient in their acquisition of STEM content knowledge. But researchers raise concerns about the use of English in the administration of STEM assessments when many test takers are not yet proficient in the language (Kopriva, Wiley, & Emick, 2007; Noble et al., 2012; Noble, Rosebery, Suarez, Warren, & O'Connor). Research findings challenge the validity of BLs' test scores on large-scale standardized STEM assessments administered in English and suggest that BLs' test scores are only measures of their ability to use English to communicate their understanding relevant to the test (Christie & Martin, 2005; Martiniello, 2009; Wolf et al., 2012a).

The research in this area establishes that BLs' test scores cannot be accepted at face value and examines the impact of the tests' linguistic features. Though the scores themselves are not accurate measures of BLs' STEM content knowledge, the qualitative data and the contexts associated with these quantified scores can help educators, policymakers, and researchers better understand the role of language in BLs' experiences engaging with these test items. In other words, the trends in BLs' STEM test scores are indicative of a broader systemic and contextual issue. This in-depth qualitative analysis explores the experiences that reveal what these scores do represent and why these standardized measures fail to measure what BLs actually know.

#### **Purpose of the Study**

The primary purpose of this qualitative study is to explore the role of language in fifthgrade BLs' experiences interacting with large-scale, standardized, science, technology, and engineering (STE) open response items from a state assessment administered in English. This qualitative study uses established theories and methods in the field of education research to understand how language impacts BLs' understanding of and engagement with open response items from a state-administered STE assessment. This study also aims to understand the opportunities available to BLs to display their knowledge of STE concepts when certain modes of communication are validated as acceptable responses to STE test items.

An additional purpose of this study is to build on prior research that examines BLs' experiences with STEM assessments in English. There is a growing body of qualitative and quantitative research in this field of study. This body of literature establishes a foundation for the purpose of this study by identifying concerns about the data collected from STEM assessments administered to BLs in English. This study acknowledges the issues highlighted in prior research and emphasizes the sociocultural contexts in which they manifest.

This study draws on sociocultural theoretical research in order to understand and account for the language-centered context of the state's STE assessment items. This study uses these perspectives in ways that frame the STE assessment as a language-based, "communicative tool" (Albert, 2000, p.2) or "communicative event" (Shaw, Geaney, & Bunch, 2010, p.914) where language plays a critical role in what and how information is communicated between the test and the test taker.

This study also draws on prior research and relevant theory to understand how the sociocultural context impacts BLs' responses and to reframe narratives that use broad-scale "descriptive statistics" to "constitute deficit-oriented, uncomplicated, and uneven narratives about students for whom English is a second language" (Gutiérrez & Faulstich Orellana, 2006, p. 502).

#### **Research Questions**

This study draws on sociocultural theoretical perspectives to identify and describe the education issues around language and the STE assessment. Therefore, the research questions that

guide this study are a reflection of sociocultural perspectives on language, STE assessments, and the assessment context. The state intends for the STE assessment referenced in this study to measure STE content knowledge specifically. However, the sociocultural frame includes and emphasizes the role of *language* in communicating STE concepts to BLs and BLs' use of language when constructing knowledge and exhibiting their understanding of the STE concepts being assessed. Therefore, the sociocultural frame challenges the assertion that test score data only measure STE content knowledge.

The research questions in this study focus on the centrality of language that is inherent in the open response items' design. The research questions aim to understand how students with multilingual means of communication and backgrounds interpret and interact with monolingual test items (test items that reflect one language's symbolic representations and cultural expectations for use).

In the test-taking context, a monolingual English perspective is central and normalized. The test is administered in the English language and anticipates that students will respond in English. BLs sometimes receive accommodations, but alterations to test administration are seen as an authorized digression from the norm (Abedi, Hofstetter, & Lord, 2004). Though the monolingual *English* perspective is a critical and significant aspect of the assessment discussed in this study, this key feature is often only implicitly evident because the assessment's linguistic features are shrouded by the prominence of the STE label. It is within this sociocultural frame that the following research questions are explored:

Research Question 1 (RQ1): What do fifth-grade BLs' (a) written responses and (b) oral thought processes communicate about their understanding of STE concepts included in STE open response items?

Research Question 2 (RQ2): What do fifth-grade BLs'(a) written responses and (b) oral thought processes communicate about their understanding of the STE assessment? Research Question 3 (RQ3): What do teachers' observations reveal about BLs' experiences responding to STE open response test items?

The research questions include concepts about communication in relation to BLs' experiences taking the assessment. Collectively, the questions also set parameters for the study by including the data sources (oral thought processes, written responses, and observations) valued and deemed necessary to answer the questions posed. In line with the sociocultural concept that "children are active subjects who create specific funds of knowledge and identify themselves through their social interactions and transactions," (Esteban-Guitart & Moll, 2014, p.73), the research questions intentionally draw on the experiences described by students and teachers because they have relevant and lived experiences interacting with STE content and assessments.

RQ1 aims to identify BLs' understanding of the STE concepts included in a selection of archived, previously administered STE open response items through BLs' written responses and oral communication about their thinking. The purpose of this question is to gather information about BLs' knowledge of STE concepts using different modes of communication. Opportunities to communicate STE knowledge orally and in several different languages can reveal more than the written mode of communication, which is the only one permitted when responding to the open response items.

RQ2 relies on BLs' written responses and oral descriptions of their understanding to explore how they view the STE assessment. This includes BLs' perceptions of the linguistic rules, structures, and expectations required to effectively understand and respond to the open response items. For example, an open response item may use a narrative to communicate information about STE concepts not typically encountered in a narrative form, followed by a prompt to assess BLs' STE content knowledge. BLs' responses to a prompt that follows this atypical use of the narrative form may reveal how assessments employ the use of different genres to target STE content knowledge. It may also show that some BLs will literally interpret this type of text as a narrative that requires a response about the story's plot, characters, or themes instead of the STE content knowledge it targets (Brisk, 2014; Christie & Martin, 2005). This question also aims to understand how BLs believe they are expected to display and communicate knowledge to an ambiguous or unidentified audience.

The last research question, RQ3, examines teachers' observations of their BLs responding to the STE open response items. This includes teacher interview data that contextualizes BLs' experiences responding to and discussing the open response items. Overall, this research question helps frame the context in which BLs experience the complex features of the STE assessment by exploring teachers' observations of BLs through their written records and interview data.

As a cohesive network of inquiry, these three research questions explore BLs' experiences taking the STE exam with the understanding that language is central to the assessment's administration and that the exam is a communicative event. With a foundation established on the sociocultural theoretical perspective, the research questions in this study are posed to gather data about BLs' experiences that can offer an alternate and more comprehensive perspective from that of the dominant narrative.

#### **Importance of the Study**

Many studies have focused on students' STEM content knowledge using data from assessments administered in English. Oftentimes, such studies make comparisons between the BLs' scores and those of monolingual English speakers, assuming that BLs possess less STEM content knowledge since "ELLs are among the lowest-scoring groups in both national and state assessments" (Martiniello, 2008). Some studies have challenged the presupposition that these test scores accurately reflect students' mastery (Martiniello, 2008) and the dominant narrative these assumptions help to establish (R. J. Kopriva, Wiley, et al., 2007; Martiniello, 2009; Shaw, Bunch, & Geaney, 2010b). These studies provide an alternate perspective on the data gathered by examining monolingual English STEM assessments and critiquing them as valid tools of measurement.

This study builds on this body of research to further develop this emerging perspective. The assessment and portrayal of BLs in education and academic literature can have a profound impact on their education experiences and the opportunities made available to them in future years. We see this echoed in education policies and initiatives like the No Child Left Behind Act (NCLB), and now the Every Student Succeeds Act (ESSA). Through ESSA, the USDOE intends to inform schools on "how to meet the needs of disadvantaged students, children with disabilities, and English learners, the needs of low-performing schools, and other educational needs of students" (ESSA, 2015). ESSA (2015) requires that "English learners" be "assessed in a valid and reliable manner and provided appropriate accommodations on assessments administered to the extent practicable."

Although now there is empirical evidence to support the argument that this mandate has not been fulfilled, the test score data have been and can still be used to determine whether students graduate, teachers keep their teaching positions, and schools remain open (Abedi, Hofstetter, & Lord, 2004; Menken, 2009). The "high-stakes consequences of policies like NCLB are particularly problematic, causing [BLs] and the schools that serve them to be more vulnerable to punishment" (Menken, 2010, p. 121). These consequences have strong implications and in many cases the stakes for BLs can be higher than those of their monolingual peers (Abedi, Hofstetter, & Lord, 2004; Menken, 2009).

The dominant narrative relies heavily on inadequate test score data to simplistically characterizes BLs' as disengaged and underachieving in the research on the assessment of BLs' (Gutiérrez & Faulstich Orellana, 2006). As a result, the research often poses equally simplistic "solutions" to increase participation in STEM subjects and to increase BLs' test scores. This study examines the linguistic aspects of the sociocultural context that frames one high-stakes STE assessment to acknowledge the complexity of BLs' experiences and to influence the development of substantial and necessary change.

#### **Theoretical and Conceptual Framework**

There are many prominent theoretical perspectives that examine language, and more specifically, second language acquisition (Snow, 1992). Some of the most established are the developmental perspective, the psycholinguistic perspective, English as a Foreign Language, and sociocultural theory (SCT) (Snow, 1992). Each of these perspectives has had a significant impact on the literature and research on language and bilingualism in education research. The developmental perspective, the psycholinguistic perspective, and EFL came to prominence through research and theories that embrace and normalize the English language and monolingual English-speakers' experiences acquiring language proficiency in English (Snow, 1992). In

monolingual English-speakers' experiences as the standard and target for "nativelike" proficiency and omitting the role of culture and context in shaping language as a social act.

SCT, on the other hand, does not presume that English proficiency is the norm or that use and acquisition of languages other than English occurs in the peripheries of communication. Instead, SCT explains that in all cases, social and cultural practices help construct different contexts where language is shared. The social and cultural norms in these different contexts define the different purposes of communication within these contexts. Therefore, SCT asserts that language takes meaning and significance in context and is never neutral or without culture.

Among the prominent perspectives on language, SCT offers a frame that can portray a context where more than one language exists at the center of an individual's experience as illustrated in Figure 1.1. SCT also helps to account for the unique STE testing context examined in this study and helps to explain what happens when different social and cultural features of the context intersect through language. SCT's prominence in the field of education research is far reaching, and many scholars have used and developed the theoretical perspective in many helpful ways. Within the scope of this research, three defining SCT concepts of language inform the development of this study: (1) language is a process, (2) language represents the meanings, values and experiences of the culture it reflects, and (3) language is social (Halliday, 1978; Dworin, 2003, Vygotsky, 1984; Wink & Putney, 2002; Veel, Christie, & Martin, 1997). These three concepts are always situated within a context.

#### Language is a Process

Some of the leading theoretical perspectives (e.g. developmental, psycholinguistic) frame language as the output derived from a set of technical skills or linear cognitive processes (Snow, 1992). Additionally, other theoretical perspectives use the concept of proficiency in second language acquisition to describe an exactness of language use that mirrors "nativelike" (Garcia, 2002; Snow, 1992; Tarone, 2007) speech. By contrast, SCT describes language as a sociocultural engaging *process* (Vygotsky, 1986), where proficiency is displayed through communicative effectiveness and social appropriateness of language use (Snow, 1992). In this process, language begins with thought and thoughts are transformed into words that outwardly manifest in spoken and written communication.

In keeping with these concepts, this study frames BLs' interactions with the STE items as a process influenced by the modes of communication represented in the open response items. The theoretical framework also helps explain how language impacts BLs' construction and communication of the STE concepts present in the open response items.

#### Language Reflects Culture

SCT explains that language is inseparable from cultural practices (Albert, 2012; Dworin, 2003; Vygotsky, 1986). Cultural practices can include shared experiences or shared meanings of a particular concept or word within a community of people. This concept also aligns with the idea that language intersects with identity. It influences the ways speakers identify as individuals and as a part of the culture that contributes to the form and use of a given language. This is a critical concept to the study because BLs navigate at least two national languages and several cultural traditions within their use of language (e.g. how to address an audience, how to present knowledge in school) when interpreting the communicative event experienced through the STE open response items. Culture norms and expectations manifest across the contexts BLs navigate when responding to the open response items. Reflections of culture are evident in BLs' personal experiences outside of school, the Ascension Middle School context, and even the context of the standardized assessment.

### Language is Social

The third SCT concept that is significant to this study is the idea that language develops through interpersonal and intrapersonal relationship(s). Vygotsky (1986) describes the "two planes of speech" which consist of "both the inner, meaningful semantic aspect of speech and the external, phonetic aspect," each governed by a different set of "laws" (p. 125). Inner speech occurs as the individual relates to the self. External speech allows the individual to relate to someone else. This concept is reflected in this study because students they must engage in inner speech to make sense of the test item before engaging in external speech by developing their written responses for an outside (ambiguous) audience. The social nature of language is also a particularly important part of this study because it helps to understand the hierarchies of language that can exist in social spaces where more than one language is represented. Socially, if one language is preferred or established as the normative or dominant language, it can influence the way speakers use both the dominant and marginalized language. This is relevant to the study because BLs and the languages they possess are positioned on one end of a communicative event and a monolingual English STE exam exists on the other, but only one language is acknowledged in the representation of external speech. The STE exam only uses and accepts communication in English; it therefore establishes a social hierarchy among all languages present in the communicative event. Within this hierarchy, English receives preference and BLs' first language becomes the "other", and is silenced. The elevation and subordination of languages is a social dynamic relevant to the study because it impacts the language(s) that can be represented in the STE test data and can diminish the presence of BLs' first language in the STE test taking process.





### Looking Across the Key Concepts

This study uses the three pertinent SCT concepts. It is important to recognize that these three concepts do not manifest themselves in isolation or distinct instances. Each SCT concept described impacts the use of language in this study. In lived experiences, they are integrated and exhibited as the contextualized and sociocultural process that is language.

#### **Researcher Positionality**

Social scientists understand researcher positionality as a central component "in the process of qualitative... data collection," and the "dynamic between researcher and participant" (Ganga & Scott, 2006). My positionality as a researcher in this study is rooted in my personal and professional education experiences, which influences the way I design, conduct, and make

analyses in this study. Furthermore, my beliefs and perspectives are linked inextricably with the study's development.

In my personal education experience, beginning in preschool and continuing through high school, I attended heavily resourced schools in an affluent, predominantly-white school district with firm rules about belonging and academic success. As a first-generation, black female student, I understood how these rules positioned me in relation to my peers. On the other hand, it took time for me to understand the implications of my positioning and to develop my understanding of education, its purpose, and the requirements for success.

In my family, education meant relief. It offered access, opportunity, and fulfilled promises beyond our community's grasp, but never without cost or negotiation. I wanted to be transformed by my "American education" but still reflect my own heritage, my home, and my community. Like many students from non-dominant cultural backgrounds living in America, I had to choose. For me, academic success required assimilation. As a young student, I began making these cultural negotiations. I did not want my value or academic abilities to be assessed based on how well I could hide my socioeconomic status or minimize the significance of my racial identity but I recognized that my academic learning environment left little room to reveal these cultural aspects of my lived experiences. Though it was costly, assimilating addressed some of my most urgent needs and I considered my education something stable on which I could rest my hopes.

In education research, attitudes toward and decisions about assimilation are often characterized dichotomously (DaSilva Iddings & Moll, 2010). Decisions to assimilate are typically equated with a positive attitude toward the dominant culture, while the maintenance of one's own cultural practices, absent of assimilative ones is seen as resistance and sometimes even defiance (Dworin & Moll, 2006; Gutiérrez, Baquedano-López, & Tejeda, 1999). In my personal experiences, assimilating was more complex. I accepted the conditions I believed academic success required because the thought of not living a life that reflected my humanity and worth seemed unbearable. I made the choice to assimilate knowing my culture and experiences were valuable to me, but not always valued within my academic environment. I believed that I needed to present the value I already possessed in ways that even prejudiced and marginalizing systems around me might acknowledge. I adopted practices from a culture outside of my own and silenced some of my personal experiences. The choice for me was not about what was right or wrong, or conceding or resisting. It was about necessity and the reality of my situation.

This gray area is not often captured in the research around the intersections of school and cultural practices. This study takes place within a national context where students are expected to assimilate their linguistic practices to display knowledge in valued and acceptable ways. My positionality as a former student who grappled with similar expectations leads me to believe that BLs may describe their experiences, rationale, and thinking in ways that *could* be sorted into the dichotomies established in existing research, but would be more appropriately understood as complex negotiations impacted by the demands of the academic context.

In my professional experience, I taught in under-resourced public schools in economically disadvantaged communities. The majority of my students were first-generation, bilingual, students of color. I observed the intersections of my students' experiences with the school's expectations and demands. As teachers, my colleagues and I participated in collaborative teacher inquiry to plan and implement culturally relevant instructional practices that addressed a range of students' needs. There was a need to transform marginalized students' education experiences and advocate for the engagement of their cultural and personal experiences in rigorous academic settings. When we spoke on behalf of our students, stakeholders positioned to influence our students' education experiences, often dismissed our contributions or qualified them as "biased." We were often speaking out, but we were rarely heard. In response, I made the difficult decision to pursue this work outside of my role as a teacher. I had to let go of the role I worked so hard to fulfill and trust that I could have an acknowledged and more effective voice as an advocate and activist through education research. I designed this study in pursuit of this goal.

### **Definition of Terms**

A set of terms used in this research requires explicit descriptions of their conceptualizations to understand the research perspectives that influence this study. In this study, the following terms describe students, teachers, the STE exam, and the language the exam includes respectively: bilingual Learners (BLs), teacher researcher, communicative event, and academic language. The descriptions provided below reflect the study's sociocultural context in relation to the terms. These descriptions acknowledge the ways traditional academic and research settings position and characterize participants and language but examine these positions and characterizations using a SCT frame.

The term *bilingual learner* refers to students who are developing proficiency in at least two languages. This term's broad definition intends to make room for the diversity of a demographic group often described as one that is homogenous (Grosjean, 1982; Proctor & Silverman, 2011). The context around the term gives depth to this definition and is used to tailor the definition to this study. The BLs this study refers to are acquiring English as their second language in U.S. school systems where laws and practices establish the centrality and dominance of English. Valued and recognized participation in these systems occurs in English (though individual classrooms may challenge this precedent). In some instances, the terms English Language Learners (ELLs) or English Learner (ELs) appear in citations that mirror the language of policy documents like NCLB, ESSA, and state law. These terms are used to refer to the same population this study identifies as BLs. Unlike ELL and EL, the term bilingual learner represents an identity that acknowledges both languages the student navigates and recognizes that the languages merge in students' thinking and experiences (Grosjean, 2010). BLs are always equipped with both languages even when they choose to outwardly exhibit the use of one. There is some ambiguity involved in defining the term "bilingual learner" and identifying BLs because some students no longer speak the language they first acquired. From an SCT perspective, students who no longer speak the language they first acquired could still be identified as BLs because the first language they learned is a language they experienced and once used to develop thoughts, experiences, relationships, and identities. BLs' past experiences are not erased by the second language acquired even if the first language is not outwardly spoken. The first language exists in the presence of thought and also in silence.

The terms *teacher and teacher researcher* are used interchangeably because teachers play an important role as active participants in this study. Teachers conduct research in their everyday practice. Though teachers' daily practices may not draw on the customs and culture of the research paradigms lauded in academic education research, they gather unique and rich data relevant to this study on a daily basis. In this study, the term teacher researcher refers to education professionals who inquire into and reflect on their practice, assess BLs' knowledge and understanding, and use data to refine and develop their instructional methods. This study values the data teacher researchers and academic researchers gather and use both as sources of data to answer the research questions.

The term *communicative event* describes the language-centered exchange between BLs and the STE assessment examined in this study. The term comes from Shaw, Bunch and Geaney's (2010) work analyzing the language demands BLs encounter in science performance assessments. These researchers explain how STE assessments that set linguistic expectations for BLs' engagement are fostered through language. Communicative events establish participant structures that determine who is involved in the communicative exchange. According to Shaw et al. (2010), the communicative modes within a communicative event can be interpersonal, interpretive, and presentational. The interpersonal mode describes the communication between the BL taking the test and the audience, while the interpretive mode describes how BLs derive meaning without two-way communication. Lastly, the presentational mode of a communicative event is the type of display required to communicate knowledge and understanding.

The last term described in this section is *academic language*. The term describes an dialect that is typically valued, preferred, and normed in academic settings (Scarcella, 2003; Snow & Uccelli, 2009). Academic language does not fully encompass the conceptualization of language in this study. However, it is important to acknowledge the role of academic language because STE assessment items use academic language and draw on the implicit cultural practices it encompasses to communicate information about the exam and expectations for students' responses. The cultural norms and uses of academic language are sometimes taught explicitly or made explicit in communication. Oftentimes in academic settings, they are implicit (Scarcella, 2003; Snow & Uccelli, 2009). Additionally, relying on academic language and English to measure the content knowledge said to be at the crux of the nation's economic future when there

is a steadily increasing student demographic not yet proficient in the language creates concerns around equitable and just education practices that limit BLs' opportunities for success.

#### **Overview of the Study**

This dissertation includes six chapters that describe this study's purpose and significance, the problem it addresses, and its research questions, methods, findings and conclusions. Chapter 1 describes some of the main issues encountered when using English to assess BLs' content knowledge and frames these issues within the cultural and political context to understand the purpose and importance of the study. It also includes a description of the research questions and definitions for important terms used in the study. Chapter 2 provides an overview of relevant academic literature to provide an empirical foundation for this study. Chapter 3 describes the methods used to explore and answer the research questions outlined in the first chapter. Chapters 4 and 5 present the findings for the study. These chapters include interview, observation, and STE test data and place them within the sociocultural contexts relevant to the study for analysis. Lastly, Chapter 6 includes a summary of the research and a discussion of the findings along with implications and directions for future research.

#### **CHAPTER TWO**

#### LITERATURE REVIEW

#### Introduction

The purpose of this qualitative study is to explore the role of language in fifth-grade BLs' experiences with a large-scale, standardized, science, technology, and engineering (STE) state assessment administered in English. An additional purpose of this study is to build on prior research that examines BLs' experiences taking STEM assessments in English. There is a growing body of qualitative and quantitative research in this field of study. This literature establishes the purpose of this study by identifying concerns about the data collected from STEM assessments administered to BLs in English. This study acknowledges the issues highlighted in prior research and emphasizes the impact of their sociocultural contexts.

For this literature review, I use a SCT framework to analyze a set of studies that examine BLs' experiences taking STEM assessments. This theoretical framework offers a lens to identify and understand the testing contexts and constructs described in this body of literature. The literature analyzed includes studies that examine science, technology, engineering, and mathematics assessments. Research involving mathematics assessments is reviewed because first, there is often overlapping content across both STE and mathematics assessments and, second, there is research relevant to the study, which focuses on BLs' engagement with math assessments.

This review also includes studies that analyze non-standardized assessments. Although the emphasis of this qualitative study is on high-stakes large-scale STE assessments, the research that includes non-standardized STEM assessments offers critical discourse on BLs' experiences. This crucial contribution cannot be captured by the literature on standardized assessments because standardized STEM assessments have strict mandates for implementation, which set limitations on the type of data these large-scale STEM assessments can yield. The nonstandardized STEM assessments described in this small subset of studies allow BLs' to use a broader range of communicative modes and thereby gather a distinct set of data unique from that gathered from standardized STEM assessments. This study uses interviews to supplement the only communicative mode (writing) accepted for open response STE state assessment items; therefore, it is reasonable to include studies that examine assessments that include the data source for the study.

The research on BLs and their interactions with STEM assessments highlight three key concepts across the literature. This research describes (1) the definitions and features of STEM assessments and how they function as communicative events, (2) the definition and functions of language, and (3) the conceptualization of STEM content knowledge. The literature offers pertinent information about each of these three concepts and allows for the identification and analysis of the relationship between these constructs using an SCT framework.

This literature review is divided into four sections. The first section describes the features of the STEM assessments, which includes ideas about STEM assessments as communicative events that also serve as tools of measurement. These STEM assessments have strict rules and customs that determine how test takers can effectively use the assessment as a platform to convey STEM content knowledge. The second section describes the definitions and functions of language. This section examines the significance of language for BLs in the administration of STEM assessments. It offers a description of language as a sociocultural process that encompasses a set of demands which engage or isolate BLs, depending on the testing context. The third section describes the conceptualization of STEM content knowledge. This knowledge base includes beliefs, assertions, and acknowledgments of concepts that are recognized as scientific, mathematical, and objective by a particular culture. To conclude this review, the final section evaluates the three sections previously described and explains how they relate to one another within an SCT frame.

#### **Definitions and Features of STEM Assessments**

This section examines research regarding BLs' experiences taking STEM assessments administered in English to describe the features of various STEM assessments and to contextualize these assessments in research. One of the main ideas established in the literature is the portrayal of STEM assessments as "communicative events" (Shaw et al., 2010b) embedded with a set of customs and practices, designed to measure BLs' STEM content knowledge. In this process, the assessment becomes a platform that can convey specific information or content.

In Shaw et al.'s (2010) analysis of BLs' performance on science assessments, the authors outline the "development and application of an analytical framework" (p. 202) grounded in the SCT perspective. These researchers' framework comprehensively outlines the components of complex performance assessments that also include a discussion of traditional paper and pencil STEM assessments. Thus, this current review of the literature applies the analytical framework offered by Shaw et al. (2010) offer. The framework identifies STEM assessments as communicative events characterized by "participant structures," and "communicative modes" (Shaw et al., 2010b), where each dimension highlights its own set of components. Within this framework, BLs must plan their work, carry out their plan, review their work, and then present it.

#### **Participant Structures**

"Participant structures" are the "rights and obligations of participants with respect to who can say what, when, and to whom" when interacting during an assessment (Shaw et al., 2010, p. 910). Participant structures are established through the STEM assessments' design and specify who the participants are. They can include whole class, small group, pair, or individual work. Each type of participant structure can offer opportunities or challenges for BLs to display their STEM content knowledge. Most studies describe STEM assessments with an "individual work" participant structure where BLs work independently to respond to test items (Kachchaf, 2014; Kopriva, 2011; Kopriva et al., 2007; Kopriva et al., 2007; Llosa et al., 2016; Martiniello, 2008, 2009; Noble et al., 2012; Noble, 2014; Wolf, Kim, & Kao, 2012).

Work independent work uniquely impacts BLs, who are not yet proficient with the English language (the language used to administer the assessment), and their engagement and scores on STEM assessments (Martiniello, 2008; Shaw et al., 2010). Within the individual work participant structure and through interviews, researchers describe BLs' independent thinking and their interpretations of the assessment items. The BLs' explanations of their thinking and rationale for their answers show how the individual work structure sets limitations on BLs' opportunities to seek clarification when formulating their responses to test items (Martiniello, 2008; Noble et al., 2012).

The individual work participant structure introduces ambiguity and restricts opportunities to exchange and clarify information in the STEM assessment. In whole class, small group, or paired assessments, BLs can benefit from cues gathered from meaningful social interactions. These interactions are typically more familiar and easier to interpret than the text typically included in paper and pencil exams. Additionally, live interactions offer more content to gather meaning for sense-making because they include expressions, gestures, and shifts in tone (Shaw et al., 2010b).

Whole class, small group, and paired participant structures also provide opportunities to clarify through back-and-forth exchanges. At the same time, however, these group interactions are still complex and governed by a set of rules that may present challenges for BLs, especially when they are only allowed to communicate using English (Llosa et al., 2016; Martiniello, 2008; Shaw et al., 2010b). Although these social interactions are complex, they may offer opportunities for BLs' success on STEM assessments because they closely resemble the classroom learning environment, which is more familiar than the type of participation promoted by traditional large scale standardized STEM assessments.

Across participant features, studies show how these structures determine who can effectively participate in the STEM assessment (Clark-Gareca, 2016; Llosa et al., 2016; Lyon, Bunch, & Shaw, 2012; Shaw et al., 2010). A major distinction highlighted in participant modes in the literature is that the individual participant structure is somewhat static. The text BLs read is fixed, though it does have implicit nuances that give it shape, depending on how the reader interprets it. Noble et al. (2012) explain that, "large-scale tests are produced as part of a sociocultural activity" and although they are "fixed" texts, they involve "expectations on the part of test-developers about the roles test-takers will play, that is, how test-takers will interpret particular uses of language and other representational forms, what knowledge they will use, how they will reason, in short, how they will act" (p. 781). The participant structures that allow BLs to engage with a real partner or audience allow interactions to shift in response to the information communicated by BLs, their peers, and their classroom communities. These participant structures immensely influence BLs' experiences and responses to the STEM assessment. Unfortunately, the participant structures that offer more meaningful interaction and more opportunities for BLs' success are not the participant structures included in high-stakes, largescale assessments (Lyon et al., 2012; Martiniello, 2008; Noble et al., 2012; Shaw et al., 2010).

### **Communicative Modes**

"Communicative modes" describe the "range of productive and receptive language demands" (Shaw et al., 2010, p.914) BLs encounter on STEM assessments. These communicative modes include interpersonal, interpretive, and presentational components. They describe the different ways BLs can communicate with their audience, based on the parameters set by the assessments' norms. Some studies describe this as the communicative means that determine how the test taker can communicate the specific and targeted information the assessment aims to measure (Llosa et al., 2016; Martiniello, 2008; Noble et al., 2012).

The interpersonal mode of assessments "involves active communication among individuals who negotiate meaning in face-to-face conversations" (Shaw et al., 2010, p.915). Only a few studies examine STEM assessments where BLs have the opportunity to engage in face-to-face conversations that allow them to develop an understanding of the requirements for participation (Bunch et al., 2010a; Clark-Gareca, 2016; Lyon et al., 2012, 2012; Turkan & Liu, 2012; Wolf et al., 2012b). Most STEM assessments examined in the literature require that BLs work independently; in these instances, BLs do not gain any benefits provided by face-to face communications.

The "interpretive mode" occurs in situations where "meaning must be derived without the assistance of two-way communication" (Shaw et al., 2010, p.915). The interpretive mode is a feature of all of the STEM assessments examined in these studies and is evident in common activities, such as reading, listening to a passage or dictation read aloud, and responding. In conjunction with the interpretional mode, BLs' responses to retrospective interview questions

explain that their interpretations of and responses to the STEM assessment are often limited to the information they can gather from reading or listening (Martiniello, 2008; Noble et al., 2014). In these studies, the researchers' interviews provide opportunities for BLs to seek clarification about the test items and more specifically, to ask about the expectations regarding their participation (Martiniello, 2008; Noble et al., 2014). When given access to these opportunities, many BLs offer better responses that indicate understandings of the STEM content knowledge the assessment aims to measure. BLs' interview responses are also deeper and more thorough than their initial written responses. This occurs from time-to-time because unchecked interpretations of test items lead BLs in the wrong direction when developing a response. In these instances, BLs' responses reflect misinterpretations of the question, as opposed to a lack of STEM content knowledge.

The "presentational mode" accounts for "the creation of messages, either oral or written, for delivery to audiences where no opportunity is present for direct negotiation of meaning" (Shaw et al., 2010, p.915). Again, in most studies, the STEM assessment only allows for written messages without opportunities to clarify or elaborate because BLs interact with a fixed text and receive no feedback (Kachchaf, 2014; Kopriva, 2011; Kopriva, Emick, Hipolito-Delgado, & Cameron, 2007; Kopriva, Wiley, & Emick, 2007; Llosa et al., 2016; Martiniello, 2008, 2009; Noble et al., 2012; 2014; Wolf, Kim, & Kao, 2012). Similar to the interpretive mode, the presentational mode also limits the information BLs have the opportunity to present. This is apparent in interview data that captures aspects of BLs' thinking and STEM knowledge not captured by written or multiple choice platforms (Martiniello, 2008; Noble et al., 2012). STEM assessments have parameters indicating how BLs present the STEM knowledge they possess, but interviews highlight the STEM knowledge BLs' have that the assessments omit via select
communicative modes. Although BLs' STEM assessment test score data reflect the limitations placed by the exams, many stakeholders accept these scores as accurate representations of their knowledge and use them to enact high-stakes consequences.

A few studies examine STEM performance assessments that permit multiple modes of presentation. The variation in communicative modes offer both benefits and challenges (Bunch et al., 2010; Lyon et al., 2012; Wolf et al., 2012). BLs have more opportunities to show what they know because they draw from more options. At the same time, without back-and-forth exchange to provide feedback and clarification about the task and not the content), BLs were still, to some degree, limited in what they could produce (Bunch et al., 2010; Lyon et al., 2012).

Looking across studies to examine STEM assessments as communicative events helps to explain test designers' and stakeholders' intentions and the discrepancies between these intentions and BLs' actual experiences. STEM assessments are designed as measurement tools which aim to gather specific information about all tested students' STEM content knowledge and make conclusions about what students do and do not know. Some assessments are designed to gather large-scale reports for accountability measures, while others are designed to offer information to teachers and practitioners about what students know and how to use this information to influence instruction.

As a platform, STEM assessments have rules for communication and interaction that determine how and what knowledge test takers can display. The purpose of the assessment is to make a judgment in order to see if the test taker knows what is deemed important and valuable. The platform tailors what it captures by directing how the exchange between the assessment and the test taker can occur and only provides opportunities for the desired, targeted exchange.

### **Definitions and Functions of Language**

The literature offers a robust definition of language as a complex and dynamic cultural exchange that demands a high degree of skill and experience to effectively comprehend and convey thought (Bunch et al., 2010; Llosa et al., 2016; Lyon et al., 2012). Studies describe linguistic complexity in relation to the use and interpretation of language. The complexity of language also involves the forms language takes in different genres, discourses, and linguistic structures (Bunch et al., 2010; Kachchaf, 201; Kopriva et al., 2007; Kopriva et al., 2007; Llosa et al., 2016; Martiniello, 2008, 2009; Noble et al., 2012; Shaw et al., 2010). In addition, these structures are influenced by various cultural practices (Bunch et al., 2010; Kachchaf, 2014; Kopriva et al., 2007; Llosa et al., 2016; Martiniello, 2008, 2009; Noble et al., 2012; Shaw et al., 2010). BLs' interactions with these linguistic structures further highlight the complex nature of language in ways that often go unnoticed, while many assume that all test takers engage with and are familiar with the tests' language in similar ways. Interestingly, though language is described as being inherently complex, a unanimous assertion emerging from the research is that there are features of language that either minimize or increase its complexity depending on the testing context (Kopriva, 2011; Kopriva et al., 2007; Martiniello, 2008; Noble et al., 2012; Turkan & Liu, 2012; Wolf et al., 2012).

Studies that examine the processes BLs undertake during formal STEM assessments describe how language can function as a set of demands that can provide opportunities or challenges for successful engagement (Bunch et al., 2010; Llosa et al., 2016; Martiniello, 2008; Noble et al., 2012; Shaw et al., 2010; Solano-flores, 2000). This perspective looks at language as it relates to certain tasks, such as reading and writing, and describes the ways language impacts BLs' experiences. Shaw et al. (2010) explain that "students are called upon to read and produce text" and that the associated "functional and interactional language demands" (p. 909) dictate how bilingual students navigate science performance assessments. Noble et al. (2012) describe how, from a sociocultural perspective, "test-taking is a language-mediated interaction between the structure and content of test items and students' sense-making resources, including language, culture and life experiences" (p. 781). Here, language, in its central function, is an intricate system that determines how test-takers experience all aspects of the test as a communicative event.

### The Dynamic Nature of Language

The research heavily emphasizes language and its dynamic nature due to its substantial role in the administration of STEM assessments. The meaning and effectiveness of language changes through interpretation and exchange (Llosa et al., 2016; Martiniello, 2008; Shaw et al., 2010b; Solano-flores, 2000). Language is used in STEM assessments to convey concepts and the instructional language provided to test takers engages them during the examination process. Yet, a third element of language during STEM tests is the language BLs draw on to interpret the test and convey their own knowledge of STEM concepts.

Studies that describe these dynamic exchanges emphasize the important linguistic relationship between the STEM assessment and the BLs. Both parties offer linguistic interpretations that, in this dynamic exchange, influence what either can effectively convey (Bunch et al., 2010a; Lyon et al., 2012). Unfortunately, in many instances, the language of the exam and BLs' interpretations are misaligned. As a result, BLs misinterpret the exam and test scorers, in turn, misrepresent BLs' responses as an indication of a lack of STEM knowledge. When the STEM assessments examined are designed with the assumption that the tests' language conveys the same meaning for all students in the same way, it either reflects a misunderstanding of the BLs' linguistic profiles or a willingness to overlook them. Overall, studies show how language is an evolving exchange that shapes and takes meaning depending on who uses it, how it is used, and how it is understood (Bunch et al., 2010; Llosa et al., 2016; Lyon et al., 2012; Martiniello, 2008; Noble et al., 2012; Solano-flores, 2000). The common uses and interpretations of test language and BLs' responses make it difficult for BLs to access opportunities to display STEM knowledge, therefore, creating a barrier between the students and the assessment (Martiniello, 2008; Noble et al., 2012; Solano-Flores, 2008; 15)

# Linguistic and Cultural Complexity

The dynamic nature of language and the influence of culture leads to its complexity. From a sociocultural perspective, linguistic complexity involves the social demands of language (Martiniello, 2008; Noble et al., 2012; Solano-Flores, 2008) and linguistic complexity is, in part, comprised of the cultural practices and experiences that influence the ways test takers interpret and produce language in STEM assessments. Nearly all of these studies refer to the cultural facets of the language represented in STEM assessments and recognize culture as one of the key attributes of language. Studies emphasize how the cultural aspects of language that are represented in social expectations, and assumptions about a particular language show up in STEM assessments. In these examples, culture is generally understood as the shared understanding within a given community of the rules for effectively comprehending and conveying thoughts through language (Bunch et al., 2010; Llosa et al., 2016; Lyon et al., 2012; Martiniello, 2008; Noble et al., 2012; Solano-flores, 2000). Understanding the cultured and shared rules associated with a particular language is integral to the comprehension and use of the language (Bunch et al., 2010; Lyon et al., 2012).

This notion is an important point in the literature, given the significance of Standard English and academic language in STEM assessments. Research examining the linguistic demands present in science education, "especially for students from non-dominant cultural and linguistic backgrounds" focuses on "the relationship between language practices that students may be familiar with outside of school and those typically associated with the learning of science" (Bunch et al., 2010, p. 913). According to this research, BLs may find the "scientific discourse practices" used in STEM assessments "alien or even alienating" (p. 913). This concern is echoed in additional studies that describe the cultural complexity of academic and scientific discourse (Avenia-Tapper & Llosa, 2015; Llosa et al., 2016; Noble et al., 2012). Avenia-Tapper and Llosa (2015) explain that "academic linguistic features are features that are more often used in written language than oral language, more often used in formal than informal language" (p.98). In the case of large-scale, standardized STEM assessments, written language is typically the linguistic mode of choice. They also explain that when academic linguistic features are "referred to as complex in studies," this means "these features are some combination of long, formal, less common, and atypical of expository written text, rather than oral narrative" (p. 98). The use of ambiguous or polysemous academic terms are common in STEM assessments, as is the use of technical, discipline-specific terms (Avenia-Tapper & Llosa, 2015; Kopriva, 2011; Llosa et al., 2016; Noble et al., 2012a). Though researchers agree that these linguistic structures are most-likely evident in any assessment, there is concern about the "unusual or unnecessary" (Llosa et al., 2016) representation of this language in STEM assessments. Academic language is not neutral, but it represents a shared cultural approach to using and interpreting language.

Although the language of test items is unchanged, studies drawing on student interviews reveal that simply acknowledging the linguistic sociocultural complexities of the test item gives BLs the opportunity to express more of their understanding of those items. BLs' responses to the interview questions showed different interpretations of an item's linguistic features and helped to identify the underlying and, often, implicit cultural assumptions communicated within the language of the test (Martiniello, 2008).

Modifying the language of assessments can allow BLs' greater success in exhibiting their STEM knowledge (Martiniello, 2008; Abedi, 2006). Martiniello (2008) asserts, "it is critical that the language simplification is not achieved at the expense of altering the construct or skill to be measured by the item or test" (p.362). When the exams' language is articulated in ways that decrease the linguistic complexity, while still addressing STEM concepts and academic standards, BLs can more meaningfully engage with the assessments' STEM content.

Studies reveal that the linguistic structures used to communicate information in STEM assessments are cultural representations that can provide opportunities or barriers for the success of BLs (Bunch et al., 2010; Lyon et al., 2012; Nelson-Barber, 2008). These cultural representations of language manifest in genres, discourses, and other linguistic structures that facilitate the functions of language. In the context of this body of research, STEM assessments include such linguistic structures to present STEM content and to convey information about what students are expected to do and how they are expected to respond. Though linguistic structures are often described in terms of their form and purpose, some of the literature also emphasizes the role and representation of culture within these linguistic structures (Bunch et al., 2010; Lyon et al., 2012). When these linguistic structures are present in test items, BLs' familiarity with them, or a lack thereof, influences their ability to respond correctly.

Studies that describe the centrality of the English language as a boundary between BLs and their opportunities to engage with the exam build on the argument that language includes a complex set of demands and further argue that these demands are restrictive when adversely positioned between the student and the test (Bunch, Shaw, & Geaney, 2010b; Lyon et al., 2012; Martiniello, 2008; Tracy Noble et al., 2012c). When applying a sociocultural lens, these studies show how the centrality of Standard English and academic language in STEM assessments is problematic.

Kopriva et al. (2003) describe the interplay between these cultured, linguistic structures and the way they impact BLs, stating that the "language, cultural, and contextual challenges of English language learners form a web of small blockages that pervade tests and tests items," given the "nature of how today's standardized tests request and communicate information" (p. 3). Bunch et al. (2010) highlight barriers *and* opportunities. They find that some linguistic structures, such as "lexical, grammatical, and rhetorical demands" (p. 910) present barriers in relation to the test design. Conceptually, Bunch et al. (2010) identify obstructions within the test and not within BLs' linguistic profiles. When BLs respond to assessment items by choosing from a selection of linguistic modes and structures, there are more opportunities for them to communicate their understanding of the tests' content.

In many of the studies on the assessment of bilingual learners, language has a central role in the construction and implementation of the test and in bilingual students' test-taking experiences (Martiniello, 2008; Noble et al., 2012; Shaw, Bunch, & Geaney, 2010; Solano-Flores, 2016; & Johnson, 2015). For bilingual learners specifically, the role of language plays a uniquely central role because students are navigating the conventions of two languages. The studies reviewed describe the role of English as a set of demands that govern the test-taker's engagement with the exam (Noble et al., 2012; Solano-Flores, 2016) and a complex system of features that establish a barrier between students and the STE content of the test items (Martiniello, 2008; Noble et al., 2012; Solano-Flores, 2016). All of these linguistic roles impact bilingual students' experiences because they must consider, comprehend, and produce language to respond to test items (Shaw, Bunch, & Geaney, 2010; Solano-Flores, 2016).

# **Developing English Proficiency**

This discussion of culture and linguistic complexity describes some of the nuances of language. These nuances necessitate the development of skills that facilitate comprehension of content and the communication of thoughts and ideas. In most instances, the literature describes the measure of these skills as language proficiency (Kopriva, 2011; Kopriva et al., 2007; Noble et al., 2012). Many studies emphasize the importance of language proficiency in BLs' interactions with STEM assessments and more specifically, English language proficiency. Though ambiguous at times, the research indicates that English proficiency can be understood as students' skills and abilities to use the English language in flexible ways that allow them to comprehend and communicate. Proficiency indicates the ability to comprehend and use language with a sense of ease and familiarity. Developing English proficiency occurs through ongoing, meaningful experiences using language successfully in sociocultural interactions (Kopriva, 2011; Kopriva et al., 2007).

Unquestioned and exact measures of English proficiency are not pinpointed in the research, but in most studies, the assumption is that there is a level of English proficiency needed to successfully engage in and fulfill the language demands required by STEM assessments (Kopriva, 2011; Martiniello, 2008; Noble et al., 2012). Because the threshold needed to comprehend and communicate knowledge in English is never identified, the uncertainty around measurements and conceptualizations of English proficiency remain a gray area. Many studies reference standardized rubrics designed to measure English proficiency and categorize BLs based on the (in)abilities suggested by their scores (Kopriva, 2011; Martiniello, 2008; Noble et al., 2012).

al., 2012 ). Research analyses rely on these measures to explain the impact of STEM assessments on BLs with varied levels of proficiency to determine which assessment features are most detrimental for particular groups. In this way, the research asserts that there are relevant distinctions in English proficiency among students, and English proficiency is an important factor in the administration of STEM assessments because it can determine whether or not the assessments' language demands present obstacles or opportunities for BLs to portray their STEM content knowledge.

Analysis of the literature shows that the conceptualization and measurement of proficiency are two distinct concepts. The research conceptualizes language proficiency as the development of awareness and use of a language in ways relevant to the sociocultural contextways that attend to the nuanced, culturally established rules of that language. The measurement of proficiency, on the other hand, heavily emphasizes English proficiency. The measurement of English proficiency carries presumptions about its value and function because it is the language of the test and the language of the dominant culture influencing instruction and the establishment of these STEM assessments. The two concepts merge as researchers use proficiency-based BL profiles to understand how BLs engage with STEM assessments administered in English. This approach highlights the ways BLs' varied experiences and skill with the English language impact test scores designed to only measure STEM content knowledge; therefore, revealing these assessments are also measures of English language proficiency. On the other hand, this methodological use of English proficiency measures and simplifies the complex conceptualization of English proficiency, especially as it relates to the influence of culture in linguistic structures. This approach undermines the discussion of linguistic complexity within the same body of work. This disconnect reveals that language proficiency and English language

proficiency are far more complex than standardized measures suggest. At times, the research acknowledges this disconnect but fails to adequately capture this concept in the data. This may occur because the use of these proficiency measures can be convenient and useful for making a specific and targeted argument, though they simplify related matters that are far more complex.

The literature on BLs' interaction with STEM assessments defines language and describes its functions as a sociocultural exchange and as a component of STEM assessments. While these studies have been implemented with several purposes and goals, they all place a common emphasis on the role of language in relation to the test itself and to the bilingual students taking the test. The research examines and draws on different linguistic traditions and perspectives to show that language functions in different ways, depending on the context and content of the STEM assessment being studied.

### Using Language to Make Sense of Content

There are limitations in the discussion and conceptualization of language throughout the research. Although studies examine the role of language in communicative events geared to assess STEM content knowledge, they offer very little about BLs' use of language to make meaning. This most likely occurs because the test score data gathered is not designed to capture the language-driven, sense-making processes that manifest in students' responses. Because these studies examine particular assessments with strict rules for engagement, they capture the data that reflects these processes. These studies also examine assessments that either elicit multiple choice responses or involve writing that must be represented in English. When prompted to write in English, BLs may offer limited responses that do not accurately represent the responses they could potentially write in their first and second languages collectively. Additionally, the studies focus on assessments of STEM content, and not necessarily on how BLs make meaning of these

concepts. In other words, assessments are designed for students to show what they know. The emphasis is on how assessments measure students' display of content knowledge, as opposed to the sense-making process that occurs before they exhibit what they know.

From an SCT perspective, the omission of the use of language for sense-making is critical to the study because BLs use language to make sense of STE concepts, language, and the assessment itself. The interview questions in the study aim to gather and interpret BLs responses about their sense-making. Research designed using an SCT perspective shows that students' oral and written thought processes are interrelated (Albert, 2000; Dixon-Krauss, 1996; Wink & Putney, 2002) and that students' content knowledge is further developed through writing (Albert, 2000). This is an important notion in the study because BLs have to communicate their thought processes in oral and written forms.

Many researchers study the concept that thought is represented and developed through language (Hussein, 2012; Vygotsky,1987; Walker, 2017). Vygotsky (1987) relates thought to a child's inner speech, which he defines as "a unique form of internal collaboration with oneself" (p. 273). The child socializes with an idea or concept through inner speech, which returns to the child as a newly developed and more complex thought (Albert, 2010). Through this internal collaboration, the child uses their private speech to develop their thoughts (Albert, 2012; Dixon-Krauss, 1995). Albert (2012) asserts, "essential to our understanding of how thoughts function, we must first consider the way in which language develops sequentially" (p. 24). In this study, BLs are asked to communicate their thoughts orally and in written form, but these processes occur before BLs can outwardly produce these responses. However, their responses may or may not adequately convey their thinking. After students engage in the processes of inner speech, "instructions to write elicit a new activity that, depending on the type of instruction and the child's stage of development, creates new abstractions and a more complex reorganization of consciousness" (Dickson-Krauss, 1995, p. 114). Writing activities require students to "become conscious of and control their own thinking (Dickson-Krauss, 1995, p. 114). In the writing process, students must think, make meaning, and represent their thoughts and sense-making in a new form. Albert (2000) explains that "the practice of writing provides a context for a new learning zone: the 'zone of proximal practice' (ZPP)." In this practice, new social and cognitive functions develop. "Students work with information and rearrange it through writing to make meaning (Albert, 2000, p. 109). As students write, they "convey ideas feelings, and experiences that lead to the development of higher cognitive functions, including critical thinking, sound reasoning, and problem-solving" (p. 109).

As students move from inner speech to oral and written communication, their thoughts and ideas develop. This means that BLs continue to develop their thoughts and understanding *throughout* the assessment process. The STE assessment treats knowledge as fixed and separate from the communicative event. It assumes that BLs' knowledge has been developed at a previous point in time and that the assessment measures that prior knowledge. On the contrary, research suggests that BLs will continue to make meaning about content knowledge, language, and the assessment as they engage with the measurement tool. Albert (2010) explains that students' written explanations reveal their "understanding of problems, strategies or procedures used to solve problems, observed patterns and relationships, and evaluation about the reasonableness of solutions to problems," (p. 131) all of which are developed thorough the process of responding to a test item.

### **Conceptualizing STEM Content Knowledge**

The literature collectively defines STEM content knowledge as a distinct class of knowledge with a foundation in science and math topics. Though there is an emerging body of research describing the intersection of STEM and other academic content areas, this research describes STEM content knowledge as distinct from (but related to) other academic content areas and also distinct from "cultural knowledge unrelated to science" (Noble et al., 2014, p.249). Furthermore, the research explains that STEM content knowledge is something a student can possess to varying and measurable degrees.

Definitions of STEM content knowledge include a set of facts, examined, asserted, and generally recognized by STEM communities. Embedded in the conceptualization of STEM content knowledge is the idea that these facts can be learned, referenced, and discussed in ways that presume agreement by all participants in a STEM community and specifically in this body of research, in communicative events intended to assess STEM content knowledge (Bunch et al., 2010; Solano-Flores, 2000).

These agreed upon STEM facts become the basis for questioning but are not established to *be* questioned. The unquestionable assertion of facts represented in STEM content knowledge is evident in STEM assessment test items (Martiniello, 2008, 2009; Noble et al., 2012). The test items the studies describe often ask students to answer test questions premised on factual STEM concepts. In order to respond, BLs must accept the fact as truth and then draw conclusions based on that truth. They are not permitted to question the veracity of the facts.

The matter of the unquestioned, fixed nature of STEM facts, the concepts they represent, and the assumptions from which they are derived is an important feature of the research on BLs experience with STEM assessments because this content represents the targeted body of knowledge the assessment aims to measure. Inherent in the attempt to accurately measure this STEM content knowledge it is inherently assumed that all students, regardless of their personal and cultural experiences, will agree with this knowledge and accept it as true. This relates to a complex and equally important aspect of the conceptualization of STEM content knowledge found in the literature- that science is cultural.

Researchers explain the relationship between cultural knowledge and STEM content knowledge in different ways. Some studies describe STEM content knowledge as distinct from cultural knowledge (Kopriva, 2011; Kopriva, et al., 2007; Wolf et al., 2012) and other studies explain that there is cultural knowledge related to and embedded STEM content knowledge (Avenia-Tapper & Llosa, 2015; Bunch et al., 2010; Martiniello, 2008). The former group of studies emphasizes the distinction between science content knowledge and cultural knowledge and explain the importance of separating the two, since STEM assessments should only assess STEM content knowledge. Some of these studies in this group acknowledge the presence of cultural features within the STEM assessment tool itself and assert, when used, these features should not prevent BLs from accessing the STEM content knowledge, nor should it prevent them from understanding the questions being asked (Martiniello, 2008; Nelson-Barber, 2008).

Studies that describe the overlap between cultural knowledge and STEM content knowledge explain that STEM content knowledge is not neutral and always represents a cultural set of values (Bunch et al., 2010; Martiniello, 2008; Noble et al., 2012). These cultural representations are evident in the inquiry process that facilitates STEM learning and in the national policies, and state frameworks that determine which STEM concepts are acknowledged, taught, and assessed. Further explanations show that the elements of culture present in STEM content knowledge and embedded in education systems promoting STEM education are often misaligned with the cultural practices and beliefs upheld by a diverse population of BLs.

The discussion of STEM knowledge as cultural in the literature (Bunch et al., 2010; Llosa et al., 2016; Martiniello, 2008; Noble et al., 2012; Solano-flores, 2000) relates to discussions of the role of federal education policies like NCLB and ESSA (Kopriva, 2011; Kopriva et al., 2007; Llosa et al., 2016; Martiniello, 2009; Noble et al., 2012) and their implementation at the state and local levels. In widely diverse regions, policies typically represent the goals and purposes of the dominant social groups (Hult, 2013; Landry & Bourhis, 1997; Moriarty, 2014). These policies are created to establish, preserve, and enforce the values held by the dominant group (Landry & Bourhis, 1997). The research makes it clear that the policies around STEM education in the United States are no different.

At the Federal level, policies mandate the administration of STEM assessments in alignment with national priorities (Martiniello, 2008; Noble et al., 2012). The ESSA requires states and districts to ensure that all students, including "children with disabilities, English learners, and other historically underserved groups, graduate high school ready for college or a career" (ESSA, 2015, p. 289). To assess states' and districts' progress towards the goal, "the law maintains the requirement that states administer to all students annual statewide assessment in …mathematics…and… science" (ESSA, 2015, p. 289). The federal policy governing STEM (and other content area) assessment practices frames "English learners" as non-dominant, cultural outsiders.

Though the federal policy doesn't define what counts as STEM content knowledge, it does require that states "have...academic standards for mathematics...and science" (p. 289) and that the standards are "challenging" and "rigorous" (ESSA, 2015, p. 289). The policy establishes

the idea that a measurable body of STEM content knowledge exists. Studies show that states and districts maintain this assertion through standards and frameworks that reflect national and regional cultural experiences and values and are included in STEM assessments (Avenia-Tapper & Llosa, 2015; Martiniello, 2008).

Through state and district implementation, these policies identify the body of STEM content knowledge to assess before students ever enter the classroom. As a result, the STEM content knowledge accepted in schools often excludes the STEM content knowledge a diverse group of BLs may have previously constructed based on their own sociocultural experiences (Bunch et al., 2010; Dworin, 2003; Martiniello, 2008; Moll, 2015; Noble et al., 2012). Schools adhere to the values and practices mandated at the state and federal levels and can be sites of tension for stakeholders, including BLs, when the design of STEM assessments presume neutrality and fail to acknowledge that large-scale STEM assessments are actually manifestations of a dominant culture. STEM assessments align with the body of STEM content knowledge validated by the curriculum is fixed before BLs are even engaged in the learning process and have constructed their own understanding of what counts (Bunch et al., 2010; Lyon et al., 2012; Shaw et al., 2010).

Additionally, a degree of skill is required to develop STEM content knowledge. But there are conflicting views of that development process. One view is that there's a set of skills needed to memorize, accept, and enact previously instantiated STEM concepts, while the other is that there are skills students need to develop in order to think critically, question, and construct an understanding of STEM concepts. In the latter view, the inquiry process by which students construct their understanding of STEM concepts is a considered an integral component of STEM

content knowledge. Researchers describe inquiry as a sense making process that engages students to construct critical awareness and understanding of STEM concepts (Bunch et al., 2010; Martiniello, 2008; Shaw et al., 2010; Solano-flores, 2000). This concept of the inquiry process aligns with SCT constructivist perspectives that view "a learner [as] an apprentice, as well as researcher and experimenter, and an inquirer, an interviewer, and an investigative reporter" (Wink & Putney, 2002, p. 12) and that "particular classroom cultures are socially constructed through interactions of participants" (Wink & Putney, 2002, p. 65).

The inquiry process and the body of STEM content knowledge validated by policies, districts, and states reveal the tension between school-based conceptions of STEM knowledge and the constructivist perspective as it relates to STEM learning. As described above, the school-based approach, imposed by federal and state education policy, requires students to accept and agree with fixed STEM concepts characterized as facts. In contrast, inquiry may involve these same concepts and learners may arrive at similar understandings, but learners are required to first question the conditions that establish these STEM facts. From the constructivist perspective, learners must have meaningful experiences that allow them to develop an understanding of STEM concepts and think about them critically. The constructivist approach requires a pliable definition of knowledge or fact. It begins with the learners' experiences and funds of knowledge (Dworin, 2003; Moll, 2015; Solano-flores, 2000) and *then* it uses learners' inquiry-based conclusions to determine which understandings are validated as facts.

Large-scale standardized assessments designed to comply with state requirements adhere to the assessment of STEM facts previously determined by education mandates that reflect the dominant culture's academic values (Avenia-Tapper & Llosa, 2015; Martiniello, 2008; Noble et al., 2012). In contrast, the studies examining local, small-scale assessments piloted by individual teachers or classrooms use performance-based assessments that require students to construct knowledge, solve a problem, pursue a line of inquiry, or draw on previously constructed knowledge to develop their response to a given prompt (Bunch et al., 2010; Shaw et al., 2010; Wolf et al., 2012). Fundamental differences between these types of assessments include the types of responses required, the opportunities available to draw on personal funds of knowledge, and the high or low-stakes consequences associated with BLs' test outcomes. Large-scale assessments allow limited communicative modes for BLs to display the targeted STEM knowledge with high-stakes consequences tied to test outcomes (Bunch et al., 2010; Shaw et al., 2010). Small-scale performance-based assessments do not have high-stakes associations and include more communicative modes for BLs to present their STEM content knowledge prompt (Bunch et al., 2010; Shaw et al., 2010).

The research describes the benefits and limitations of both types of assessments for BLs. Large-scale assessments offer a standardized approach aligned with standards and frameworks and when taught explicitly, their structure and content offer a degree of familiarity. At the same time, given their standardized design, large-scale assessments do not offer room to question the concepts included in test item prompts. On the other hand, small-scale assessments offer BLs flexibility and can be tailored to the STEM content knowledge relevant to the classroom context. Some studies (Bunch et al., 2010; Shaw et al., 2010; Turkan & Liu, 2012) found that the communication of complex STEM concepts requires the use of various communicative modes.

There is additional and unresolved tension in the ways researchers, educators, and policymakers conceptualize STEM content knowledge. Many agree that the development of STEM content knowledge requires a degree of skill, but the ability to *display* this knowledge requires considerable skill as well. The linguistic communication of STEM knowledge is

currently at the center of debate. Some researchers, educators, and academic standards describe the ability to communicate STEM knowledge as a facet of STEM content knowledge itself (NGSS, 2013; Pellegrino, 2014), while other stakeholders and researchers contend that the possession of STEM knowledge is distinct from the ability to *communicate* the knowledge one possesses. The ability to communicate that knowledge in oral or written form is a linguistic skill and not STEM content knowledge itself. The linguistic demands are relevant to the assessment process but not the targets of measurement. It is likely that stakeholders will continue to debate the issue with the implementation of new standards and the increasing linguistic diversification of the nation's schools.

### Conclusion

A critical examination across the literature and an analysis of the conceptualizations and functions of STEM assessments as measurement tools, language as a sociocultural exchange, and STEM content knowledge reveals the interrelation of these three components. This description of STEM assessments supports the assertion that they always involve some linguistic components and that "all tests are to some extent measures of students' language proficiency" (Bunch et al., 2010, p. 190). The emphasis on definitions and features of STEM assessments overlaps with the discussion of how language manifests in these communicative events.

STEM assessments serve as a complex cultural construct positioned between BLs and the predetermined purpose to display select STEM content knowledge. As a construct, the STEM assessments studied facilitate communication between BLs and the assessments' purposes. In the contexts of these studies, STEM assessments become a platform to represent STEM concepts and measure BLs' knowledge of those concepts in accordance with a predetermined standard of achievement or proficiency.

At the same time, the assessment process is mediated and facilitated by language and the role and impact of language on the process cannot be ignored. Though the design of most of the STEM assessments treated language as a neutral component of test facilitation, the SCT analyses in the research, clearly show that this is not the case.

The SCT perspectives offered by researchers in the field (Albert, 2010; Albert, 2012; Dixon-Krauss, 1995; Vygotsky, 1987) help to understand and accurately characterize the function of language as a mediator between BLs and the STE assessment. Rooted in empirical and theoretical foundations, these concepts help identify the unobservable cognitive processes BLs engage in when responding to the STE assessment and answering questions about their responses.

When language is present it carries the values, beliefs, priorities, and implicit and explicit messages of the culture it represents. Further examination of the role of language and its impact on BLs' experience with and performance on STEM assessments can identify the challenges and opportunities present in longstanding, silencing test practices. It can also help to identify the changes needed to pursue meaningful and equitable assessment practices in education.

## CHAPTER THREE METHODOLOGY

### Introduction

This chapter describes the design of the data sources, data collection procedures, and data analysis strategies used to examine BLs' experiences with STE open response items designed for a large-scale state assessment administered in English. The research methods and procedures are developed to answer the following research questions: (RQ1) *What do fifth-grade BLs' (a) written responses and (b) oral thought processes communicate about their understanding of STE concepts included in STE open response items?* (RQ2) *What do fifth-grade BLs'(a) written responses and (b) oral thought processes communicate about their understanding of the STE assessment?* (RQ3) *What do teachers' observations reveal about BLs' experiences responding to STE open response test items?* Collectively, I posed the research questions to understand how language impacts BLs' experiences responding to and engaging with test items from the STE assessment administered in English and their opportunities to display their STE content knowledge.

These questions are guided by the SCT framework with the understanding that the language(s) the test engages are socially positioned within a high-stakes standardized testing context with STE content knowledge as a target of measurement. Language mediates the relationships between these concepts and every facet of the context is cultural. The SCT framework thoroughly influences the study's design by acknowledging and emphasizing the complexity of the contexts BLs and teachers navigate and the roles participants hold within them. The description of access and entry captures the nuances of practice in qualitative research in a time of political fragility, and the need to exercise caution in the engagement of student populations that have become targets of political injustice in the United States. The data

collection and data analysis sections include the procedures for gathering data and are informed by the SCT frame. The final section of this chapter presents the limitations to explain the study's restrictions and the influence of these restrictions on implications for practice and recommendations.

### **Design of the Study**

This is a qualitative study designed to gather complex data and bring it into focus through the application of an SCT lens. Creswell (1998) defines qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem" (p. 110). Additionally, Denzin and Lincoln (1994) state that qualitative research allows "researchers to study things in their natural setting" while "attempting to make sense of or interpret phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 1998, p. 2). In this qualitative study, the inquiry process centers on BLs' experiences with a large-scale STE assessment to understand how language, in its complexity, influences BLs' participation and engagement when responding to STE open response test items. The qualitative approach allows for the study of BLs' engagement with STE open response items in a school environment and for the analysis of BLs' descriptions and representations of their sensemaking. The qualitative approach is also appropriate for this study, given that the qualitative research aims to capture the nuances of complex social experiences. Qualitative research also allows the researcher to hold onto and highlight the many features of data captured from data sources like interviews, observations, and artifacts. Most importantly, the research questions guiding the study are influenced by the SCT perspective and seek answers that need to account for many interrelated factors like language, experience, context, and STE content knowledge.

The qualitative approach offers a platform to tailor the data sources and analytic approaches needed to arrive at these answers.

This qualitative study is designed as an instrumental case study to answer the research questions (Creswell 2013; Stake, 1995, 2006). For this study, an instrumental approach is used to gain an understanding of BLs' experience with large-scale STE assessment items and how language influences their engagement with these items. The case study design is appropriate for this study because it allows an in-depth approach for gathering rich and detailed information. The instrumental case study classification allows the researcher to draw on multiple data sources that include BLs' account of their personal experiences as well as teachers' observations of BLs' experiences and contextual details the students may not provide in their responses.

The research questions specifically ask about BLs' experiences with the STE assessment with the understanding that BLs represent a very diverse demographic. Each student particpant represents a case and the case study design captures the diversity in students' unique experiences and perspectives while still acknowledging their shared experiences.

This study takes place in a northeastern state in the U.S. The study's geographical location plays a meaningful role in the interpretation of the research given the region's demographic composition and shifting education policies. With firm rules for federal and state governance, the region has a distinct set of practices that direct BLs' education and assessment. Though there is some variation in the education and assessment of BLs across schools in the state, the overall sociopolitical climate influences the experiences of all learners. At the local level, the study takes place at Ascension, a small private middle school located in a metropolitan neighborhood where the participating students and teachers work and live. The rich demographic composition of Ascension is diverse in racial, ethnic, and linguistic representation. Ascension is

a high need indepedent school that serves students from economically disadvantaged backgrounds. To qualify for admission, students have to meet the state's qualifications for free and reduced lunch and reside in the city where the school is located.

Ascension is located in a geographical region governed by a set of education and language policies. When the study began and the data was collected, the state had an English only education policy, but over the course of the research, this policy has been reversed. The faculty and staff at Ascension have a considerable degree of autonomy that allows them to push against policies that fail to align with their institution's language ideologies. At the same time, many of the students who attend the school matriculate from the city's public school system and reenter the public school system as high school students upon graduating from Ascension.

The education policies once at play in the region influenced the structures of the schools and classrooms students attended and will attend upon graduation. The impact of these policies can vary greatly depending on the type of school (e.g. charter schools, traditional, pilot, and, turnaround public schools), which ultimately influences students' instruction and assessment. Additionally, the sociopolitical landscape also influences the types of classrooms where students learn and are assessed. More specifically for BLs, classroom types may include Sheltered English Immersion (SEI), bilingual, or "mainstream" classes with pull out services. Lastly, due in part to the sociopolitical underpinnings of the region (and the country), many of the schools in this region of the city are under-resourced and educate students from economically disadvantaged backgrounds. All of these sociocultural factors influence the implementation and analysis of this study in ways visible and unseen.

Within this context, student observations, and student and teacher interviews occur. The participants include three classroom teachers and a total of 6 of their BLs (students). Each

teacher is bilingual, speaking English and their participating students' first language. The students speak 4 different first languages including: Haitian Creole, Cape Verdean Creole,

Spanish, and Portuguese.

Table 3.1. Stude	ent Prof	ile Snapshot				
Student	First L	anguage(s)		Second Langu	age	Gender
Pseudonym						
Cecilio	Spanish	1		English		Male
Danila	Cape V	erdean Creole and Portu	iguese	English		Female
Ida	Spanisł	1		English		Female
Marisol	Spanisł	1		English		Female
Nadina	Spanisł	1		English		Female
Nestor	Haitian	Creole and French		English		Male
Table 3.2. Teac	her Prof	file Snapshot				
Teacher Pseud	onym	First Language(s)	Secon	d language(s)	Years Teachin	Gender
Fabiola Jacobs		Haitian Creole and French	Spanis	h and English	2 years	Female
Lisette Mendes		Cape Verdean Creole and Portuguese	Spanis	h and English	1 year	Female
Isabella Morale	S	Spanish	Englis	h	3 years	Female

The teacher participants are prepared and equipped to facilitate a bilingual, semistructured interview with their (BL) student participants and make observations of their (BL) students' participation as they responded to STE open response items. The teachers followed the same observation and interview protocols after completing a training session for all teacher participants. This training provided opportunities for teachers to review the interview protocols, ask questions, make suggestions, and practice the interviews and observations with one another and myself. After the teachers interviewed and observed their students, I interviewed the teachers and inquired about both their experiences interviewing students and their school's practices around instruction and assessment.

The STE open response items used in this study were gathered from publically accessible archives on the state's Department of Education website. They are understood as both

assessment and policy documents because they are artifacts designed to fulfill the state's response to federal education policy mandates. The state associates each STE test item with at least one state STE standard. These state standards play a key role in understanding and coding the STE content in BLs' written responses.

### Access and Entry

In my professional work as a teacher, teacher educator, and researcher, I have worked with a heavily diverse group of teachers and school leaders in the city and more specifically within the neighborhood of this study's participants. This professional network includes educators and researchers with a range of pedagogical practices and ideologies. The professionals in this network conduct and participate in university-based research projects through collaborative university-school partnerships and some conduct school-based research in their classrooms.

Outreach within this network located the study within the community of educators working at Ascension Middle School. The school serves a similar student demographic to that of public schools in the same neighborhood but differs from nearby public schools because it has a diverse group of teachers and administrators. I facilitated access within this school and the engagement of participants with care and consideration of the vulnerabilities of the BL student population due to heightened political hostility toward immigrant students and families. Due to the tensely controversial political climate, this study does not include personal identifiers with information about students' citizenship, or years they have resided in the U.S. Some student interviews do reveal information about the relative time students have spent in U.S. schools. At times, the analysis may indicate that a student arrived in the states at a young age, but the exact number of years, time in the U.S., and conditions around their immigration experience is omitted. Although it may be helpful to include this information to strengthen the analysis of a study, the research questions can nevertheless be fully addressed without providing this level of demographic detail.

### **Data Collection Procedures**

Creswell (1998) describes data collections as "a series of interrelated activities aimed at gathering good information to answer emerging research questions" (p. 110). In this process, the researcher has to "select the sites or people" from an "array of possibilities," and "present a rationale for the selected approach" (p. 111). This section includes an overview of the participants and the selection process, as well as the data sources and procedures for gathering this data. It also includes the rationale for the methodological approach based on the SCT framework.

### **Participants and Selection**

The teacher participants play a critical role in this study. The study is informed by their professional expertise in order to answer questions about BLs' experiences. The teachers in this study have developed relationships with their BL students over the course of the academic year and their students have worked with and learned from these teachers in class during science instruction in these classrooms. They also speak at least two languages, allowing them to conduct bilingual interviews, representing multiple languages within the same study. From an SCT perspective, BL students develop their language and thinking about science concepts (in part) during instruction. Having a shared experience facilitated by language allows students to discuss science content with teachers in a way that draws on their actual learning experiences, something that cannot be accomplished in interactions with an outside researcher or interviewer who has not spent a substantial amount of time in the participating students' classrooms. Teacher participants

and BL student participants share a contextual frame of reference in discussing science content. Teacher participants draw on these experiences in their student interactions and observations in the study.

The teacher participants are also crucial to the study because teachers offer perspectives that are often missing in the literature on the assessment of BLs. The teacher participants are in class with and teaching students daily. They have administered large-scale standardized science assessments in the past and can help identify the contexts that situate BLs' experiences. The three teacher participants in this study inquire into their practice and student learning and are professionals with expertise relevant to the study's implementation.

These teachers were selected for participation through the professional network previously described. Outreach, via email and phone calls, targeted bilingual fifth-grade teachers with bilingual students in schools with varying classroom structures. The schools which were contacted to participate included 3 traditional public schools, 2 turnaround public schools, 1 public charter school, and 1 private school. Nearly all of the administrators in these schools expressed interest in participating. A smaller number of teachers expressed considerable interest, but could not make the time commitment. Of the fifteen teachers recruited, only three teachers were able to make the commitment and had the full support of their school's administrative team to participate. All three of the participating teachers are employed at Ascension Middle School. Although these teachers also have many time consuming demands and responsibilities for which they are held accountable, overall, they had more flexibility within their schedules than the public school employees contacted.

The 6 participating students are fifth-grade BLs enrolled in the same private school where the teacher participants are employed. Because the teachers speak Haitian Creole, French, Cape Verdean Creole, Spanish, and Portuguese, in addition to English, the student participants had to be selected from those who spoke either Haitian Creole, Cape Verdean Creole, Spanish, and/or Portuguese as their first language(s). The student participants also had to receive instruction from one of the three participating fifth grade teachers. This significantly narrowed the pool of eligible students. Eligible students received consent forms and the selection pool was narrowed to those whose parents/guardians gave consent for their child's participation. From this group, the criteria needed to select the final six students was based on gender. The study includes 4 female student participants and 2 male student participants. The three teacher participants are all female.

# **Data Sources**

Creswell (1998) explains that to collect pertinent information, the "researcher develops protocols or written forms for recording the information and needs to assess the logistics of this recording process" (Creswell, 1998, p. 111). The data sources included in this study are designed and selected to serve specific functions. They influence the data captured and can be analyzed using the SCT framework.

The following data sources are used to answer the research questions: (1) BL interviews, which include field observations (2) BL written responses to STE open response items, and (3) teacher interviews. Each of the data sources addresses at least one of the three research questions as indicated in Table 3.3.

Research Questions	Data Sources
RQ1) What do fifth-grade BLs' (a) written	BL interviews: Include BLs' oral communication about
test responses and (b) oral thought processes	their responses to test items and responses to questions
communicate about their understanding of	about the STE concepts in the test items.
STE concepts included in STE open response	BL written responses to STE OR items: Includes BLs'
items?	written answers to test questions that ask about STE
	concepts.
(RO2) What do fifth-grade BLs' (a) ) written	BL interviews: Include BLs' oral responses to questions

Table 3.3. Data Sources Linked to Research Questions

test responses and (b) oral thought processes	asking for their perspective on how they are being
communicate about their understanding of	assessed.
the assessment?	BL written responses to CAS STE OR items: Look at
	BLs' responses as an indication of their interpretation
	of the test; for example, if BLs write their responses in
	their first language, or English, or both, it may indicate
	an interpretation of a monolingual or bilingual
	communicative event.
(RQ3) What do teachers' observations reveal	Teacher interviews
about BLs' experiences responding to STE	Field observations: Include teachers' observations of
open response items?	BLs' behaviors when responding to OR items. This
	may include the types of questions students ask and the
	clarifications they seek.

**BLs Interview Protocol**. The interviews of BLs are based on protocols that address research questions one and two (See Appendix A). Students were individually interviewed once for approximately one hour. During the one-hour interview, students completed 1-2 previously selected open response items and then orally answered questions (oral thought processes) about their responses to the items in English and or their first language. Each of the three teachers conducted individual interviews with their two BL participants at the school site. Teachers offered to conduct the interview in BLs' first language, English, or a combination of both, giving BLs more accessibility. This methodological approach is grounded in the SCT perspective because teacher participants and their BLs share a frame of reference for STE instruction, BLs can draw on their shared classroom experiences learning about STE concepts to explain their thinking. This provided more opportunities for BLs to communicate their STE knowledge and ultimately for the data to more accurately reflect their understanding.

I drew on the interview practices of qualitative researchers studying the intersection of education practices and BLs' experiences in order to design the interview protocols used in this study (Albert, 2010; Chia, 2014; Jiménez, 2000; Johnstone, 2006; Quellmalz, Timms, Silberglitt, & Buckley, 2012; Spycher, 2009; Young et al., 2008). In these studies, researchers use think-

aloud interview protocols to understand how students think and feel about particular linguistic experiences or science and math concepts.

Some studies include the interview protocols or sample questions (Johnstone, 2006; Spycher, 2009). Many of the interview questions are guided by texts like reading passages and pictures similar to those found in the STE open response items. Researchers provide prompts on science test items like "Describe what you see in this picture. Tell me everything you can about what you see" and questions about students' thought processes, such as "How would you find out about how it eats/where it lives/ what it does/how it changes?" (Spycher, 2009, p. 368). These open-ended questions about items facilitate discussion about students' sense making within an assessment context.

Jiménez (2000) explains that think aloud interviews "provided a glimpse into the ways students approached text, the strategies they used for understanding text, and some information about their fluency and accuracy when reading" (p. 233). The data gathered from these interviews address research questions about what BLs' "know about reading [and] the potential literacy strengths they might possess" (p. 233). Additionally, Chia (2014) implements a retrospective cognitive lab technique where students first complete an item and then interview students about how they interacted with the items. Afterwards, Chia interviewed teachers about students' learning strategies when "attempting to understand a mathematics question or problem, when selecting a method or approach to solve it, and when articulating the answer" (p. 270).

This study uses the relevant interview procedures described above, when designing in the BL and teacher interviews. One study emphasizes that, "interview data need to be interpreted according to the students' cultures, as students from some cultures may feel uncomfortable performing actions such as challenging the interviewer or questioning a test item-aspects of central interest in item cognitive interviews" (Chia, 2014, p. 310). These are all important factors critical to the study's implementation and purpose.

The goal of the protocol is to obtain detailed information about the interview participants' experience with the language as a mediator between the test item and BLs' ability to convey their STE content knowledge. BLs first answer the test question through written response. The teachers used the interview protocol prompts to introduce the item and prompt students to provide their written responses. Once students wrote their answers, they discussed their answers with the teacher interviewer in their native language or English. The written response indicate what BLs produce on their own, when limited to one communicative mode. This response is most similar to the response they might produce during a formal STE assessment. The oral communication that occurred after BLs provided their written responses reveals what, if any, STE knowledge is apparent when there are opportunities for BLs to orally discuss their understanding using more than one language.

**Teacher Interviews**. This study applies semi-structured interviews to address research question three (See Appendix B). The three teachers participating in this study were interviewed individually, each interview lasting approximately one hour. There was one interview per teacher, and these interviews occurred after student interviews. The purpose of the interview is to understand teachers' perceptions of BLs' experiences when interacting with the state's STE open response items. The teacher interview also provides an opportunity to learn about the school and classroom context, which will influence the analysis of the data. The teacher interviews provide opportunities to clarify and further describe concepts that emerge from the BL interviews, BLs' written responses, and field observations. Teacher interviews were audio recorded and transcribed.

**Field Observations.** During the interview, teacher participants made field observations. They gathered information on BL' experiences answering the open response test items that couldn't always be captured in the written and recorded oral responses. This data can help capture responses to the exam that are not written or verbal, and may influence the other data collection procedures since interviews will not be video recorded.

**STE Open Response Items**. The open response items included in this study were selected from the state's released items archived on the department of education website. At the time, this study occurred, there were sixteen items available items representing the years 2009-2016 (two items per year). The state categorizes the available items by reporting category, state standard, and year. The four reporting categories are: Technology/Engineering, Life Sciences, Earth and Space Sciences. The fifth-grade science, technology, and engineering standards fall within the four reporting categories and specify the relevant skills and concepts students are expected to have attained at this grade level.

Within the confines of the study's design, it was approximated that students had enough time to answer one or two open response items during the one-hour interview. Though the representation of a broad range of items could be beneficial, it would require a larger sample size and more extensive interview procedures beyond the scope of this study. It would require several more students to be interviewed about multiple items or the same group of students to participate in multiple interviews where they answer a different set of items.

The decision to interview students on a maximum of two items was also contextually and developmentally appropriate. Some students were interviewed at the end of the school day and had already completed their daily academic routines, making it challenging to respond to more than one or two open response items. Limiting the number of items also allocated more time to ask questions and gather data about student participants' written responses. Despite these limitations, focusing on two items offers many unique benefits that align with the project's research questions and goals. The process of responding to any open response item represents the structures of a communicative event. Though items have different linguistic features and structures, they are all equally viewed as sociocultural and political artifacts from the study's SCT lens.

The two items selected and included in this study were randomly selected. Through the selection process, each of the sixteen items received a random number (1-16). Two numbers were then randomly drawn. The two items included in this study are: *Alicia's Garden* and *Seesaw* Figure 3.1 shows these two items below. *Alicia's Garden* an item from the state's 2012 assessment and represents the Earth and Space Science reporting category. This item addresses State Standard 5, "*Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants."* The second item, *Seesaw*, is from the state's 2013 assessment and represents the Technology and Engineering reporting category. This item addresses State Standard 2.3, "*Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem*" and State Standard 1.1, "*Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility*. Additional item features and their relationship to students' experiences developing their responses are further described in chapters 4 and 5.

<ul> <li>Question 21 is an open-response question.</li> <li>BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.</li> <li>Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.</li> <li>If you do the work in your head, explain in writing how you did the work. Write your answer to question 21 in the space provided in your Student Answer Booklet.</li> <li>21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.</li> <li>a. Describe two properties of sandy soil that make growing vegetables difficult</li> <li>b. Describe one thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.</li> </ul>
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#### **Data Analysis**

The SCT framework and accompanying conceptual framework guided the analysis for this study. When the analysis began, the following theoretical concepts characterized the conceptual framework: (1) language is a process; (2) language represents the culture it reflects; (3) language is social (Halliday, 1978; Dworin, 2003, Vygotsky, 1984; Wink & Putney, 2002; Veel, Christie, & Martin, 1997); and (4) language occurs within context. As the analysis develops, the relationships between these concepts emerged and further refine the conceptual framework.

It is clear that BLs processed the language of the exam at intrapersonal and interpersonal levels. In this process, BLs read the item text and engaged in inner speech, developed their response and then recorded it in writing. BLs engaged in this process drawing from more than one context. Some contexts were defined by personal experiences embedded with a particular language and its affiliated sociocultural features. All students, to varying degrees, drew on the testing context introduced through the use of the two state STE open response items. In this study, the context of the state's STE assessment is referred to as the *Standardized STE Assessment* context. It is identified by, but not limited to, the following characteristics: monolingual, uses English, academic language, ambiguous audience, fixed text, and requires reading and writing in the same language. The analysis examines the alignment and tension across the contexts in which BLs engage, including the *Standardized STE Assessment* context, to better understand BLs' experiences responding to the test items. The changes to the conceptual

framework resulted from an iterative process that linked both data and theory. These changes are outlined in detail in Chapter 4.

The evolution of the conceptual framework strengthened the framework's ability to connect the data to the research questions in ways that captured the complexity of participants' experiences. With the conceptual framework in mind, I began the analysis by examining the STE content features of the test items and listening to and reading all of the interview recordings and interview transcripts, respectively, to develop a sense of data from a holistic perspective. Next, I connected each of the data sources to the relevant research question(s). The analyses for each of the interview questions are not only interconnected, but also have distinct nuances.

The two randomly selected test items played a critical role in the study's analysis. Each test item has distinct features and at least one assigned STE state standard. The state standards indicate the targeted STE content knowledge for a given item. BLs' written responses were analyzed to understand what, if any, information they included in their response aligned with the targeted STE content knowledge for a given item. This is *not* synonymous with providing a "correct" answer. The written responses were *not* analyzed for accuracy. The written responses were sorted into categories based on what they revealed about BLs' understanding of the targeted STE concepts. BLs had a range of interpretations for the items' linguistic features as well. Each of the two test items have unique and distinct features, which had an overall impact on the research questions they informed.

To analyze the first research question, I examined BLs written responses and oral thought processes separately. I initially coded each of the written responses for any references to the targeted, standards-based, STE concepts for that item. Then I categorized the responses based on the degree to which they referenced the targeted STE content. I analyzed the oral thought processes to examine how BLs described their understanding of the STE concepts and how they contextualized their responses. I concluded the analysis for RQ1 by looking across cases and discussing the overarching findings as they relate to the conceptual framework.

To analyze the second research question, I also examined the written responses and oral thought processes separately. The written responses were examined for any features that communicated what BLs believed to be the linguistic expectations and norms for participation. This was evident in the linguistic structure and content of their written responses. I identified common features that were prevalent across cases, and I examined the oral thought processes to again contextualize the trends that emerged across the data. I also examined the oral thought processes to understand the linguistic structure of the written response and its impact and relevance to the content of the written response.

Lastly, for research question 3, I analyzed the teacher interviews. These interviews inquired into teachers' observations of BLs responding to the open response items and teachers' instructional and assessment practices. This data helped to contextualize BLs' experiences responding to the open response items. It provided deep insight into BLs' experiences with classroom and school-wide assessments, as well as science instruction. This proved to be significant for the analysis because BLs sometimes draw on school experiences to interpret and respond to the open response items.

Overall, the analytical process shows strong connections between the language of the test and BLs' experiences engaging with the STE test items. The details and nuances of the analytical process are further described in Chapters 4 and 5, as the findings are presented.

#### Limitations

The limitations of this study relate to its context and its scale and generalizability. The sociopolitical context may influence the data captured. Given the palpable hostility towards BLs in the U.S. and the dominant perspective of bilingualism as a problem in education language policy, BLs may be reluctant to traverse both of their languages during interviews. Though teachers are encouraged to facilitate a bilingual interview, BLs may choose not to speak in their native language. Students who are aware of and impacted by the subjugation of their first language in school settings may default to the use of English, even if it does not capture the entire STEM content knowledge they possess.

This study involves three teachers and 6 students within one school. The scale of the study is limited to a small region and a small group of students and teachers that may present experiences and perspectives that are not indicative of the entire teacher and BL student population. Although the findings of this study may not be generalizable through a statistical procedure orientation, it considers the interrelated ideas of generalizability employed in qualitative research: credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1983). These criteria are the hallmarks for judging the quality of qualitative research and its trustworthiness (Yin, 2014; Stake, 2006). This is commonly seen as a limitation in the traditional field of social science research. On the other hand, I assert that the uniqueness of BLs' and teachers' perspectives and experiences help identify where there is variation in experience. Situating this research within a composition of large-scale studies can locate BLs' distinct experiences within the patterns of experiences fostered by inequitable school systems.

#### **CHAPTER FOUR**

# **CONTEXTUAL INTERPRETATIONS OF FIXED TEXTS**

## Introduction

The research purpose, theoretical and conceptual framework, and research questions inform and guide the analysis for this qualitative case study. The overarching purpose of the study is to explore the influence of language on BLs' experiences with a state STE assessment administered in English. Using established theories and methods in the field of education research, this study draws on BLs' and teachers' deeply informative, personal accounts, which speak to the impact of language on BLs' engagement with open response test items.

The analysis in this qualitative case study, examines nine interviews and ten written responses to two test items. The three participating teachers each conducted two student interviews. This yielded a total of six student interviews. The three remaining individual interviews occurred between each the three teachers and myself, the researcher. Each of the six participating students responded to 1-2 open response test questions. Each of the six students responded to the first open response item, *Beach Garden*. Only four of the six students also had time during their interview to respond to *Seesaw*, the second open response item. This yielded a total of ten written responses.

The research questions and the theoretical and conceptual framework drove the analytical process. Identifying and conceptualizing the STE content was a key part of the analysis given that the assessment aims to measure the STE content and RQ1 explores what BLs' written responses and oral thought processes communicate about their understanding of the STE content. For RQ1, I coded BLs' written responses to understand how, and ultimately if, the written responses communicated STE content knowledge. I used the STE standards that the state

associates with the tests items to conceptualize the STE content. I used the same standards and conceptualization of STE content knowledge to code BLs' oral thought processes. After coding the data and looking across cases, I categorized the written responses based on the degree to which they represented the targeted STE content. Next, I analyzed the STE content evident in the oral thought processes and drew comparisons to the written responses. This process situated the written responses within various contexts that BLs engaged while developing their written responses. The application of the study's conceptualization of the STE content moves the focus towards BLs' communication of STE content knowledge, and away from a focus on correctness.

For RQ2, the analytical process followed a similar pattern of drawing on BLs' written responses and oral thought processes. The written responses and oral thought processes were coded to identify when and how students described their understanding of the expectations and norms around communication. This includes a range of norms like BLs' discussions of the assumptions they held about the appropriate language to include in their written responses and the proper structure and format for written responses. The coding process was iterative and the analysis identifies prevalent trends across the data. The findings emerging from the analysis of data generated from RQ1 and RQ2 are included in this chapter as well.

The analytical process for RQ3 differed from the process for RQ1 and RQ2. For RQ3, the process is singularly focused on teacher interview data. During these interviews, teachers allude to BLs' written work and oral thought processes but teachers' accounts are the source of data and not those of BLs. Therefore, the findings from the data, generated from analysis of RQ3, is included in Chapter 5. During the teacher interviews, teachers provide their observations regarding BLs' responses. The teachers support these observations by contextualizing them through accounts of their teaching practices and personal knowledge of their BLs. For example,

one teacher makes an observation of a student circling a writing prompt and explains that most of the paper and pencil assessments administered in class are multiple-choice exams. Another teacher explains that she scaffolds the linguistic features of the assignments for one of the BLs in the study and wouldn't typically ask the student to respond to texts like the open response items without providing support. The teachers' interviews critically influence the development of the conceptual framework because the teachers explicitly describe the different contexts BLs encounter, which include the contexts' linguistic nuances. The teachers also critically influence the analytical process by providing informative and substantive feedback during "member checking" (Stake1995).

Prior research that explores the impact of language on the development and administration of standardized STEM assessments informs the focus of the analytical process. Much of the prior research examines the use of the English in the implementation of STE assessments and the implications of this practice for BLs (Kopriva, Wiley, & Emick, 2007; Noble et al., 2012). The research finds that the use of English in the wide-scale administration of STEM assessments adversely impact BLs' test scores in ways that are disproportionate to some of their monolingual, English-speaking peers (Kopriva, Wiley, & Emick, 2007; Martiniello, 2009). These findings are critical to this study because they help identify issues deserving further exploration. While test scores gain increasing prominence in students' education experience, they are simply the product of a larger system. The research also suggests that the discrepancies in test scores across linguistic groups highlight concerns about the relevance and appropriateness of standardized STEM assessments as valid tools of measurement (Kopriva, Wiley, & Emick, 2007; Martiniello, 2009; Wolf et al., 2012a). The study presented here acknowledges these findings and explores the experiences behind the test scores. Additionally, this study aims to understand how BLs' engagement with a monolingual assessment impacts the structure and content of their written responses. The existing relevant literature in this field of research informs the analytical process for this study by placing a spotlight on the role of language in these assessments.

Using prior research as a foundation, the analytical process for this study examines BLs' written responses to and oral thought processes regarding open response test items from a standardized state STE assessment. Similar to previous research, this study finds that the assessment functions as a communicative event with boundaries that establish language-centered parameters for participation. For example, when BLs engaged with the fixed item text, they gather information and structure the language of their responses in ways they presume to be appropriate and accurate, based on their expectations and beliefs about the assessment. Additionally, this study's findings relate to those of previous studies that found that the linguistic features of STEM assessments sometimes served as obstacles that impede BLs from exhibiting their content knowledge. The SCT framework and the conceptual framework inform these parallel findings.

The sociocultural framework informs the conceptual framework that facilitates the analytical process for this study. SCT grounds the analysis by providing a lens to examine the complexity of language with regards to its social, cultural, contextual, and process-based features. From a theoretical perspective, language is always social and occurs when engaging in intrapersonal private speech and interpersonal dialog between two or more individuals (Albert, 2012; Vygotsky, 1986). Culture accounts for the established and shared norms and expectations that set the boundaries around and structures for communication. Given that "the cultural tools of communicative signs and symbols handed down to us" (Wink & Putney, 2012, p. 12) and

applied in interpersonal and intrapersonal interaction, the social and cultural features of language are intertwined. The process that develops through interpersonal and intrapersonal communications draws on the sociocultural features of language. In this study, this sociocultural process of communication occurs within various and sometimes overlapping contexts where cultural norms can complement or compete with one another.

The conceptual framework applied in this study represents the theoretical concepts described above and is iteratively refined though the analytical process. Prior to the analysis, the conceptual framework represented language as social, cultural, and a process, with these three features overlaying the context. These three key concepts are rooted in SCT and prominent in the existing literature. The relationships between these concepts are clarified through the analytical process. The key features of the conceptual framework are illustrated in Figure 4.1 and described below.

Figure 4.1. Conceptual Framework: Processing Language within a Context



Figure 4.1 illustrates how language occurs as a social (intrapersonal or interpersonal) process where information is received and interpreted (input) as well as formulated and expressed (output) (Vygotsky, 1986). This process occurs within a context embedded with

sociocultural features. The contexts' features can be understood as physical or conceptual spaces bound by sociocultural expectations about the language spoken or not spoken, the dominance of one language over another, and the modes of communication made implicit or explicit (Wink & Putney, 2012).

In this study, interaction between the sociocultural features of the context and sociocultural features of the process were evident in BLs' accounts of their experiences. When BLs interacted with the item text, they developed their understanding and written responses through intrapersonal and interpersonal engagement (processing language). As BLs made sense of the text and developed their responses, they navigated the sociocultural linguistic features of multiple contexts, including those from their experiences at home, school, and testing. At times, BLs drew knowledge from a range of contexts when processing language (interpreting and responding to the text). This is illustrated in Figure 4.2 below.

Figure 4.2. Conceptual Framework: Processing Language across Multiple Contexts



In other cases, BLs drew on knowledge from some contexts and not others, especially when the sociocultural norms were dissonant across contexts. This is illustrated in Figure 4.3, which shows how the process of reading and interpreting the open response item (processing language) could draw on experiences from home, school, and the *Standardized STE Assessment* context interpreting the content but omitting BLs' home experiences from the output. The analysis in this study describes how the contexts that BLs draw from impact their interpretations of the item text and written responses. Additionally, this analysis examines how BLs' decisions to draw from (a) select context(s) impact the science content knowledge displayed. Figure 4.3. Conceptual Framework: Processing Language across Select Contexts



Using this conceptual framework as a guide, this chapter provides the analysis and findings for RQ1 and RQ2. These questions draw on the data provided by BLs' written responses and the student-teacher interviews. The findings illustrate patterns across the data and include excerpts from BLs' interviews and written responses. The analysis is organized by research question and explained based on the features of the conceptual framework. As the analysis unfolds, the conceptual framework illustrates how different contexts' sociocultural features impact how BLs interpret and respond to standardized, monolingual, open response test items.

# **Displays of Science Technology and Engineering Content Knowledge**

This section includes the findings and analysis for the first research question (RQ1): What do fifth-grade BLs' (a) written test responses and (b) oral thought processes communicate *about their understanding of STE concepts included in STE open response items?* This analysis draws on data gathered from each of the six BLs' written responses to 1-2 open response test items and oral responses to questions posed during their interviews. The findings and analysis from this data are organized to respond to the research question and emphasize how they relate to the theoretical and conceptual framework.

RQ1 specifically examines BLs' communication about "STE concepts included in the STE open response items." For this reason, the findings for this research question are organized, in part, based on the state's STE standard(s) for each of the two test items included in the study. The findings and analysis for BLs' written responses are presented first and the findings for BLs' oral thought processes are presented second. This section of Chapter 4 closes with an overarching summary of the findings and analysis for RQ1 that looks across BLs' written and oral responses.

## Test Items: Beach Garden and Seesaw

The first open response item, *Beach Garden*, aligns with the state's *Earth and Space Science* reporting category and the following state standard: *Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants.* This is the first test item each of the six participating BLs received during their interview. All six student-participants provided a written response for this test item.

The second open response item, *Seesaw*, aligns with the state's *Technology and Engineering* reporting category and the following state standards: *Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem*" and "*Identify materials used to accomplish a design task based on a specific property, e.g., strength,*  *hardness, and flexibility.* "This is the second test item that 4 of the 6 participating BLs received. Two students were unable to provide responses to the second item due to time constraints.

## **Categories for Science, Technology, and Engineering Concepts**

BLs' written responses communicate varied degrees of understanding of the STE concepts included in the open response items. The categories described below are not intended to align with or serve as a substitute for the state's scoring rubric. They simply represent the types of responses students provide in relation to the targeted STE content for a given test item. The categories emerge from the STE characteristics of the written responses. They are based on the STE information included or excluded from the written responses. The various degrees of understanding evident in BLs' written responses are classified accordingly: (1) BLs' written responses communicate a thorough and deep understanding of the STE concepts included in the open response item; (2) BLs' written responses communicate some understanding of the STE concepts included in the Open response item; and (3) BLs' written responses communicate little to no understanding of the STE concepts included in the open response item.

### Looking Across Categories in Written Responses

Table 4.1 and Figures 4.4 and 4.5 illustrate the findings for RQ1. The narrative included in this chapter expands on these illustrations to explain these findings in relation to the conceptual framework. Figure 4.1 and Table 4.1 demonstrate how the six BLs' ten written responses are classified across the three categories previously described. The two charts represent overlapping data but Table 4.1 also shows who provides the responses. This is important given that this is a qualitative analysis. Knowing *who* provides which responses is necessary for the analytical process (for example, Cecilio provided the two and only written

responses that represented a thorough understanding of STE concepts). The discussion for the written responses is first provided, followed by the discussion of BLs' oral thought processes. Figure 4.4.. Written Responses Classified by Category



	Written Responses Classified by Category		
	Category 1: Thorough Understanding Communicated	Category 2: Some Understanding Communicated	Category 3: Little to No Understanding Communicated
Cecilio: Beach Garden	Х		
Cecilio: Seesaw	Х		
Danila: Seesaw			Х
Danila: Beach Garden			Х
Ida: Beach Garden		Х	
Ida: Seesaw			Х
Marisol: Beach Garden			Х
Marisol: Seesaw			Х
Nadina: Beach Garden		Х	
Nestor Beach Garden		Х	
a 1 1	1 1		

Table 4.1. Written Responses Classified by Category with Student Data

Some students only responded to one item due to time constraints.

# Analysis for Category 1: Thorough Understanding of STE Content Communicated

Category 1 includes written responses that communicate a thorough understanding of the targeted STE content for a given item as described in the STE standard assigned by the state. These responses include written information that explicitly shows that the student comprehends the STE content. This means there is written information that captures the student's understanding and it is not subtle or implied in their written response. As indicated in Table 4.1, two out of the ten written student responses analyzed in this study are classified in this category. Table 4.1 shows that both responses are provided by Cecilio, which is presented in Figure 4.5.

# Figure 4.5. Category 1: Two Written Responses from Cecilio for Seesaw and Beach Garden

Seesaw

C. May should make the material guarding what fut. A. I think wood would be a 9000 matched to wake Greesch belowse work coerscuss we worke of wood and beau the is should and been that up much in the SUM. The students in a class want to build the type of seesaw shown below. The students can make the seesaw out of any material, but they know some materials have properties that make them a better choice to use for the seesaw than other materials. 21 a. Identify one material that would be a good choice for the students to use to build the b. Describe two properties of the material you identified in part (a) that make it a good choice to use to build the seesaw.

### Beach Garden

Session 2 Ouestion 21 is an open-response question BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION. Show all your work (diagrams, tables, or computation) in your Student Ar Booklet. If you do the work in your head, explain in writing how you did the work. Write your answer to question 21 in the space provided in our Student Answer Booklet. 21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard. a. Describe two properties of sandy soil that make growing vegetables difficult be one thing Alicia could add to the soil to make it better for a vegetables. Explain the reasoning for your answer. The cand be disferent to from it because first the fond will have Prant the seeds and AMMENT Second it would have a of of MUHVSever B. Aticu could all surfitized to us, more within us,

Cecilio's written response for *Seesaw* communicates a thorough understanding of the state's technology and engineering standards for this item: *Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem*" and "*Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.*" For this test item, the student must identify a material that would be a good choice to build a seesaw, describe the material's properties, and a design feature to consider before building the seesaw. Cecilio's written response communicates his understanding of the concepts represented in these standards. Cecilio identifies "wood" as the material "*used to accomplish a design task based on a specific property*" and describes its properties by writing that it is "sturdy and doesn't heat up much in the sun." The standard also requires that students "*identify relevant design features...for building a prototype.*" In Cecilio's written response he explains that "they [the students referred to in the item text] should make the material [the wood]

smooth and flat". This response is categorized as one that communicates a thorough knowledge of the STE content because of the accuracy and reasoning evident in the response.

Underlying the state-assigned technology and engineering standards for this item is the idea that students can provide a rationale to warrant their selection of a material "*based on*" the properties of the material itself and that students can identify a design feature "*relevant*" to the function of the prototype (in this case the seesaw). Cecilio not only identifies wood as a material, but also rationalizes his selection based on the seesaw's function. The seesaw should be made from a material that is structurally sound or "sturdy" and able to withstand outdoor conditions, it "doesn't heat up in the sun".

Cecilio engages his personal knowledge about seesaws to explain and support his statement that "wood would be a good material to make [a] seesaw." He states that the wood "doesn't heat up in the sun" indicating that the seesaw would be exposed to the sun. The item text does not describe what seesaws are or that seesaws are typically built for outdoor use. In this case, engaging contextual information external to the item text and relating it back to the *Standardized STE Assessment* context helps Cecilio develop a thorough written response. Presumably, a student could provide a thorough response without this knowledge, but in Cecilio's case, his personal knowledge about seesaws allowed him to provide a rationale for his written response. Cecilio's written response for *Seesaw* also includes information about conduction and the sun as a source of heat. This is not targeted STE content but it helps Cecilio develop a comprehensive written response.

Cecilio's written response shows that he draws on different contexts to interpret and respond to the item text. There are *at least* two contexts evident in his response. This does not mean that Cecilio only drew from two contexts, but there are two distinct contexts, *observable* in

his written response. Cecilio includes information in his written response that aligns with the Standardized STE Assessment context. The Standardized STE Assessment context includes sociocultural norms like a shared language (in this case English) and the STE concepts represented in the state standards. Cecilio's entire response is communicated in English and much of the content knowledge he communicates aligns with the content knowledge that helps characterize the Standardized STE Assessment context. Cecilio also draws on at least one other context. The full nature of this context is not explicit from his writing but it is a context in which he has personal experience and knowledge about seesaws, their outdoor use, and the impact of the sun on materials placed outdoors. Cecilio may have gained this knowledge from more than one other context but this isn't explicated in his written response. Cecilio shows that, for him, the contexts he draws from overlap. He does this by providing a tight rationale that includes content knowledge and personal experiences from each. As Cecilio draws from these contexts, he processes the Seesaw test item. Cecilio's written response draws primarily from the Standardized STE Assessment context and he draws from the other context(s) for support to make a cohesive argument. In his Cecilio's case, the written response benefits from his primary reliance on Standardized STE Assessment context. The information included in his response shows a substantive understanding of the technology and engineering content knowledge targeted by the item.

### Analysis for Category 2: Some Understanding of STE content Communicated

Category 2 includes written responses that communicate some understanding of the targeted STE content for an item. These written responses communicate an understanding of key aspects of the targeted STE content but differ from the written responses in Category 1 because they do not include critical components of the targeted STE content. The analysis emphasizes

what STE knowledge is communicated in writing. A lack of written information is not presumed to indicate a lack of STE *knowledge* in this analysis. This goes hand in hand with the perspective that the written responses may include some *or* all that the STE content knowledge the student understands. Three of ten written responses provided by three different students comprise Category 2. The written responses in this category only include written responses to the *Beach Garden test item*. Additionally, all the responses in Category 2 also include references to untargeted science content. As a point of illustration for Category 2, Nestor's response to the Beach Garden test item is presented in Figure 4.6. This written response communicates some understanding of the following science standard; *Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants,* but there are also STE concepts the question targets that are not included in the response.

Figure 4.6. Category 2: Written Response from Nestor for Beach Garden Item

Session 2 Question 21 is an open-response question BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION. Show all your work (diagrams, tables, or computations) in your Student Answe Booklet. If you do the work in your head, explain in writing how you did the work. Write your answer to question 21 in the space provided in your Student Answer Booklet. 21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard. a. Describe two properties of sandy soil that make growing vegetables difficult b. Describe one thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer. Two properties OF sandy soil that Maske graving vegetables difficult if the sand not being maist enough and high tide blowing against the shore. B. One thing Alicia could and to the soil is Fertilizer to help the Plants grow better.

Before examining Nestor's response as a representation of the those classified in Category 2, it is important to first understand what a thorough response communicates in order to identify what STE content is present and missing in his written response. A written response exemplifying a thorough understanding of the science standard for this item would communicate a grasp of both explicit and implicit STE concepts targeted in the item. The written response must communicate knowledge of the properties of (sandy) soil. The science standard provides examples of properties like "color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants. However, only some of these examples are relevant to the Beach Garden item. Students must identify specific properties of sandy soil that "make growing vegetables difficult." This qualification narrows the selection of properties to discuss in their written responses. For example, the color of sandy soil is not necessarily a property that makes growing vegetables difficult. On the other hand, the texture (or particle size) of sandy soil and its ability to retain water can be useful in formulating a response. "The ability to support the growth of plants is listed as a property of soil in the science standard but this information is given in the text of the item where it reads, "vegetables will be difficult to grow in the sandy soil". This indicates that the item doesn't target this content as something students must communicate because the information is already provided.

The information included in this item establishes a context that narrows and consequently targets the properties students can include in their written responses. For this item, it is not sufficient to simply communicate the properties of sandy soil. Students must isolate which properties of sandy soil make it difficult to grow vegetables. They must then associate those properties of sandy soil with a lack of something vegetables need to grow and in addition,

identify something which can be added to the soil that addresses that lack. Students must communicate, in writing, why or how their suggestion accounts for what the sandy soil lacks.

In keeping with this criterion for a thorough response, Nestor's written response (Figure 4.6) communicates his understanding of some key science concepts delineated in the standard but not others. In Nestor's response, he writes that a property "of sandy soil that make[s] growing vegetables difficult is the sand not being moist enough..." which aligns with the state's science standard that includes "*the ability to retain water*" as a property of soil]. "The sand not being moist enough" is a property of soil that is relevant to this particular test item because it describes a property that accounts for an attribute sandy soil lacks and therefore, makes it unsuitable for growing vegetables. Additionally, Nestor explains, "One thing Alicia could add to the soil is fertilizer to help the plants grow better." This written response indicates that Nestor can identify something the sandy soil lacks that is needed to help grow vegetables.

However, there are key STE concepts Nestor does not communicate in his written response. The test item requires that students "explain the reasoning for [their] answer" in relation to the prompt, "Describe one thing Alicia could add to the soil to make it better for growing vegetables." Though Nestor identifies "fertilizer" as something that Alicia can add to the soil, he writes "to help the plants grow better" to explain the reasoning for his answer. The answer Nestor provides does not fully reflect the targeted science content because it does not explain why or how the fertilizer makes the sandy soil better for growing vegetables. Additionally, the reasoning Nestor communicates mirrors the science content already provided in the text. It is accurate to state that fertilizer helps the plants grow better given that "*the ability to support the growth of plants*" is part of the state science standard for this written response. At the same time, this cannot be coded as thoroughly communicating targeted science content knowledge because it restates information already provided in the item text without making deeper and more specific connections to the impact of fertilizer on plant growth. Overall, the features of Nestor's response are attributed to Category 2 because he provides important and relevant science content in his written response but leaves out implicitly targeted science content.

Like Cecilio, Nestor's written response also provides data that reveals information about the contexts he engages as he interprets and responds to the *Beach Garden item*. Nestor engages the *Standardized STE Assessment* context. This is evident in the sections of his response that align with the targeted STE concepts and the fact that he writes his entire response in English. The item itself includes information about the beach as a way to situate the science content but the beach itself is not the targeted standard and content.

There is evidence that Nestor draws from at least one other context to develop and communicate his response. Nestor draws on his personal knowledge of the beach outside of the information provided and includes this in his response. This includes science content knowledge about weather conditions at the beach. He writes about "high tide" and "the shore." Nestor lists "high tide blowing against the shore" as a property of sandy soil. When Cecilio drew from his personal knowledge, it helped him to build a strong rationale in his response. In Nestor's case, drawing from another context doesn't strengthen his answer in this way. The information Nestor pulls from his personal knowledge and into his written response is not relevant to the targeted science content though it relates to the beach context.

Both Cecilio and Nestor draw from different contexts to develop their responses. When Cecilio does this, the knowledge he pulled into his response provides a rationale for his answer but when Nestor does this it does not communicate the targeted science content knowledge. This shows that context plays an important role in processing language but select information from that context may or may not be relevant to develop a comprehensive written response.

## Analysis for Category 3: Little to No Understanding of STE content Communicated

Category 3 includes written responses that communicate very little, if any information that conveys an understanding of the targeted STE knowledge for a given item. The analysis does not infer that students do not possess this understanding because it is not represented in written form. The analysis examines what can be gathered, if anything, about the STE knowledge students may or may not possess. It can be concluded that some student responses communicate nothing or very little about students' understanding, as is the case here. The analysis examines how much of what they understand is communicated in the text.

Five of the ten written student responses are classified in Category 3. The five responses classified here span both test items and belong to three of the six students who participated in the study. There is a broad range of responses included in this category. In some cases, the only STE content knowledge included in the response repeats STE content already provided in the item's text. This information cannot be attributed to written documentation of students' STE knowledge because there is no way to determine if students already possessed this knowledge or are reproducing information already provided. Marisol's written response to the *Beach Garden item* and Danila's written response to the *Seesaw item* are highlighted to represent a range of responses for this Category 3.. Figure 4.7 includes both of their responses.

Figure 4.7. Category 3: Written Response from Marisol and Danila for *Beach Garden* Item Marisol



# Danila



Like the previously discussed responses for the *Beach Garden item*, Marisol's written response was analyzed using the same state science standards. In Marisol's response to Part A, "*Describe two properties of sandy soil that make growing vegetables difficult*," she writes, "Sandy thinks it could be difficult because she lives next to a beach." This written response indicates that Sandy is a person who thinks growing vegetables could be difficult because it occurs next to a beach. The science content included in her response is limited, and therefore, the response is limited in its capacity to convey Marisol's science content knowledge. The words in Part A of Marisol's written response that relate to the targeted science content, even if tangentially, are "difficult" and "beach." The word difficult, however, is used to relate back to the beach location and not the properties of the sand itself. In fact, "*sandy*" is interpreted as a name and not a type of soil. Sandy soil represents a critical component of the targeted science knowledge. Marisol's interpretation of "*sandy*" as the name of a character in the text diminishes her opportunity to discuss it scientifically and as an adjective describing the soil. Marisol's written response shows a misaligned interpretation of the STE content. Aside from her interpretation of "sandy," most of what Marisol writes in response to Part A repeats what is stated in the text.

Marisol's responds to Part B, "describe one thing Alicia could add to the soil to make it better for growing vegetables..." writing, "Alicia could add more water..." Marisol's response gives some information about what might be added to soil to impact plant growth. However, this response reflects limited understanding of the targeted science content because it is supposed to relate to "*sandy*" soil. This is implied in Part B which simply refers to the sandy soil as, "the soil." The prompt works from the assumption that the soil is sandy and asks for something to add to the soil because sandy soil has properties that make growing vegetables difficult. Marisol ends her response to Part B with "...and kind of in a shad[y] place." This segment of her response relates to beach conditions. This is not something Alicia can add to the soil nor is it a rationale for adding water.

Marisol draws from different contexts to develop her written response and yet it reveals little about her knowledge of the science content. She draws on the *Standardized STE*  *Assessment* context like Cecilio and Nestor in the first two categories. Marisol also includes information in her response that resembles a written response for a fictional narrative text. Although the *Standardized STE Assessment* context uses characters like "*Alicia*" and the beach garden scenario to deliver and assess science content, it is not intended to be read and responded to as a passage from a book or a short story. However, this is how Marisol responds. Additionally, Marisol writes that Alicia "could add more water…in a shad[y] place." This suggests some knowledge of sunny beach conditions that may impact plant growth. Marisol pulls information from different contexts that could be appropriate for other forms of assessment, but they are misaligned with the *Standardized STE Assessment* context, providing little information about her science content knowledge.

Danila's response to the *Seesaw* item is the second response analyzed for Category 3. Danila's responses for the *Seesaw* and *Beach Garden* items are similar in format and unique from all of the other responses in this study. Her written response take the form of selection and include no additional words. In her response to the *Seesaw* item's prompt, Danila circled the letter (a) "*Identify one material that would be a good choice for the students to use to build the seesaw*." Danila's written response to the *Seesaw* item does not reveal any relevant information about her understanding of the targeted technology and engineering content knowledge because the response is entirely comprised from the text provided.

Danila's interpretation and response to the item text draws from one recognizable assessment context. Her response indicates that she believes this is a multiple-choice test and that the first section of the item text is prompting her to choose from options (a), (b), or (c). This is often an appropriate way to respond to a standardized test item however it is not appropriate in for an open response item. The exact context(s) and associated experiences Danila draws from are unclear but they are misaligned with the linguistic expectations that establish the *Standardized STE Assessment* context.

The critical importance of the exam's contextual sociocultural features becomes apparent when looking across the three categories. In each category, and in each case, BLs draw from multiple contexts that have sociocultural expectations around language (Vygotsky, 1986; Wink & Putney, 2012). This is significant to the study because all participants navigate at least two languages and the expectations and norms associated with a particular language can shift depending on context. The importance of the test items' sociocultural context is emphasized by the fact that English was the only language visibly represented in each of the written responses.

When BLs' interpretations and responses align with or fall within the *Standardized STE Assessment* context, the written responses reveal a thorough understanding of the targeted content knowledge. This only occurred in the case of one participant, Cecilio, who has had the most experience in American schools and is one of the most fluent speakers of English among the six student participants. Drawing from additional contexts only helps to show BLs' STE content knowledge when the concepts and norms BLs apply align with the *Standardized STE Assessment* context. In many cases, BLs draw from contexts that were related to the *Standardized STE Assessment* context but not in ways that allowed BLs to exhibit their understanding of STE concepts. In other instances, some BLs engage contexts that misalign with that of the test and consequently show very little if any of the STE knowledge these BLs' possess. Looking across categories shows that the written responses, which convey the most STE content knowledge are those that most closely align with the *Standardized STE Assessment* context. This does not indicate that a written response that aligns with the *Standardized STE Assessment* context will always demonstrate a thorough or some understanding of the targeted STE concepts. It does however suggest that a written response capable of demonstrating an understanding of the targeted STE concepts must first draw from a context that either aligns with or is relevant to the *Standardized STE Assessment* context.

This analysis is solely based on the written responses BLs provide. Their written responses are the products of their thought processes but these thoughts are not always explicit in the written text (Albert, 2012). The next section of the analysis examines BLs' oral account of their thought processes to understanding how language impacts their experiences when conveying their STE content knowledge in writing.

### **Contextualizing Written Responses through Oral Thought Processes**

The six participating BLs were interviewed by one of the three participating teachers. The interviews were recorded and transcribed and capture BLs' oral thought processes. During the interviews, BLs were given the option to speak in their first language or in English. This option was given to provide BLs with the opportunity to explain their thinking and communicate any STE content knowledge that they did not represent in English when writing their responses to the test items. However, three of the six BLs chose to complete their interviews entirely in English and the other three used their first language to exhibit practices, such as counting or translating a few words related to their written responses. The sparse occasions where BLs used their first language. This is an important part of the analysis because the study was designed, in part, to understand how a bilingual interview could reveal more of BLs' STE content knowledge with the assumption that some BLs would choose to speak in their first language. Although English was the dominant language during the interviews, they still revealed that BLs possessed more STE content knowledge than what they portrayed in their written

responses. This became evident when the interviews contextualized BLs' written responses in ways that illuminated their thinking.

The interview data was coded using the same method used to analyze the written responses. the analysis began with the identification of all sections of the transcripts where BLs communicate knowledge of the targeted STE content articulated in the state's STE standards. The transcripts were then coded to identify the features of the contexts BLs describe when communicating their STE knowledge. These features included the physical and socially constructed spaces and norms. BLs gave an account of these contextual features when connecting their thinking to personal experiences. These features established the contexts BLs' drew from when interpreting the item text and developing their written responses. The primary interview questions, along with teachers' follow up questions, that helped identify these contexts were: (1) *What did you think about before you wrote your answer? and (2) What language did you use when you were thinking? Did you use any other languages?* 

The theoretical and conceptual framework guiding the study was instrumental when coding the features of the contexts. The codes provide substantive evidence that all BLs in the study draw from multiple and distinct contexts as they interpret and respond to the test items. BLs encounter these contexts through personal experiences and develop funds of knowledge (Esteban-Guitart & Moll, 2014) which include their understanding of the associated norms and expectations. The analysis provided describes these contexts and how they (mis)align with the *Standardized STE Assessment* context. Additionally, the analysis shows that the relationships between contexts impact how BLs interpret the test item and communicate their STE knowledge.

## The Alignment of Contexts

Only one BL, Cecilio, conveys a thorough understanding of the targeted STE content, hence it was important to examine the impact of context on his written responses and see how it differed or related to other cases. Cecilio describes his thinking during his interview by contextualizing what he communicates in writing. In his interview about the *Seesaw* item he explains, "Wood would be a good material to make a seesaw... because most seesaws are made out of wood." We know that the item text does not indicate that most seesaws are made out of wood so this is knowledge that Cecilio has introduced are from an external and a personal context. Cecilio has personal knowledge that indicates that most seesaws are made of wood and in conversation he reveals that this is reason enough for him to believe that wood is a good material to make a seesaw. However, in his *written* response Cecilio indicates that wood is also a suitable material to make a seesaw because it is "sturdy and doesn't heat up much in the sun." He recognizes that some information from his personal context was relevant to the *Standardized STE Assessment* context but he needed to provide a rationale that scientifically connected his experience to his written response.

Cecilio recognized the need to include a rationale that aligned with the *Standardized STE Assessment* context as well as the targeted STE content. He chose not to rely solely on his personal experiences in his written response though he found them a suitable source of information. In Cecilio's interview he also explained, "on hot sunny days where children usually play [the seesaw] would heat up and be very hot," if it was made of metal. He again tied information from a personal context to his verbal response that differed from what he included in writing. In Cecilio's written response he omitted information about "hot sunny days where children...play." He limits his response to the science-related content, metal conducting heat. Cecilio effectively navigates the *STE Assessment* context and the context of his personal experiences to interpret and respond to the item in a way that thoroughly conveys his STE knowledge. This becomes increasingly evident in his interview because he describes the personal knowledge he draws from and it clear to see what information is omitted in his written response.

Conceptually, as Cecilio interprets the test item (input) and begins to form his response, he draws on a personal context and the *Standardized STE Assessment* context. However, his final written response (output) relies most heavily on the *Standardized STE Assessment* context. Cecilio identified what information was relevant to the *Standardized STE Assessment Context* and omitted key pieces of personal knowledge (in writing) that helped him develop a suitable and thorough response. His ability to determine what information was extraneous allowed him to offer a response that showed his knowledge of the targeted information.

Nestor's written response conveys some understanding of the targeted STE content, and like Cecilio, he contextualizes his written response during his interview. Unlike Cecilio, however, Nestor draws heavily on the contexts of his personal experiences when interpreting and responding to the item. When asked about his written response for the Beach Garden item, Nestor expresses skepticism and uncertainty about the item text because the *Standardized STE Assessment context* and his personal experiences are misaligned. This impacts how his written response reflects his science content knowledge. Nestor says, "trust me, I've been to the beach a lot" and "I just know that if you plant something by the beach, it's not really gonna help. Because it's just gonna get washed off. Probably gonna go into the sea..." This verbal response aligns with Nestor's written response, which states, "high tides blowing against the shore" will make growing vegetables difficult. High tides are not a property of sandy soil but as someone who has "been to the beach a lot," Nestor verbally indicates that the soil is irrelevant because

whatever is planted in it will be blown or washed away. Nestor also explains that he would advise "another person, planting their own things...not to plant it near, like sand or, um a beach." Nestor realizes he has to respond to the text but his interview reveals that he disagrees with the premise that contextualizes the test item. Nestor makes the decision to include his personal knowledge of beach conditions that make gardening unsuitable rather than focus on the properties of sandy soil. As a consequence, his written response reveals some information about the targeted science content knowledge but omits important information as well.

There is some alignment between the *Standardized STE Assessment* context and Nestor's personal gardening experiences. He describes this in his interview and includes it in his written response as well. In Nestor's interview he describes his experiences "planting the other day at [his] mom's job" and gardening in his back yard with his stepfather. When planting at his mom's job the woman facilitating the activity explained, "if you want the plants to grow better, you could put little blue pebbles, like nutrients…you could put fertilizer…" Nestor says, "like I guess it helps the plants, makes it stronger. I guess that's what she told me." This experience is mirrored in Nestor's written response.

Nestor's written response states that Alicia could add "fertilizer to help the plants grow better." He learned about adding fertilizer to plants from his personal gardening experience and includes it in his written response. Here, the knowledge he attained in his personal experience aligns with the targeted science content in a way that is relevant across both of these contexts. At the same time the targeted science content calls for a scientific rationale for adding fertilizer. Nestor's rationale is that fertilizer "help[s] plants grow better" because that's what he was told, or to put it in his own words, "I guess it helps the plants, makes it stronger. I guess that's what she told me." This is similar to Cecilio's verbal rationale for wooden seesaws. Cecilio knows from personal experience that most seesaws (that he has seen) are made of wood so wood is a good material to build a seesaw. Nestor knows from personal experience that fertilizer helps plants grow because that's what he was told. The difference is in their written responses. Cecilio decided to provide a rationale that aligned with the *Standardized STE Assessment* context and not just based on his personal knowledge about wooden seesaws. Nestor, on the other hand, included a rationale solely based on what he learned gardening at his mom's job. Consequently, his written rationale does not fully display the targeted STE content knowledge.

Conceptually, the interview reveals that Nestor's draws heavily from his personal contexts as he processes the item's text. At times these personal contexts align with the *Standardized STE Assessment* context and at times they are in conflict. When in conflict, Nestor chooses to include knowledge from his personal contexts in his interpretation (input) of the item and in his written response (output). When the two contexts align, the written response displays Nestor's science knowledge. Consequently, Nestor's written response shows some understanding of the targeted science content knowledge but omits important content as well.

Danila's written responses show none of her understanding of the items' targeted STE concepts. In her interview for the *Beach Garden item*, Danila contextualizes her written response by explaining that she visited the beaches in Cabo Verde where she was born and spent most of her life until recently when her family moved to the U.S. and she entered the American school system. When asked specifically about the item she explains, "Alicia [is] trying to grow a vegetable garden but she can't because of the sandy soil," continuing in which she justifies, "you just find which one is the best answer." When developing her written response, Danila does not draw on any of her personal experiences. She does however describe a type of test experience she must have encountered that requires the test taker to select the best answer. She draws from

this context to complete her written response and as a consequence she doesn't communicate any of her science content knowledge.

At the same time, Danila's interview reveals that she has a deeper understanding of the science content than is evident in her written response. In conversation, without prompting or leading, she explains the item's premise in more detail. Danila says that Alicia, "Have to make ...she have to add...before she can use the soil. She has to think before she can make the soil healthy...she has to add one thing, which is water, to make the soil...uh to make the soil wet before she plants it." None of what Danila reveals in this part of her interview is included in her written response. Conceptually, it appears as though Danila's interprets and responds to the item text by drawing solely from her personal experiences. Her experience with a multiple-choice test format is evident in her written response. For this reason, her response does not communicate her knowledge of the targeted science content.

The analysis for RQ1 reveals the complexity of BLs' written responses and oral thought processes in relation to BLs' STE content knowledge. The analysis shows that there are considerable and meaningful variations in BLs' representations of STE content in their written responses. The variations revealed in the written responses are contextualized through BLs oral thought processes. Only two of the ten written responses showed a deep understanding of the STE content and were provided by the same student. Half of the written responses contained limited information regarding the targeted STE content. These responses were categorized as displaying little, if any of BLs' STE content knowledge because there wasn't enough information provided to determine if there was a deep or somewhat meaningful understanding of the targeted STE content.

What is striking about the responses in this category is not necessarily the limited amount of STE knowledge communicated in the written responses, but the reasons *why* they are limited, which is explored during the interview. The limits reflect misinterpretations of the item's text and not necessarily a lack of understanding of STE concepts. BLs' seem to be answering an entirely different question or type of question. From an empirical standpoint, it would be misleading to say the majority of the written responses are "wrong." The responses are misaligned with targeted content and often exclude representations of the targeted information.

The misaligned responses are made evident through the analysis of BLs' understanding of the STE content but point to a linguistic issue. In the interviews, the communication structure shifted to an oral discussion of thought processes and the science concepts these discussions included. When this research began, the targeted science content knowledge was conceptualized as a factor distinct from language. However, BLs' written and interview responses show that a line distinguishing science content and language cannot be firmly drawn. Language is the mediator for the development of the very knowledge assessment tests aim to measure and students strive to communicate (Albert 2012; Vygotsky, 1986; Wink &Putney, 2012). This begins to explain why the analysis of the written responses constructs a set of findings specific to BLs. Initially, it may be challenging to see how the concerns around these responses relate to specifically to BLs. However, the analysis in the next section of this chapter explores the linguistic features of the context and the processing of language. The upcoming analysis reveals the critical role of the relationship between multiple languages and its impact on BLs' experiences when engaging with the open response test items.

## Understanding the STE Assessment through Linguistic Expectations
This section includes the findings and analysis for the second research question in this study (RQ2): *What do fifth-grade BLs' (a) written test responses and (b) oral thought processes communicate about their understanding of the STE assessment?* The first section of the analysis for RQ2 examines BLs' written responses and the second section examines the oral thought processes gathered from BLs' interviews. The analysis for RQ2 concludes by looking across responses.

BLs' written responses and interview data were examined to understand what BLs' believed was necessary to communicate their knowledge and engage with the text. Both sources of data were coded to capture the ways BLs interpret the language of the test and structure the language of their responses based on their perceptions about the test context. There is evidence of BLs' perceptions in their written responses but BLs elaborate on their writing through their oral thought processes, during their interview. These codes were informed by an iterative process grounded in prior research on science assessments as communicative events and themes within the data itself.

Analysis of data indicates that BLs' drew from multiple contexts when determining how to interpret the language of the test and use language to structure their written responses. These contexts include beliefs about who was reading and grading their responses (the audience), formal writing techniques, and overarching rules about participation with the test items. The analysis shows how BLs' beliefs about the assessment stemmed from their use of language in out-of-school and academic contexts. These beliefs set parameters around the languages BLs chose to include and exclude in their responses.

The analysis for the written responses and oral thought processes are offered in two separate sections. Each section is organized based on two overarching categories: (1) the

structure of the responses and (2) the content of the responses. The structure of the responses focuses on how BLs use language to organize their responses. The content focuses on the information included in the item. This is an especially important category because many BLs included information in their responses that was not related to the *science* content. BLs' interpretation of the item and the structure of their response sometimes led them to include this type of untargeted information. The information BLs include is important in the analysis because it helps delineate their understanding of the STE assessment, even when they do not understand it to be an *STE* assessment at all.

#### Mirroring in the structure and content of written responses

The previous analysis shows that BLs' written responses include a wide range of information. At the same time, there is a far narrower range of linguistic structures used to organize the information found within BLs' written responses. The linguistic structures used in the written responses are similar across cases. This was somewhat unexpected given the diverse range of personal knowledge and academic experiences that BLs drew from when developing their written responses. Deep examination of this overarching finding reveals that the similarities in the linguistic structures of the written responses derive from the item text itself. This text-based linguistic structure, evident across written responses is described below. This is important because it indicates that students received cues from the text and used those cues to develop their written responses. This is also important because analysis shows that the structure of the written responses influences the content of the response.

BLs' written responses are often structured with some form of *mirroring*. Here the term *mirroring* encompasses the different ways that BLs reflect the ideas and words included in the item text within their own written responses. The linguistic structures of the written responses

display the practice of *mirroring* when BLs: 1) include the exact wording from the item text to frame their responses; 2) establish one to one correspondences between the item's prompts and the written response; and 3) use English as the language of response. Each of these facets of *mirroring* is interconnected.

Many written responses include the exact wording from the item text to frame the response. This type of written response typically begins with phrases and sentences pulled from the item text and ends with a few student-generated words to complete the response. Framing a written response with the exact wording in the test item influences the type of self-generated text that can follow and complete the response. This type of response also indicates how much of the written response BLs believe should represent the language of the test and how much should be self-generated. Additionally, using the exact wording form the item text can often lead to one to one correspondence, another form of mirroring described next.

One to one correspondence between the item's prompts and the written responses refers to the ways written responses relate to specific prompts in the item text. This occurs when the item text includes phrases that prompt students include "*two properties of sandy soil*," "*one thing Alicia could add to the soil*," or "*two properties* of [an identified] *material*." When BLs' responses include two ideas or concepts to indicate two properties or one substance that represents one thing what could be added to the soil, it represents one to one correspondence. This can easily be overlooked as a common practice when developing a written response for this type of open response text but it represents more than that. When one to one correspondence is displayed, it gives direct insight into BLs' understanding of what they are being asked to provide. It is reasonable to conclude that the two things that a student lists in response to "*describe two properties*..." represent what that student believes properties to be. A lack of one

to one correspondence indicates that information is missing either because the targeted knowledge has not been attained or because the item text has been misinterpreted.

The use of English, and more specifically, the *sole* use of English is the third and final form of *mirroring*. It is certainly interrelated with the other forms of *mirroring* described above and is displayed in each of the ten written responses. The analysis includes the use of English as a form of mirroring because it is a critical feature of the item text and the written responses that can be easily overlooked. English is the only language represented in the item text but it is not the only language represented within the contexts BLs draw from when formulating their responses. This indicates that BLs are mirroring monolingual practices in their written responses, though not necessarily in their thinking. In some cases, BLs can only write their response in English because they cannot write in their first language. If they possess knowledge and represent it in their first language and cannot translate it into English, they cannot include it in their written response. In other cases, BLs can write in more than one language. When these students use English for their response it represents a choice to include one language. This is also an important feature of mirroring because it indicates that BLs' believe they are writing for a monolingual English speaking audience or a multilingual audience that shares English as a common language. This alone indicates that BLs experience the assessment as one that is either English-centered or English dominant.

## Exact Wording

BLs structure many of the written responses using the exact wording derived from the item text. An example of this exact wording can be seen in Nestor's written response for the *Beach Garden item*. The prompt reads, "*Describe two properties of sandy soil that make growing vegetables difficult*." Nestor begins his written response by mirroring many of the same words;

"two properties of sandy soil that make growing vegetables difficult." Nestor then completes his written response with self-generated text; "the sand not being moist enough and the high tide blowing against the shore." The structure of Nestor's response shows how he sifts through the item text and zeroes in on the prompt that calls for a response. In other words, he identifies the part of the text that signals his response.

The linguistic structure of this written response pulls directly from the item text and as a consequence influences the content of Nestor's response. Nestor's response suggests that he believes "the sand not being moist enough" and "high tide" are two properties of sandy soil. The content of his response tells us that he understands properties to be characteristics of the soil but also external weather conditions that impact the soil though they aren't attributes of the soil itself. This also indicates that Nestor gave considerable weight to the scenario presented in the item text instead of focusing exclusively on properties of sandy soil that make growing vegetables difficult. The exact wording in Nestor's written response shows that he can identify prompts within the item text and use those prompts to set parameters around the self-generated text he provides. Overall there is cohesion between the structure and content of his response. Interestingly, this type of cohesion was not always evident in the written responses structured using the exact wording from the item text.

Marisol's written response for the *Seesaw* item provides another example of exact wording as a *mirroring* practice but the mirrored and self-generated text are disconnected. The prompt reads, "*Describe two properties of the material you identified in part (a) that make it a good choice to use to build the seesaw*." In response, Marisol writes, "you could identified in part a is that the long wood stick could use like something that you could hold on." Marisol uses the item text to structure the beginning of her response. However, her response becomes disjointed and challenging to comprehend when combined with her self-generated text. This differs from Nestor's practice of mirroring. When Nestor selects a segment of the item text to structure his response he accurately identifies words that cue his thoughts. The words Marisol selects from the item text are not the words that prompt the test taker to respond. This makes it challenging for her to provide a cohesive response. Looking across Nestor and Marisol's responses shows that some degree of accuracy is necessary for effective communication when mirroring words from the text.

Danila's responses for the both the *Beach Garden* and *Seesaw items* provide examples of written responses that use exact wording to mirror the text to a greater degree than Nestor and Marisol's responses. Danila does not introduce any new text because she answers by circling a prompt. Danila's entire response is composed of mirrored text making the structure and content of her response completely reliant on the item text. Danila's responses differ significantly from Nestor and Marisol's responses. Nestor and Marisol recognized that words in the item text included prompts that signaled the need to provide a written response that included self-generated text. However, Danila interpreted these same words differently. She did not view the item text as one that signaled an open-ended response. Instead she believes an appropriate response is one that selects exclusively from what is provided. She identifies the prompts as mutually exclusive statements where one represents the correct answer. Danila's interpretation of the text makes it challenging to analyze the content of her response. However, it is reasonable to conclude that Danila selected a prompt, because she doesn't recognize that they are opened response items, which require written responses or explanations.

This cross-case examination shows that the practice of mirroring the exact wording from the text is prevalent across cases and can lead to a range of responses. When BLs use the exact wording to frame their written responses it sometimes helps to develop appropriate and complete responses but at times it does not. The fact that BLs mirror the text suggests that they believe their responses should be closely related to what has been presented in the prompt and that the item prompts are not designed to evoke entirely open-ended responses.

## One to One Correspondence

The mirroring practice of establishing one to one correspondence between the item text and the written response is a key feature that structured the written responses. At times, establishing one to one correspondence relates back to the practice of mirroring the exact wording from the item text. If the words repeated from the text signal how much information to provide, it can prompt students to respond accordingly. This may be expected because the numerical words that signal the test taker to provide a set number of "materials," "properties," or "features" are emphasized in bold letters. However, despite what appears to be obvious and explicit, some BLs did not establish this one to one correspondence between the text and their written responses.

Nadina's written response for the *Beach Garden* item illustrates how she establishes one to one correspondence between the item text and her response. Nadina writes, "Two properties of sand[y] soil that make growing vegetables difficult are to grow a plant you need wet and moist soil and the seeds would probably blow away with the dry sand." Her written response begins with "two properties of sand soil…" indicating that she will then provide a response that includes two separate properties of sand[y] soil. This is an important structure in her written response because it indicates where particular pieces of information can be found and gives insight to Nadina's comprehension of the word "properties" (Proctor, Silverman, Harring, & Montecillo).

Nadina lists the following as two properties of sandy soil; (1) "you need wet and moist soil" and (2) "the seeds would probably blow away with the dry sand. This is of particular interest because it shows a disconnection between the mirrored text and structure and the content of the response. Nadina lists conditions that can impact the constitution of sandy soil and alludes to sandy soil's properties but never states properties explicitly. She begins her response intending to list two properties of soil, as prompted by the item text but provides two conditions instead. The disconnection in Nadina's response may indicate a misinterpretation the word "properties" or it may indicate that she found difficulty merging the mirrored portion of her response with the personal, self-generated portion of her response. Both of these challenges are intrinsically language-based.

The structure of Nadina's response mirrors the prompt for one to one correspondence in the text and she has included pertinent information regarding two properties of sandy soil. Despite this, Nadina's interpretation of the word "properties" and the challenge of reflecting both the text and her personal knowledge in writing leads her to provide a response that is misaligned with the information actually sought by the item's prompt.

Ida's written response for the *Seesaw* item provides another example of a response that establishes one to one correspondence between the item text and her response. Ida's written response strongly represents one to one correspondence because she, very literally lists her answers. In response to the prompt, "*Describe two properties of the material you identified in part (a) that make it a good choice to use to build a seesaw,*" Ida lists, "handle" and "wood." Though her written response is minimal, it conveys important information about her interpretation of the vocabulary included in the STE assessment. Her response shows that she understands the assessment as a communicative event that solicits specific and targeted

information. Ida's response also reveals some information about her definition of the word "properties." She believes the handle and wood are properties. This suggests that in this context she understands "properties" to mean components, parts, or materials used to build the seesaw.

Ida's uses one to one correspondence to assist her in structuring her response. This structure establishes a direct connection between her understanding of the word "properties" and her written response. In its entirety, her response reveals an understanding of the item's prompt from a structural perspective but a misunderstanding of the item's content. Like Nadina's response to the *Beach Garden* item, the disconnection in Ida's response is language-based. The tense relationship between the disconnections in BLs' written responses and the linguistic features of the items are made evident through the analysis of data.

The two mirroring practices of exact wording and establishing one to one correspondence are important to examine because they surface a quiet but foundational question about BLs' experiences and the relevance of the analysis. These mirroring practices are likely present in written responses provided by monolingual English speaking test takers. Though this population is not the focus of the study or the analysis, this is relevant to the analysis. With this in mind, the analysis provided underscores the importance of what mirroring practices *reveal* and not simply the practice of mirroring in and of itself. Mirroring the linguistic components of the test item shows that BLs are required to enter a monolingual, English-centered communicative event when they themselves navigate more than one language. This experience is fundamentally different from the experience of a monolingual English speaker entering a monolingual Englishcentered communicative event because bilingual students do not experience each of the languages they use and comprehend in isolation (Grosjean, 1982). This distinction is relevant to the sole use of English, the third mirroring practice, observed in BLs' written responses.

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# English only

English is the only language visibly represented in each of the ten written responses examined in this study. This is worth noting because all of the student participants in this study are bilingual and some of these student participants can write in their first language as well as in English. This mirroring practice is closely related to the use of exact wording and establishing one to one correspondence. Additionally, the sole visibility of English in the written responses shows that all BLs who participated in the study perceived the assessment to be a monolingual communicative event though this is never communicated explicitly.

Looking across cases, responding in English certainly relates to the use of exact wording and the practice of establishing one to one correspondence in the written responses. The words in the item text are provided in English so using the exact wording from the test to structure the response automatically invites the English language into the written response. Similarly, students often incorporated the test language to establish one to one correspondence in their responses. This, in part, influences the use of English. However, it does not explain why students did not use a combination of languages, even though they were instructed to respond to the item in the language they prefered.

The analysis of the written responses alone is limited in its ability to capture BLs' understanding of the monolingual features of the assessment. The data points to the dominance of English in the item text but the responses do not clearly indicate why it also dominant in BLs' written responses. The analysis of BLs' oral thought processes, as communicated in the student interviews, explains and contextualizes the dominance of English in BLs' written responses as well as the additional mirroring practices that structure BLs' responses. Looking across cases, the written responses show how BLs mirror the assessment's language in the content of their written responses. Mirroring the language of the test items reveals BLs interpretation of the assessment as a monolingual communicative event. It also reveals the challenges and requirements BLs face when developing and communicating their responses in writing.

# **Understanding and Contextualizing Mirroring Practices in Oral Thought Processes**

This section examines BLs' oral thought processes to understand and contextualize the mirroring practices revealed in their written responses. During their interviews, BLs were asked specific questions about their individual written responses and about their general understandings of the assessment. BLs' verbal responses to questions about their individual written responses describe how they make decisions regarding the structure of their responses in ways that mirror the item text. Additionally, BLs' verbal responses to questions about their general understandings of the assessment describe why they believe it necessary to incorporate mirroring practices in their written responses. The structure of this section parallels the previous section. It is organized based on the three identified mirroring practices and incorporates BLs' verbal responses to questions about their general understandings of the assessment throughout.

## Understanding and Contextualizing Exact Wording

During their interviews, BLs describe their mirroring practices in explicit detail and explain their thinking regarding the exact wording strategy. As BLs discuss their thinking, they provide a rationale that supports their decisions to mirror the item text. The rationales BLs provide connect with their beliefs about and expectations of the assessment. Some BLs describe this mirroring practice as a strategy that allows them to appropriately structure their responses. Many BLs describe this mirroring practice as a means to offer what they believe to be a complete or correct response. This rationale is at times connected to the belief that the correct answer was, at least in part, located within the item text. This section of the analysis examines the accounts BLs offer around these rationales.

Some BLs describe their use of exact words from the item text to structure their responses. They believe the assessment is designed to prompt a response that is constructed by words from the item text and words that convey their own ideas. Nestor provides an example of this in his interview. He refers to the exact wording mirroring practice as "echoing." When describing his thinking prior to writing his response Nestor says, "I would echo. I would like write the question....and I would write my thoughts about like what I think." Nestor describes a practice that is evident in his written response. His responses begin with the item text and he completes the response with his own personal thoughts. Nestor explains this practice as an appropriate strategy when responding to an opened response test item.

Nadina also describes her mirroring practice explicitly. Like Nestor, she also provides an account of her thought processes prior to writing her response. She describes her decision-making around the construction of her response to *Beach Garden* saying, "I was thinking about if I should like, if I can...to use some words of it [the item text] or if I should just write my answer without it." Her written response makes her decision to include words from the item text apparent. She begins her written response with words derived from the item text, with "two properties of sand soil that make growing vegetables difficult are...," and completes her response with her own thoughts. Her thinking around the decision to include words from the item text shows that this is an intentional practice. She makes a distinction between a response that does

include item text and one that does not. Like Nestor, she deems a response that uses words from the item text appropriate for this type of communicative event.

Both Nestor and Nadina describe their inclusion of words from the item text as a way to structure their responses. There is evidence of BLs' beliefs and practices pertaining to this practice that emerged in the analysis of the written responses but here, they are identified explicitly as a practice. More importantly, the oral thought processes highlighted here offer more information about the context and intention behind the practice. Both Nestor and Nadina identify two distinct parts of a response that appropriately mirror the item text; the mirrored words and the words that represent their own thoughts.

This recognition is critical because it marks a distinction within written responses that use the exact wording from the item text. Written responses that take the form of a multiple choice selection echo the entire text and never introduce another segment that represents the test taker's personal thoughts and ideas. This recognition is also of key importance in this analysis because it reveals that there is a form of division in these types of responses. Furthermore, the division described here is distinguished by ownership. BLs may include the item text in the written response but they don't claim ownership over those words. Nestor makes it clear that there is a distinction between the echoed text and his "thoughts." Nadina does the same when she explains that she has the option to "just write [her] answer without it." This practice of discernment rests behind the written responses. It only surfaces in BLs' descriptions of their oral thought processes.

The decision to provide a response that does include the item text connects to another rationale made evident through BLs' oral thought processes. BLs relate the practice of repeating the item text to the development of a complete or correct response. This indicates that BLs

believe the assessment is not only a test of their content knowledge but also of their ability to mirror the language of the test. Ida describes this belief when she explains that students taking the test need to know "like, how to answer a question, like fully, instead of like just saying 'rocky,' 'wet', like that, just answering.... rocky *properties* really wet *properties*." Here, Ida not only explains the practice of mirroring but also connects it to the quality or appropriateness of the response. To answer "fully" is to include your own ideas and connect them with the words from the item.

Marisol's oral thought processes also relate her mirroring practices to her conception of a correct answer. She uses text from the *Seesaw* item to structure a segment of her response but also looked within the text for the correct response. Marisol says, "I was thinking like what it was telling me. Like if it told me what would be a good choice [to build the seesaw]." She assumed that the correct answer was located within the text. This was unexpected because the practice of locating the answer to an open response test item within the text provided is typical of a reading comprehension test.

Marisol's oral thought processes suggest that she believes the item represents a narrative text to some extent. She says, "these two questions could help you in this story...you know like you could understand it more and like you could just like add onto the story." This description reveals that Marisol believes the text tells a "story" and that a correct response reaffirms the story and then adds to the story with self-generated information. Marisol does explain that she encounters difficulty in responding, explicitly saying, "I didn't understand mostly the question" and "these questions are kind of weird." This helps explain the disconnect between Marisol's written response and rationale. She repeats the words in the text, but admittedly does not know exactly what they mean. Like Marisol, Danila also believes the correct answer is located within the text. Danila circles a prompt as though she is responding to a multiple-choice test item. She mirrors the text because she believes the text encompasses the answer in full. In her interview, Danila says, "you just find which one is the best answer" and, "just picked the one that sounds the best…" For Danila, "its eas[y] to write your answer because you already know what its asking for." She assumes her mirroring practices are appropriate based on her beliefs about the type of communicative event in which she is engaging. She assumes that her mirroring practice is appropriate as well as correct.

Collectively, BLs' thought processes reveal the context and thinking around the practice of using the exact wording from the item text in their written responses. The oral thought processes reveal the intentionality and deliberation behind this mirroring practice. BLs' oral thought processes reveal that BLs relate this mirroring practice to a test taker's ability to provide an appropriate and correct response. This shows that BLs who participated in this study believe the open response test items are designed to assess their linguistic abilities to some degree.

#### Understanding and Contextualizing One to One correspondence

During their interviews, BLs discuss their use of one to one correspondence to structure their written responses. This mirroring practice, apparent in most of the written responses, establishes a relationship between the amount of information requested from the item text and the information provided in the written response. Establishing one to one correspondence is a mirroring practice BLs discuss in their interviews in relation to their linguistic abilities and content knowledge. BLs describe their use of one to one correspondence to provide an accurate and correct response. In many ways BLs' discussion of this practice explains how the practice sets parameters around how much and what type of information they provide. One to one correspondence is evident in both of Cecilio's written responses. His oral thought processes provide context and understanding around the practice. When discussing how his thought processes developed into his written response for the *Beach Garden* prompt, Cecilio explains, "I thought either take one of the problems that was, um, one of the two problems that make it hard to grow, and think of something to do to fix that situation." He identifies the two problems, which are the two properties of sandy soil, and something to remedy one of the two problems (properties) he identifies. Cecilio explains how he uses his understanding of what the text asked for to design and complete his response.

Cecilio also uses this rationale when developing his response for the *Seesaw* item. He explains that before he wrote his answer he first "just brainstormed why, um, and like the positive things about the wood and how good it was." He then explains that he "couldn't think of too many but...those are the two main things." He recognizes that of all the properties he comes up with, he only needs to provide two. He thought about his response in terms of the two main, or primary properties and then included them in his response. Cecilio remains within the parameters set by the information requested in the item text. He does not provide any more or less of the information required. He self-assesses his practice of establishing one to one correspondence between his written responses when he states, "I think I did a good job." He associates correctness and completion with his ability to provide the requested information with accuracy. This relationship between one to one correspondence and correctness or completion is evident in other written responses.

Nestor also assesses his written response during his interview. He explains the decisions he makes about what information to include and ultimately says, "I feel like my answer is like, I feel like I answered it properly." Nestor very explicitly says that he believes his response to be correct in part, "because it [the item text] says one and I don't want to put more than one...I just want to follow what the question says." He decides that it is important to follow the parameters indicated in the text and uses them as a signal for what he believes is a proper or appropriate response. In Nestor's interview he says, "but if I were to add like more..." and goes on to discuss additional responses he has in mind but chooses not to include. He decides to edit his knowledge to match the requested information with precision.

Other BLs, who participated in the study, describe their thinking around establishing one to one correspondence but in less detail. Both Marisol and Nadina commented on one to one correspondence in their interviews. Marisol explains the challenges she encounters in her effort to provide a complete written response, stating, "I was thinking about like two properties and I didn't write two, so then I was like thinking about more." Similar to Cecilio and Nestor, she identifies the need to match her response to the parameters established in the item text. Both Nestor and Nadina explain how they edit their responses. Nadina states, "the question for [part] B, it said more about the little story because it tells me to explain like, to reason my answer…and it only gives me like one thing not like two or three." She recognizes that there is a signal to provide one reason and makes the decision to edit her response to meet the demands of that request.

Some BLs identify the text-based signals to establish one to one correspondence between the item text and the written response. Though it may seem like an obvious or explicit feature of the test items, it is not always evident in BLs' responses. Some BLs do not identify the signal consistently and others do not identify it at all. Interestingly, BLs who do identify these signals associate it with a "proper" or "good" answer. The students who do not identifying the signal,

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also, do not indicate that this is an expectation or request to fulfill in providing a response to the open response item.

# Understanding and Contextualizing the Sole Use of English

English is the only visible language evident in each of the ten written responses. The concept of language's visibility in written text is critical to the analysis of this study because BLs' oral thought processes reveal that monolingual written responses are founded in bilingual thought processes. The sole use of English is conceptualized as a mirroring practice in this study because BLs' oral thought processes reveal how BLs drew from multiple languages in their thinking and came to an understanding of what languages to include or omit in their written responses. BLs explicitly describe their thoughts about the use of English in two main areas: their ability to read and write in a given language and their beliefs about the audience's linguistic profile. This section describes why and how BLs mirrored the English language in their written responses and relates this mirroring practice to BLs' understandings of the assessment as a communicative event.

When asked what test takers need to know in order to do well on the assessment, most BLs explain that test takers need to know how to read and how to write. Students rarely mention anything related to science, technology, and engineering content knowledge. BLs place the primary emphasis on linguist abilities. Additionally, BLs oral thought processes convey that test takers need to know how to read and write in English.

Many students communicated similar ideas about the importance of reading and writing as a means to do well on the assessment. Danila explains that test takers need to know how "to read. How to read and, mostly, how to write...and...like how to...read the difficult words mostly." Similarly, Nadina says, test takers need to know "what they learned in like, reading writing class...." Aligned with Danila and Nadina's oral thought processes, Marisol offers advice for test takers saying, "Don't read like, fast. Just take time to read." and "Read the question again and again." Finally, Nestor explains that test takers should know "how to spell...what they're gonna write before they write it" and that "you want to know what you're writing, why you're writing it about, and like you have to read the question more than once."

In each of these statements, BLs describe the role and prominence of reading and writing to comprehend the item text, think about a written response, and then provide the written response. One may expect most test takers to recognize these linguistic features in relation to the assessment. However, BLs were not specifically asked what *linguistic* skills or knowledge test takers needed to possess to do well on the assessment. BLs' perspectives emphasized the prominence of these linguistic features. This shows that most BLs in the study understood the assessment as a language-based communicative event centered on its linguistic features and not on its STE components.

Marisol, Nadina, and Cecilio characterize their perceptions of the expectations around reading and writing in further detail. Furthermore, they explain how their personal reading and writing skills intersect with the expectations they perceive. Both Marisol and Cecilio explain that they only speak and understand Spanish but they do not read or write in the language. Marisol says, "I don't know how to write and read in Spanish. I just know how to speak it. So I'd rather say it [her answer] in English." Similarly, Cecilio says, "I actually don't know how to read and write in Spanish. I can only speak and understand it." This excluded Spanish, their first language as an option for the language of their written response. Therefore, they had no choice but to mirror English, the language of the test. Nadina also expresses how her writing skills influenced her written response. When asked about the decisions she made before writing her answer she explains that she thought, "um, ill probably do the one I know how to write more in ...English." She can write in Spanish but because her writing skills in English are more advanced she decides to write in English.

The linguistic skills BLs draw from and their deliberative decision-making adds nuance to the sole use of English as a mirroring practice. BLs who can only write in English have one option for the language to use in their written response. Though their options are limited in these instances, this is still considered a mirroring practice. It is mirroring practice because BLs' distinct experiences with language establish a relationship between English in the item text and English in their written responses that differs from monolingual English speakers who can write in English. For BLs, the language they can write in is not their first or only language. BLs can only capture in writing, that which they understand or can translate into written English. One might assume that the sole visibility of English in BLs' responses and the sole visibility of English in a monolingual English speaker's written response reflect uniform experiences and understandings but BLs oral thought processes reveal that this is not the case at all.

In addition to identifying the prominence of reading and writing in English on the assessment, BLs also discussed their beliefs about their audience's linguistic identity. Additionally, BLs describe how their perceptions of the audience influenced their written responses. BLs' discussion of the perceived audience is an important factor that helps explain their understanding of the STE assessment because language is social and the intention behind communication is to be understood. BLs' oral thought processes reveal implicit social expectations around language in contexts that represent multiple languages.

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Nestor provides explicit details when discussing his use of the English in relation to the audience. He says of the open response item, "If this was in Haitian Creole, I would talk in Haitian Creole...and I would think in that...[but] this was in English. I don't know if anybody else knows the language I would write in...so I just wrote in the language that's most common, like right in [names the city]... if it was in Haitian Creole, I probably would've written it in my language...the best I could...." Here, Nestor explains that he made the decision to respond in English based on his uncertainty about the language(s) the audience understands. He took his cue directly from the text; because it is written in English, he wrote and thought in English, thereby mirroring the English language. At the same time, Nestor ties in an additional context beyond that of the assessment. He refers to the context of city where he lives, where English is the "most common" language. This influences his perception of the audience and the assessment as a geographically local assessment. Nestor does not assume that the audience is monolingual but he is unsure if the audience understands Haitian Creole and assumes that the audience has a command of the English language. Nestor also makes an interesting distinction between English and Haitian Creole. He describes English as a "common" language shared by people in his city but he describes Haitian Creole as "my language." This illustrates how Nestor understood the assessment to represent a shared language that he can use but does not claim as his own. His experience of the test is governed by a language that is not his own.

Nestor was not the only participant who attributes a linguistic identity to the audience. Ida, Marisol, and Cecilio also describe their beliefs about the audience when they explain where they think the assessment originates and to whom they think scores the assessment. Ida states she believes the scorer is "…like a person who is sitting and has an answer sheet and just checking off the answers that are correct or just a machine that puts papers in and it just tells you which ones are correct." She explains, "the person who is doing this doesn't really speak Spanish... maybe it's just "secretaries who have the answer sheets and just check off the answers that are correct." Ida then adds her conclusion "because the question is in English" and she is "pretty sure that, like, I don't...I'm not positive but maybe that person who, the reporter, isn't, doesn't speak both languages so she might not know Spanish, so I just put it in English."

Ida's interview reveals the importance of relaying information to the audience in a language they will understand. She relates this to the scoring process and receiving credit for the correct response. She assumes that Spanish, her first language, would not be understood, in part, because the text is offered in English. In other words, like Nestor, there is no indication that the audience understands a language other than English; therefore, she takes her signal from text and mirrors English in her response.

Marisol and Cecilio briefly describe their perceptions of the audience. Marisol simply says, "They don't, like, know Spanish." and Cecilio believes the audience only understands English. He says, "I just thought if [my answer] would make sense and just said it over in my head. Over and over in English, to see if it makes sense...yeah and like that it's not um, um, yeah, it's understandable and it's not, um, something goofy." He assesses his written responses with regard to the scorers, "I think it will make sense to them." Both Marisol and Cecilio believe the audience understands English and think it is important to write in English, so that the audience will understand their responses and scores their answers accordingly.

Looking across BLs' oral thought processes reveals the nuances involved when BLs mirror the language of the test. BLs provided many different rationales behind their use of English. For some it was the only language in which they could write and others used English because they assumed that was at least one of the languages (or the only language) the audience could understand. BLs' oral thought processes reveal the importance of English as a shared language used to understand the item text and convey their ideas in writing.

#### Chapter Summary

This analysis provided above centers on the research question (RQ2): *What do fifth-grade BLs' (a) written test responses and (b) oral thought processes communicate about their understanding of the STE assessment?* BLs' written responses and oral thought processes reveal a great deal about their understandings of the STE assessment as a communicative event. BLs' written responses and oral thought processes also reveal that most of the BLs who participated in this study saw the test primarily as language assessment and not an STE assessment. These findings surfaced because the written responses included similar linguistic patterns. The oral thought processes confirmed, contextualized, and elaborated on the what was evident in BLs' written responses.

BLs written responses include a set of language-based *mirroring* practices. BLs mirror the language of the assessment in the structure and content of their responses. These practices were evident in BLs' written responses and were contextualized through BLs' oral thought processes. BLs' oral thought processes also revealed how BLs made decisions about what language to use and include in their responses. Though each BL engages with the items uniquely, looking across cases shows that BLs' saw English as a central and critical component in the content and structure of their responses. Overall, the analysis finds that BLs understand the STE assessment to be English-centered with built-in expectations for how BLs use English to reflect concepts found in the text and/or convey their own personal thoughts and ideas.

#### **CHAPTER FIVE**

# TEACHERS DISCUSS THE IMPACT OF CONTEXTS

#### Introduction

This chapter provides analysis and subsequent findings for the third research question (RQ3): *What do teachers' observations reveal about BLs' experiences responding to STE open response test items?* This research question was separated from the other research questions because it focuses on teachers' observations of BLs' written responses and oral thought processes. This is important to acknowledge because RQ3 considers perspectives about BLs' experiences that are not generated from BLs themselves.

The three teachers interviewed, Ms. Mendes, Ms. Jacobs, and Ms. Morales, are all fifthgrade teachers at Ascension Middle School. Each of the teachers who participated in the study teaches the BLs who participated though they only interviewed two students each. At the time the study occurred, Ms. Mendes was a first-year teacher, teaching fifth-grade science and a technology and engineering enrichment class. Ms. Jacobs was a second-year teacher who taught fifth-grade English Language Arts. Ms. Morales was in her third year of teaching and taught fifth-grade math.

Each of the three teachers speaks at least two languages and have different experiences as K-12 learners. During their interviews, the teachers discuss how their personal experiences as young BLs impact the support they provide for BLs in their classroom. Teachers' perspectives are important because they describe the lenses teachers use to make observations of BLs and the contexts BLs engage when they interact with the open response items.

Together, they represent the fifth-grade team and work collaboratively to plan and implement instruction for all fifth-graders at Ascension Middle School. Through their

collaboration, these teachers integrate disciplines during instruction. During the training teachers received prior to conducting the interviews, teachers explained that they each support the instruction students receive in other content areas. This support also includes the integration of instructional and assessment practices to create a learning environment with clear, and consistent expectations. Though they work collaboratively, there are also distinctions in their roles as teachers that influence their ability to speak about the STE instruction students receive and the range of assessment practices for fifth grade BLs at Ascension Middle School.

The analysis for RQ1 and RQ2 heavily emphasizes how BLs process language and situates it within the contexts they draw from. The analysis for RQ1 an RQ2 also describes some characteristics of the contexts BLs engage when interacting with the open response item text from BLs' perspective. The analysis for RQ3 complements findings emerging from analysis of RQ1 and RQ2. However, it provides additional details regarding the nature of the contexts BLs draw from and the relationships between the contexts and BLs' experiences processing language as they engage with the text.

Teachers' observations, shared in their interviews, help to explain how and why the contexts BLs' engage impact of BLs' interpretations of the item text and their written responses. Teachers connect their observations with accounts of the STE instruction BLs' receive in class and the common testing procedures at Ascension Middle School. Teachers explain how these contexts impact BLs' experiences engaging with the item text. Teachers provide vital information about and how BLs' experiences in and out of school influences their learning on a day-to-day basis. Because teachers have a wide breadth of academic experiences with the BLs who participated in this study, they are able to make connections between their experiences with BLs and their experiences observing and interviewing BLs as they completed the open response

items.

The analytical process for the teacher interviews was, in part, an iterative process. The process unfolded in this way because the teacher interviews were a rich source of data. Teachers provided detailed descriptions during their interviews, illustrating a deep and personal knowledge of the BLs who participated in the study. As a result, this data informed many aspects of the study. Some of the teacher interview data informed the development of the conceptual framework. Teachers' observations and subsequent discussions described BLs' processing language through contexts from an emic perspective. Teachers' observations also confirm that there are multiple contexts at play, as surfaced in BLs' written responses and oral thought processes. The use of teacher interviews to refine the conceptual framework strengthened the analytical connection between data generated from the teachers and BLs in the study. In this way, the analysis of teachers' interview data is in sync with data gathered from BLs.

The process of refining the conceptual framework using teacher interview data informed the analytical process for RQ3. The teacher interview data confirmed that BLs drew from multiple contexts but there was additional data that revealed how the context impacted BLs' experiences in ways that were not entirely explicit in BLs written responses and oral thought processes. Teacher interviews were first coded to identify how teachers describe BLs' experiences in terms of the key features of language; social, cultural, a process, and contextual. This was a challenging aspect of the analytical process because there is considerable overlap among these features in teachers' descriptions. This indicates that there are clear and strong relationships between the key features of language. The analysis of RQ1 and RQ2 helps to illustrate these relationships through student data. The analysis for RQ3 helps to illustrate how and why these relationships exist when BLs engage with the open response items. Overall, the coding and analytical process for RQ3 reveals that teachers' observations identify and describe three overarching contexts that impact BLs experience engaging with the open response test items. Furthermore, the analysis shows the relationships between these contexts and the impact of these contexts on BLs interpretations of the item text and the development of BLs' written responses.

### **Teachers Identify and Characterize Contexts**

Each of the three teachers in the study identify three overarching contexts in their interviews; (1) BLs' home and community context; (2) The Ascension Middle School context; and; (3) The *Standardized STE Assessment* context. It is important to note that teachers did not explicitly refer to these as "contexts." Teachers described these settings and provided a description of their characteristics. Teachers' descriptions of these physical and social spaces include discussion of sociocultural norms and expectations within those spaces and are therefore, from an SCT perspective, classified as contexts (Vygotsky, 1986; Wink & Putney, 2012). During their interviews, teachers were asked specific questions about the STE instruction BLs receive and the general assessment practices at Ascension Middle School and the STE assessment.

Teachers' responses to these questions help to characterize the Ascension Middle school context and the *Standardized STE Assessment* context. Though teachers were not explicitly asked questions about BLs' home and community life, teachers were very knowledgeable about BLs' out-of-school experiences. Teachers frequently included information about BLs' personal experiences in their discussions without prompting. This helped to identify and characterize BLs' home and community life context. Teachers' identification and characterization of these three contexts are informative, but more importantly, their discussion makes connections between these contexts and BLs' experiences with the open response items.

## Teachers Identify and Characterize the Home and Community Context

Teachers identify BLs' home and community life as a context relevant to BLs' school experience. The discussions of BLs' home and community include numerous accounts of BLs experiences around language. Teachers describe how BLs and their families' migration and heritage, attitudes towards the use of their first language in school, and use of language outside of school influence BLs' understanding of and responses to the open response items. Teachers explain that these out-of-school experiences impact BLs' engagement because students approach the open response item with an existing set of beliefs, expectations, and experiences regarding language.

In their interviews, teachers share that the BLs participating in the study represent a range of nations, including Cape Verde, Colombia, Haiti, and Puerto Rico. Ms. Mendes describes how one BL participating in the study has "been here [in the U.S.] since she was five" and has "a bit more familiarity with English compared to another BL who is in "her second year in the country, so this is really officially her first year in a full English language program. She came into her school year halfway through last year..." and this "impacts [her] general comfort with the [English] language." They explain that "there's gonna be a range in [BLs'] familiarity with English because of their various experiences. The circumstances around BLs' migration experiences intersect with the social and academic expectations they encounter in the U.S. This occurs because many of the expectations BLs encounter in the U.S., like the STE assessment, are facilitated in English.

Ms. Morales connects the experiences BLs have outside of the U.S. to their experiences engaging with the open response items. She says,

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One student explain[s] that as she's thinking about how to answer [Beach Garden], she thought back to her visit to Colombia and what her cousin had told her... about the beach and she was able to explain, "My cousin said this to me in Spanish, so in my mind, I thought about it in Spanish."

In this case, the experience encountered outside of school impacts the understanding and interpretation of the open response item. Ms. Morales finds it "interesting to get a picture of how [her] students think." The practice of processing language while drawing on a particular context is not visible. Ms. Morales observes her student taking time to read and respond to the test item but does not know the thoughts or contexts behind the process until her interview discussion with the student.

Ms. Morales explains that her student:

Thinks about things in two different languages, ... and her thinking was just so profound and ... gave me insight into why it took her time. She was taking things that she had heard from relatives and friends, and...she was thinking about them in the language that they were presented to her... and she used all of that to inform her thinking. It seems so easy for her to switch back and forth, which I understand, because I grew up speaking two languages.

Ms. Morales's observation and interview with her student provide an example of how BLs connect their home and community context to their experiences with the exam. The account Ms. Morales offers during her one-on-one interview helps to describe the concept of the home and community context and makes connections between context and their experiences with the open response item.

According to the teachers, the impact of migration on BLs' language-based experiences is not only about the country of origin or the national cultures BLs represent, but the circumstances and complications around migration itself. Ms. Mendes explains how migration has led to custody complications, which then impacts who BLs live with and what languages they speak with their parents or caregivers. Some live with grandparents who "pick them up afterschool and do homework with them." She also explains that some BLs may share the same first language as their grandparents, but rarely speak English with them. These experiences also help to describe the home and community context because it shows that BLs have experiences outside of school that are related to their academic work. The experiences outside of school are distinct because they center on BLs' first language.

# Teachers Identify and Characterize the Ascension Middle School Context

The three teachers in the study explain how Ascension Middle School functions as a context relevant to BLs' experiences engaging with the open response items. Their observations and interview discussions explain the STE instruction and general assessment practices BLs encounter at Ascension and teachers relate these practices to BLs' performance. The teachers highlight that within the Ascension context, language plays an essential role during STE instruction, including the administration of classroom assessments. As teachers describe Ascension's practices, they relate their discussion to BLs' experiences with the state's standardized STE Assessment. Teachers compare and contrast Ascension's assessment practices with those of the standardized STE Assessment. In the process, teachers explain how these similarities and differences influence BLs' approach to the open response items.

Ms. Mendes provides most of the accounts of STE instruction given that she teaches the subject. The fifth-grade team at Ascension integrates curricular content across academic subjects,

providing the opportunity for Ms. Jacobs and Ms. Morales to provide informed accounts as well. Ms. Mendes explains how she structures STE instruction saying:

I usually love to start off with experiments so they can talk about it before anything comes from me at all. I love for them to have an experience with it...and have the opportunity to talk and take notes ...and after notes, we'll try to jump back into more hands-on things. I really think the beauty of science is just getting in there, and doing it, and seeing what happens.

Here, Ms. Mendes describes a "hands-on" approach to instruction that allows BLs to explore tangible materials, record notes, and engage in conversation with their peers. These experiences are relevant to BLs' experiences with the open response items because the STE instruction they receive is part of the context in which they learn STE content knowledge.

Teachers reference and describe the hands-on projects BLs complete during science instruction. For example, Ms. Jacobs provides a description of BLs' experiences growing plants in the school garden. She states, "The greenhouse isn't up yet, but we do have the garden. It's a fully functioning garden...Students do get a chance to go and pick food from it and we'll bring it back and we cook it here. So, it is something they have a little exposure to…" Ms. Mendes also references her experience working with students at the beginning of the year asserting, "We identify, or just study, and also grow our own plants…the stages of the life cycle of a plant, so…some of the projects that we were able to do was to…grow plants and grow seeds." Ms. Mendes prefers that BLs spend most of their time during instruction engaging in hands-on activities and discussions. She says, in terms of note taking, I keep it very simple, where it's not asking too much writing."

This contrasts with the Standardized STE Assessment context in which BLs read and

write exclusively. When BLs respond to the open response items they have no materials to manipulate or engage with. This is the case for all students taking the test, however, BLs' command of the English language can set parameters around what they are able to express in writing. Working with materials and engaging in discussion allows for gestural modes of communication that cannot be readily expressed in writing. Within the Ascension Middle school context, BLs gardening experiences do relate to the STE assessment in some ways. According to Ms. Morales, the Beach garden test item describes plants as "living things" and asks, "What is necessary for them to thrive?" She explains that the test item "very much has to do with…objectives [BLs] learned in class" and that "the life cycle of a plant is an objective that [they have] taught…" Teachers' accounts reveal that the content taught aligns with the content tested; yet, the ways BLs are invited to engage with the content differ significantly. In class, the engagement is hands on and communication is often verbal. In the open response items, the content is abstract (Albert, 2000; Vygotsky, 1986) and communication occurs via reading and writing.

Ms. Mendes provides an additional account of STE instruction that characterizes BLs' experiences at Ascension that informs how BLs' engage with the open response items. She describes a project where BLs worked in groups to create "a biome in a bottle." Ms. Mendes explains, "They were to do their own research, use their own binders with information [from] all the pervious lessons, [and] notes that...help them create their biome...and show how an ecosystem works together." She assessed their learning through a group project where students worked together to create and present a diorama of their biomes, labeling and detailing how the "biotic and abiotic elements work together." Students "were given a rubric where they were scored from one to four." The rubric connected the scores to "previous lessons and expectations

for each [score] from the lowest one to proficient." Ms. Mendes placed students in linguistically diverse groups and observed that "working with native English speakers was useful for non-native English speakers...it [was] very helpful just speaking with people who have expertise in a certain language." Ms. Mendes observed her students and says, "I noticed that the bilingual speakers...I can't really conclude what the reason behind this was, but the bilingual speakers actually used way more scientific language than the native English speakers." She specifically refers to Danila, stating, Danila "use[d] way more scientific words than her partner...who is born and raised in America."

This account of STE instructional and assessment practices describes a context that varies significantly from the expectations BLs encounter through the *Standardized STE Assessment* context. In class instruction and assessment, students can manipulate materials and engage in discussion with their peers. During classroom conversations, BLs can seek clarification and guidance as they experiment with materials and make observations. These social exchanges are prohibited when BLs engage with the open response items because they work independently and cannot seek clarification beyond what is evident in the text (Shaw, Geaney, & Bunch, 2010). Additionally, the *Standardized* STE Assessment context does not include a rubric. BLs can make assumptions about what types of information to include and how to structure their arguments; though the actual requirements and demands are never communicated explicitly.

One area of alignment between Ms. Mendes's account of the Ascension context and the *Standardized STE Assessment* context is her observation of BLs' use of scientific language. Ms. Mendes explains that the lessons she designs sometimes include "tier three, dense vocabulary, where there's just so much science vocabulary [BLs] might not pick up in very easily." In response to this, Ms. Mendes teaches the vocabulary very explicitly. She provides many

opportunities for group discussion so students can practice using the vocabulary. This aligns with the mirroring practices BLs displayed in their written responses. It also aligns with the implicit expectation that students understand and use scientific language in their written responses to the open response items.

In addition to STE instruction, the teachers also describe Ascension Middle School's assessment practices. These descriptions provide insight into BLs' experiences with assessments in their classrooms and how these experiences inform and impact their interactions with the open response items. Analysis of the interviews reveals that teachers scaffold and differentiate assessments for BLs based on BLs' abilities to read and write in English. Additionally, teachers' accounts of their assessment practices describe the types of assessments BLs' encounter in the classroom and how BLs' are prepared to engage with these assessments. Overall, scaffolding and assessment practices contextualize BLs' written responses to the open response items as well as their oral thought processes.

Furthermore, teachers scaffold and differentiate instruction built on their knowledge of BLs and specifically, on BLs' linguistic abilities and needs. Teachers explain that this is part of the context around assessment and instruction at Ascension Middle School, which differs from BLs' experiences with the open response items. The differences between these contexts offer insights about BLs' experiences with the open response items in relation to their experiences with assessments at Ascension Middle School.

When asked about the assessment practices at Ascension Middle School, Ms. Jacobs replies, "We don't have a set formula-because it looks different for everyone." She explains that she "scaffolds differently" than when working with the STE assessment and provides "more supports around building [BLs'] language skills but [BLs] still struggle with language

acquisition." She continues, "I even think of how I format some of my assignments and how it's important that I constantly think about how it could... remove any confusion ahead of time" because many BLs in her class have "a hard time understanding what to do or what's being asked of [them]." The teachers provide this type of support in lieu of teaching to the test and from Ms. Jacobs's account, they "don't spend too much time teaching test structures." Ms. Morales supports this statement asserting, "I have to be honest...because we are a private school-there really isn't a push [to prepare] for standardized tests."

Ms. Jacobs's description of her practices emphasizes the importance of tailoring assessment practices to BLs' needs based on their linguistic profiles. She explains that the purpose of scaffolding assessments is to "remove confusion" and make the assessment accessible. Ms. Jacobs places emphasis on BLs' ability to discern what is being asked of them. This aligns with the analysis of BLs' written responses in this study, which reveals varying degrees of uncertainty about what is being asked.

Ms. Jacobs contrasts her tailored approach with that of the standardized open response items. Her description of her assessment practices not only helps characterize the Ascension context but also shows how it differs from what BLs experience with a standardized approach. BLs' who participated in this study experience assessments at Ascension differently from largescale standardized assessments with firm rules and regulations about the test's administration and permissible accommodations.

In addition to these accounts, Ms. Mendes and Ms. Morales also explained the importance of scaffolding assessments and instruction. With regards to scaffolding for assessments, Ms. Mendes elaborates, "I just know that as a teacher that I'm setting up my students for a success." Ms. Morales provides this explanation, stating, "I try to vary the way I

assess [BLs] learning because I understand that students learn in different ways...I try to be flexible. I trust what [BLs] are choosing to do, even if it's not the traditional way." Ms. Morales continues with an example of how flexibility and differentiation are aligned with her assessment practices:

I love doing projects. It's my thing. I will give out project menus and allow students to choose from a variety of projects and work in teams and as the year goes on [assessment] just becomes more independent... So, for example, I have a [BLs] reading at a kindergarten level, and I have [BLs] reading at a seventh-grade level. They come in like [reading at these levels], very varied, and... by gradually allowing them to become independent...they become more confident in themselves. But they also ... just do better, you know? They-they don't feel like it's so much pressure to be perfect, and to just know everything.

The approaches Ms. Mendes and Ms. Morales provide are similar to the practices Ms. Jacobs describes. Ms. Mendes believes that scaffolding for assessments sets her BLs up for success because it allows them to understand the exam. For Ms. Morales, scaffolding and differentiating assessments is about access and the purpose of assessing knowledge. She does not place a high priority on standardized or "traditional" modes of assessment and doesn't expect that students will be "perfect" or know "everything." Assessments are intended to reveal what students know and areas where they still need to learn and develop deep understanding. This differs from BLs' experiences with the open response items where the emphasis is placed on getting the right answer and being graded with rigidity.

The accounts all three teachers provide describe the scaffolding and differentiation for instruction and assessment that occur at Ascension Middle School. They show a considerable
difference between the context around assessment at Ascension and the *Standardized STE Assessment* context. At Ascension, the assessments are tailored, provide options for participation, and allow students to work in teams and independently. While teachers' accounts include strong statements and affirmations about assessment practices at Ascension Middle School, tensions underly their assessment practices as well. The teachers also describe some of the limitations they encounter while reflecting on the connections between BLs' written responses and the scaffolded instruction implemented at Ascension. For example, the teachers explain that assessments at Ascension include computer-based, paper and pencil, and multiple-choice tests. In addition to BLs' oral thought processes, the teachers' descriptions of their assessment practices in these areas draw clear connections to BLs' mirroring practices and interpretations of the open response items.

For Ms. Morales, "Chromebooks [can be used] as a way to assess math" content knowledge. She and Ms. Jacobs explain that students are familiar with the structure of these assessments because they engage with them on a regular basis. She explains that these Chromebook assessments and other assessments they implement are "multiple choice item [where] the answer is provided" and sometimes it is a "process of elimination." She elaborates, "Maybe I'm just way too easy on my kids…they're basically being asked to find the answer." This account of multiple-choice structures may explain why one of the BLs in this study interpreted the open response items as multiple choice test questions. Ms. Mendes suggests that the open response items "looked like they were multiple choice questions" and BLs at Ascension are "used to seeing that." Furthermore, Ms. Mendes explains that for the open response items, Danila "had to really think, *am I being asked to choose an answer, like A,B, or C or am I being asked to do a task.*" If BLs do not receive appropriate scaffolds to clarify the text and support their interpretations of the item, it may lead to misaligned interpretations. Additionally, Ms. Morales's reference to the ease around participation in Ascension's assessments compared to the standardized STE assessment suggests that there are contrasting and possibly conflicting features of ease and difficulty between the Ascension Middle School context and the *Standardized STE Assessment* context. In the Ascension context, teachers make concerted efforts to scaffold and differentiate assessment practices to give students access to the test. This makes the test easier in one respect. Ms. Mendes questions if this makes the assessment "too easy." It is important to recognize that there may be meaningful distinctions and areas overlap associated with the ease in engaging with the test because of its administration.

Teachers' accounts of Ascension's use of multiple-choice assessments explain that BLs are accustomed to that particular assessment format. The influence of the Ascension context on BLs' experience with the open response items is evident when Danila interprets the open response item as a multiple-choice item. Though only one student in the study made this interpretation of the test, it does show that different interpretations arise when there is uncertainty around the language used for the assessment.

Teachers' descriptions of Ascension's assessment practices also gave an account of the type of open response items BLs encounter in class and how this also influenced the written responses BLs provided in this study. When comparing classroom assessments and the state's STE assessment, Ms. Morales says, the assessments "[BLs] encounter in class "might [have] a few open response questions, but they might be framed in a different way...which I don't think they were used to." The teachers' accounts of the open response items included in classroom assessments and the approach BLs are taught help explain why BLs are not used to the state's open response items. Teachers report that BLs at Ascension only encounter open response items

during English Language Arts assessments. This does not mean that BLs have not encountered open response items in their past learning environments. However, teachers' accounts describe practices that are evident in BLs' written responses and therefore, show that BLs' experiences with open response items in the Ascension context influence how BLs engage with the state open response items.

Teachers describe how they scaffold open response items through instruction. Ms. Morales explains that they teach BLs (and other students) to "identify major themes…specific situations in fictional texts to help [BLs] understand the books conflict, characters, or personalities in fictional texts." Some BLs applied their understanding of this concept to their written responses. In some cases, BLs' written responses and oral thought processes revealed that they were interpreting the STE open response items as narrative texts. BLs like Marisol and Nadina paid close attention to the characters, settings, and conflicts in the text of the STE open response items and referenced them in their written responses and interpretations of the text. In some instances, STE open response items were treated as reading comprehension texts. In addition to this, BLs' oral thought processes reveal that they interpreted the item text as a "story" and thought the STE open response items were primarily about reading and writing and not STE content.

Teachers' descriptions of the Ascension context align with the structures evidenced in BLs' written responses. More specifically, teachers' descriptions contextualize the responses BLs provided. Ms. Jacobs explains that "teaching accountable talk" is a key feature of instruction when preparing BLs to write their answers for written responses. Through this instruction, BLs "focus on being able to uses sentence stems or accountable talk frames." This refers to the use of pre- constructed sentence starters, which are provided in English. They offer BLs an "entry point" to respond because BLs' often "freeze up" when presented with an open response item. For instance, Ms. Jacobs states, "There are gaps as far as writing skills so if there is a question, often times we'll structure the sentence for them." Many of the written responses examined in this study have similar structures where they begin with a phrase that provides a structure that allows BLs to insert the self-generated portion of their written response. Teachers view this practice as "scaffolding" as opposed to "teaching to the test." Arguably, it can qualify as both. It provides an entry point for BLs but in the process, reformats the open response item to resemble a fill-in-the-blank test structure.

Teaching "accountable talk" and using "sentence starters" aligns with Ms. Mendes's account of another practice around the use of open response assessments at Ascension. She explains that "we... as a community, have this thing called echoing, where students know that... before they respond they need to echo parts of the question...so [for example] why Charlotte save Wilbur's life? Charlotte saved Wilbur's life because..." This practice precisely contextualizes much of what is observed in BLs' written responses BLs and speaks to the mirroring practice of repeating words used in the STE item text. "Echoing" is considered a "community" practice at Ascension and not a scaffold for BLs. Demographically, Ascension has a high multilingual student population but this suggests that echoing is a practice deemed relevant for all learners including those who are monolingual. Though all students are taught this practice, it has particular nuances for BLs because they are explicitly taught to respond using one of the languages they know.

This practice also shows that assessments at Ascension are also administered in English. When asked about monolingual assessment practices, Ms. Mendes explained that as a school, they aim to prepare BLs for the future academic expectations they will encounter and that this includes "English proficiency." She explains that in a community like Ascension, English is not always seen as a dominant language or one that is more prominent than other languages. It is the shared language in a multilingual learning community and is valued for the "opportunities" and "access" it provides students. This varies from the common narrative around monolingual instruction in the U.S. The Ascension context is therefore representative of many different languages, including English. Within this context, languages have values around their use based on the purposes and goals they serve. This varies from the monolingual *Standardized STE Assessment* context. The attitudes and ideologies of a monolingual standardized English assessment can only be inferred; thus, it limits, comparisons of the Ascension context beyond the scope of this study. However, teachers share some observations of the *STE Assessment* based on their interviews with BLs.

#### Teachers Identify and Characterize BLs' the Standardized STE Assessment Context

Teachers describe the *Standardized STE Assessment* context as observed through BLs' experiences responding to the open response items. The teachers in this study have limited exposure to and knowledge of the state STE assessment because it is not one that they administer. They cannot speak to the nuances of the *Standardized STE Assessment* context to the same degree at the other two contexts analyzed and described in this chapter. At the same time, they reviewed the open response items during their training and are firsthand witnesses to BLs' experiences engaging with them. Teachers describe the *Standardized STE Assessment* context as a communicative event wherein BLs have to navigate the boundaries for participation and discern the appropriate practices to engage. Teachers describe the range of experiences BLs have locating the boundaries around communication when responding to the STE open response items and making sense of the text's meaning. Some were able to locate these boundaries with

precision and others had difficulty doing so. This is evident in BLs' written responses with specific alignment to mirroring practices.

Ms. Mendes describes Cecilio's experience, which aligns with the one to one correspondence mirroring practice. This practice sets clear boundaries around the written response. She suggests that Cecilio is "just very sure of himself…very sure…and he provides one answer, some students give- like with these open questions, even if it's asking for one they throw [in] others to see if the others are right answers." Despite the accuracy of Cecilio's response, Ms. Mendes explains that his written answer…

...isn't really reflective of his knowledge because it is just straight and to the point, and he just knows and just writes it down. And it's hard to get more out of him- to really pull it out because he's like, "No, I have the right answer, and...I gave you what you wanted already."

This account helps to show the boundaries that exist within the structure of the exam. In this instance, Ms. Mendes explains that Cecilio knows more than what is communicated his written responses but he chooses to edit what he knows to provide an answer that meets the assessment's criteria. Though Ms. Mendes deems his answer appropriate, given that "he gave the expected answer," it didn't reflect Cecilio's thinking. In this case, Ms. Mendes identifies that editing one's knowledge and structuring a response to fit within specific parameters is part of the *Standardized STE Assessment* context. This is a critical part of the context because it speaks to the purposes of a *standardized* assessment. The aim of the standardized assessment is not to capture all that students know. The assessment aims to first establish what should be known and measure if students possess that particular knowledge base. Ms. Mendes identifies how the parameters of the open response items establish a ceiling. She wanted Cecilio's written response

"to get a little bit more if his thinking behind the answer because he came in so strong." She concludes saying, "quite honestly, he gave the *expected* answer."

Ms. Jacobs identifies the *Standardized STE Assessment* context's parameters in terms of BLs written responses as well. When comparing Nestor's written work and oral thought processes she says, "what he told me and what is written is kind of imbalanced...he was more able to verbally explain his thoughts... his understanding of what was being asked of him." She explains that his answer includes "the echoing thing that I see we've been trying, and then he just gives the answer where, when he was just talking to me he had all these ideas and all this understanding he was just really expressive..." This is a complex observation that involves the *Standardized STE Assessment* context and the Ascension Middle School context. Like with Cecilio, Ms. Jacobs identifies a difference between what is conveyed in writing and orally. This highlights the importance of writing in the assessment. For BLs, the practice of writing captures notably different information than an oral response. Ms. Jacobs also identifies how Nestor drew from the *Standardized STE Assessment* context and the Ascension Middle School context when he uses "echoing" to provide an answer. When observing Nestor's use of this practice, Ms. Jacobs sees that the practice of echoing sets limits around his response.

Regarding the content of the item text, Ms. Morales explains that "there were a few misconceptions in terms like *properties*" and "when [they] talked about the word later [in the day] Marisol said, "yeah like properties, like you know, Property Brothers" like HGTV... she didn't actually make a connection at all, I don't think, to the science curriculum or anything that she's done in science class."

Teachers recognize that the *Standardized STE Assessment* context includes parameters that influence the structures of BLs' responses. They also explained that precise interpretations are an important part of the *Standardized STE Assessment* context. This is critical because test takers cannot seek clarification about the meaning of the item text and what is being asked. Ms. Mendes describes the differences she observed between two interviews saying, Cecilio "read through [the item] and he recognized that this is a question he has to answer," while Danila "didn't understand what was being asked of her. So, she just skimmed through it and circled her response, because she didn't understand what was being asked or she was having difficulty reading the text..." Danila was not the only BL who had difficulty interpreting the nuance and complex text. Ms. Mendes identifies that the context requires that BLs accurately read the text and understand its meaning and the task they must complete. This aligns with the linguistic challenges BLs faced and is apparent in the range of approaches and content evidenced in their written responses.

#### Summary

The three teachers who participated in this study identify and describe three major contexts that BLs draw from when responding to the open response items. Teachers' descriptions help to explain the role and importance of context in assessment. The relationship between the contexts and BLs' experiences engaging with the open response items coincides with the SCT lens. Teachers' accounts of BLs' experiences reveal how language is indeed contextual and, in the case of the STE open response items, influences the interpretations and understanding of the text. Additionally, teachers draw explicit connections between the contexts, how BLs navigate the different contexts and how these connections manifest. Teachers describe BLs' home and community context, the Ascension Middle School context, and the *Standardized STE Assessment* context. The descriptions of BLs' home and community context explain how the expectations and rules for each language in a bilingual context can be particular and distinct. BLs transfer the expectations for the purposes and functions of a particular language into their engagement with the monolingual STE open response items. Teachers describe how they connect BLs' home and community context and the Ascension Middle School context. They scaffold and differentiate instruction to bridge the linguistic divide between the two contexts.

The Ascension Middle School context represents a linguistically diverse faculty and student body. Within this context, English is viewed as a shared and common language. Teachers explain how the Ascension Middle School context impacts BLs engagement with the STE open response items. BLs employ scaffolding and differentiation practices learned at Ascension to structure their written responses in English. These practices provide an entry point for BLs to respond to open response items but also set limits around how much information BLs include in their written responses.

The linguistic limits and parameters of the *Standardized* STE Assessment context critically impact BLs' engagement with the STE open response items. The monolingual, standardization of the open response items, in conjunction with scaffolding and mirroring practices, set firm boundaries around the responses BLs' provided. In some instances, it posed challenges for BLs to include relevant information in their responses. In other instances, it established a ceiling that excluded relevant content knowledge that BLs possess from the written response.

Ms. Mendes provides an insightful summary that coincides with the observations in this study and her personal reflection as the fifth-grade science, technology, and engineering teacher. She captures the complexity involved in teaching and assessing a heterogeneous group of BLs saying, "they think in so many different types of ways...whether it's using their outside experiences, or linguistic experiences...they're all so different. And you know just to think about teaching and having to tap into all those different pieces, it's pretty mind-blowing to be honest."

#### **CHAPTER SIX**

#### SUMMARY, CONCLUSION AND IMPLICATIONS

The findings for this qualitative case study are included in Chapters Four and Five. This chapter includes a summary of the research, a discussion of the findings, and the conclusions, implications, and limitations of the study. The summary of the research highlights the purposes and the goals of the study and situates them within relevant theory and existing research in the field. The discussion of findings describes the relationships among key findings, across research questions. The implications relate the findings to the purpose and significance of the study and focus on how the findings impact education stakeholders ranging from teachers to policymakers. Limitations include the impact of logistics and the sociopolitical context on the research. With the study's purpose, significance, implications, and limitations in mind, the chapter closes with recommendations for future research and practice.

#### Summary of the Study

The purpose of this qualitative case study was to understand how language impacts fifthgrade BLs' experiences interacting with standardized, STE open response items from a state assessment administered in English. The study used SCT as a theoretical framework to conceptualize language as a contextualized sociocultural process. The conceptualization of language through the SCT lens led to the development and subsequent refinement of the conceptual framework. The conceptual framework represents how BLs' process language through intrapersonal engagement, which includes understanding, translating, and responding to the open response item text (Albert, 2010; Vygotsky, 1986). As BLs process the open response item text, they draw from different contexts. These sociocultural contexts have rules and expectations for the purposes and uses of a given language. Using the SCT and conceptual frameworks as a guide, this study's aim was to understand how the language included in the open response items impacted BLs' opportunities to display their knowledge of STE concepts. This was especially important given that some modes of communication are validated and made available while others are not. Additionally, this study built on prior research that examined BLs' language-based experiences with assessments by exploring the features of the sociocultural contexts in which these experiences occurred.

I approached the research with a set of assumptions about research perspectives, the participants in the study, and the study's setting. The first of these assumptions was that the dominant research narratives that frame BLs' intellectual and linguistic abilities from a deficit perspective need to be examined and deeply questioned. Secondly, I assumed that students and teachers can speak knowledgably about their experiences and observations when given the opportunity and that their accounts meaningfully contribute to rigorous research. Lastly, I assumed that the sociopolitical and school contexts would impact what data were gathered and how. All of these assumptions influenced the research design and the implementation of the study.

# Importance of the Study

The importance of the study relates to the narratives regarding BLs in existing research and the policies and practices that rely on data gathered from standardized tests. For many years a growing body of research used standardized test scores to argue that BLs' (typically referred to as ELLs) fail to achieve at levels comparable to their monolingual, English-speaking peers. It has often been argued that BLs' first language was a detriment to their learning and an obstruction to developing English language proficiency. The body of research this study draws on calls this narrative into question. Researchers argue that language is a key feature of any assessment and the nuances of the English language often impact what BLs are able to communicate when English is not their first language (R. J. Kopriva, Wiley, et al., 2007; Martiniello, 2009; Shaw, Bunch, & Geaney, 2010b). In addition to highlighting the importance of language, these studies describe the challenges that arise when BLs are assessed in their second language. Using the existing body of research as a spotlight, this study also contends with the dominant deficit-based narrative by examining *why* monolingual, standardized assessments fail to capture what BLs know (Christie & Martin, 2005; Martiniello, 2009; Wolf et al., 2012).

This study is also important given the high-stakes political and academic decisions that result from the use of standardized test scores. There is considerable concern about using invalid or questionable standardized measures to determine if BLs graduate, teachers and school faculty maintain their positions, and schools remain open. There are also developing questions and concerns that emerge with the establishment of national and state standards like CCSS and NGSS because the implementation of large-scale standards substantiates an instructional focus on standardization and, as a consequence, may marginalize students who have limited or no experience with the academic cultures and practices these standards promote.

From a political perspective, this study is significant because the research is situated in a context with existing federal education policies with specific requirements for BLs' academic achievement. The study is also significant to recently shifting, state-level policies on bilingual education. These policies impact the opportunities available for BLs to include their existing knowledge into new academic settings. The study shows there is an adverse impact on BLs when these opportunities are limited.

# **Research Questions**

The research questions for this study focus primarily on the role of language in BLs' experiences with the open response items. The research questions represent the acknowledgment of language as a central component of the STE assessment's design and implementation. Given that BLs can use more than one language to communicate, the research questions aim to understand how their multilingual modes of communication are included or excluded when engaging with the open response items. Together, the three research questions explore BLs' language-facilitated experiences when the open response items function as a communicative event. Grounded in SCT, the research questions in this study are:

(RQ1): What do fifth-grade BLs' (a) written responses and (b) oral thought processes communicate about their understanding of STE concepts included in STE open response items?

(RQ2): What do fifth-grade BLs'(a) written responses and (b) oral thought processes communicate about their understanding of the STE assessment?

(RQ3): What do teachers' observations reveal about BLs' experiences responding to STE open response test items?

#### **Discussions of Findings**

This qualitative case study examines six fifth-grade BLs' experiences navigating the linguistic features of STE open response items. BLs' written responses and interviews reveal BLs' beliefs and expectations about the assessment, patterns in BLs' interpretations of the item text, and patterns across BLs' written responses. Teachers' interviews and observations identify and describe the main contexts BLs' draw from to interpret the item text and develop their

written responses. There are three main findings from the study which are highlighted below and coincide with the research questions.

## **Misinterpretations of the Open Response Items**

RQ1 explores how BLs' communicate their knowledge of STE concepts orally and in written form. However, the findings reveal that BLs' understanding of STE concepts can only be examined when BLs' accurately interpret the language in the open response item text. In several instances BLs' understanding of STE concepts cannot be examined because the written responses include very little STE content at all. Further examination of the written responses and oral thought processes show that some BLs do not include STE content in their responses because they interpret the open response texts as a reading comprehension question or even a multiple-choice question. Instead of revealing their STE content knowledge, the responses often reveal a misinterpretation of the item altogether. In the few instances when BLs' interpretations and responses align with the intended meaning of the text, the written responses reveal a thorough understanding of the targeted content knowledge. However, this only occurs with the one participant who has the most experience in American schools and is the most fluent speakers of English among the six BL participants.

BLs describe how they arrive at their various interpretations of the text through their oral thought processes. Their oral thought processes provide a glimpse into their engagement of different contexts as they interpret the text and develop their written responses. The contexts BLs draw from are not always explicit (Esteban-Guitart & Moll) in their written responses and oral thought processes. They do show that BLs introduce information outside of what was provided in the item text. In some cases, BLs draw from contexts that misaligned with that of the test, and

in other cases, BLs draw from contexts that were aligned. Misinterpretations of the item text often resulted from misaligned contexts.

The key findings around the misinterpretation of the open response items align with the findings in previous studies in the field. Though the emphasis of the analysis is not on test scores, it explains one reason why many BLs receive lows scores on large-scale standardized tests. If BLs misinterpret the item text and do not recognize what is being asked of them, they are not able to provide a relevant written response. Many of the responses BLs in the study provide do not answer the open response item prompts . However, characterizing the responses as incorrect is misleading because this characterization obscures the true nature of these responses.

To say that the written responses are incorrect suggests that BLs correctly interpreted the question but provided the wrong answer. In reality, responses that resulted from misinterpretations of the text answer a different question entirely. The responses were therefore misaligned as opposed too incorrect. This finding highlights why it is important to understand what the test scores represent. When the assessment tool does not capture, let alone measure the intended knowledge base, it is incapable of providing valid data (Kopriva, Wiley, et al., 2007; Martiniello, 2009).

#### The Assessment as a Communicative Event

The findings from RQ1 and RQ2 are interrelated. RQ1 examines BLs' communication of their STE content knowledge, while RQ2 examines BLs' understanding of the assessment as it relates to their interpretations of the text and their participation with the assessment. However, given that most BLs' in the study misinterpret the item text or omit STE content from their written responses, the analysis of data generated from RQ1 addresses BLs' interpretations and understanding of the open response items before the analysis for RQ2 was underway.

In conjunction with the findings from RQ1, RQ2 finds that most of the BLs who participated in this study viewed the open response items as a language assessment and not an STE assessment. Additionally, BLs' written responses and oral thought processes reveal their understandings of the STE assessment as a communicative event. They drew from multiple contexts to interpret the open response item text and use the language to structure their written responses. BLs interpretations and written responses capture their beliefs about their audience, the appropriate writing techniques to employ, and overarching rules about their participation. BLs' beliefs about the expectations for their participation set parameters around the structure and content of their written responses.

All of the written responses examined in this study are provided in English and none of the BLs in the study included their first language in their written responses. Their responses do include a set of mirroring practices where they mirror the language of the assessment in the structure and content of their responses. Mirroring practices manifest when BLs: 1) included the exact wording from the item text to frame their responses; 2) established one to one correspondences between the item's prompts and the written response; and 3) used English as the sole language of response.

BLs' oral thought processes revealed how BLs made decisions about what language to include and exclude in their responses. Although each BL answered the item(s) uniquely, looking across cases showed that BLs' saw English as a central and critical to the content and structure of their response(s). Overall, BLs interpreted the STE assessment as an English-centered communicative event or communicative tool with specific expectations for effective engagement (Albert, 2000; Shaw, Geaney, & Bunch, 2010).

The findings regarding BLs' understanding of the assessment as a communicative event raised some concerns about equity in assessment. The assessment and student performance is so strongly centered around the English language that it placed BLs at a disadvantage. This disadvantage went beyond the basic fact that the assessment is administered in English, BLs' second language. It was a significant and pressing concern because the monolingual nature of the assessment was implicit and places the burden or responsibility to compensate for the assessment's linguistic limitations on the test taker.

The assessment never explicitly stated that test takers must respond in English. But the entire text from instructions to prompt is provided in English. Many BLs saw this as a signal to respond in English. This also led BLs to believe that their audience understood English and not BLs' first language. The implicit and sole use of English as a feature of the communicative event may go unnoticed by monolingual English speakers. BLs however, perceived the use of English as an intentional and cultural decision. They did not perceive the use of English to be neutral or without implications.

BLs explained the decisions and efforts they made to respond to the monolingual English assessment. Some BLs translated their knowledge from their first language to English; others made interpretations of the text was based on the words they understood. The presence of two languages in their linguistic repertoire was always a part of BLs' experiences regardless of the language represented in the text. The standardized linguistic features of the assessment placed an expectation on BLs to make the necessary translations, interpretations, and connections across languages. This was problematic because the standardized test does not produce a standardized experience because it did not represent various linguistic cultures and backgrounds. Furthermore, it was also problematic because it was never explicitly stated. It was assumed that communication in English was the norm. These findings show that it is not the norm for everyone.

#### **Teachers Observe the Role of Context**

RQ3 examines BLs' experiences responding to STE open response test items through teachers' observations of BLs responding to the open response text. The three teachers who participated in the study describe the contexts BLs draw from when they responded to the open response items. The findings for RQ3 are tightly aligned with those from RQ1 and RQ2. As teachers identified and described the primary contexts BLs engaged, they explained how the linguistic norms around those contexts conflicted, aligned and influenced BLs' written responses.

Teachers identified and described BLs' home and community context, the Ascension Middle School context, and the *Standardized STE Assessment* context as the primary contexts BLs draw from to interpret and respond to the open response item text. The teachers provided descriptions of BLs' home and community life. They offered an account of the nuances of bilingual contexts and how BLs' first language and English are treated differently and used for distinct purposes. The teachers recognized that there were linguistic disconnections between BLs' home and community context and the Ascension Middle School context. Ascension Middle School represented a linguistically diverse faculty and student body. Within this context, English is viewed as a shared language and instruction occurs in English. Teachers addressed the disconnection between the language of instruction and BLs' experiences with language by scaffolding and differentiating instruction. Of the three contexts identified and described, teachers were admittedly least familiar with the *Standardized STE Assessment* context. At the BLs had to locate the boundaries and understand specific practices required to engage in the assessment task. Some BLs were able to make the necessary distinctions and others struggled. BLs' experiences in and outside of school influenced their understanding of the *Standardized* STE Assessment context and this was demonstrated in their written responses. BLs' home and community experiences impacted their interpretations of the item text and their school experiences influenced their expectations around how to engage with the text (Dworin & Moll, 2006; Esteban-Guitart & Moll, 2014). There was often a strong disconnection between BLs' home and community context and the *Standardized STE Assessment* context. These misaligned contexts often led BLs to misinterpreting the item text; thus, they provided written responses that did little to address the prompts being posed in the item text.

Teachers described how BLs looked across contexts and some of the difficulties they encountered doing so. Teachers' observations were of critical importance because they highlighted features of BLs' experiences that were not visible in their written responses and were not always explicitly stated in BLs' oral thought processes. This was an essential feature of the analysis; it helped tell the story behind the written responses. Knowing that BLs drew on different contexts and different languages and interpretations in those contexts matters because it showed that there were distinct experiences behind the answers.

Some written responses looked like the responses provided by a monolingual English speaker but that did not mean that the process and experience behind the written responses were the same as the process and experience of a monolingual English speaker. There are many reasons why a test taker might misinterpret a text or interpret it correctly. It is not enough to say that the use of standardized assessments is acceptable because BLs can learn to take them or simply because test takers provided a correct response. The reason for this is that BLs are systemically placed at a disadvantage and have to surmount a set of obstacles related to their linguistic background in order to answer successfully. These are hurdles that monolingual English speakers do not encounter. BLs are making the difference and the effort to format their responses in ways relevant to the test and there is an unfair burden placed on BLs that again brings up issues of equity. Without an account of the contexts and the role the contexts play in BLs' experiences, the issues around equity can be easily shrouded.

### **Conclusions and Implications**

The study's findings have important implications for practicing teachers, test designers, and policymakers because they each have the capacity to influence BLs' experiences with standardized assessments. It is important to discuss implications for practice because teachers are an important part of the study and they provide practice-based insights and reflections. This section also includes implications for test designers because they construct the assessments that function as measuring tools. Test designers determine the linguistic structure of the items and have the opportunity to critically design the assessments. They can work from a deeper understanding of the test taker and how the assessment's linguistic features influence certain patterns of interpretation among BLs. Policymakers also play a critical role in determining BLs' experiences with these assessments because they are empowered to make decisions about the tests BLs take and the purposes behind them. They are also poised to dis(associate) high-stakes outcomes with BLs' test scores. Policymakers command a large audience and exercise substantial power in education. They should do this with a thorough understanding of how standardized assessments are structured and how they function. The implications for each group relate to the positioning of these stakeholders and their range of impact on BLs' experiences. Altogether, the implications point to systemic issues around equity in assessment for BLs.

# **Implications for Practice**

Teachers' reflections on their instructional practices and observations of BLs engaging with the open response item text inform the implications for practice. Through the analysis, the findings revealed that it was important for BLs to make connections across home, school, and assessment contexts that have different and sometimes conflicting expectations around language. Teachers can foster these connections when they teach content and when they teach test-taking strategies. The implications for practice are not simple and require intention. These implications acknowledge the complexity of teaching and the fact that educators often teach from areas of tension.

When teachers scaffold instruction for BLs based on their linguistic strengths and needs, it allows BLs to draw connections between home and school contexts. The connection between home and school is one of the first steps needed to establish a connection between what is learned in school and what is communicated through a standardized assessment. This is critical with regards to the standardized assessment because presumably, it aims to measure what BLs learn in school. There are additional issues that arise and present obstacles between what BLs know and what is communicated on the test, therefore, it is *first* necessary to establish connections around language between home and school.

A key part of establishing linguistic connections between home and school relates to teachers' awareness of BLs' personal experiences and teacher's professional perspectives. This means having substantial knowledge and understanding of BLs home life and first language. Without this, teachers cannot draw connections across languages. Norms and expectations around home language practices can be drawn into the school context and paralleled with school practices. When there are misalignments between language practices, teachers should identify and address them explicitly so BLs can begin to make distinctions across contexts and thoroughly grasp what is being communicated.

Many of the teachers at Ascension Middle school speak more than one language and learned English as a second or third language. The teachers who participated in the study describe similarities between their personal experiences and those of BLs in the study. Whether multilingual or not, all teachers should have an understanding of the linguistic features of the context BLs' navigate. Teachers will develop this understanding to varying degrees. At the same time, teachers should recognize that a standardized approach to teaching, based on the experiences of monolingual English speakers is inappropriate for BLs. This surfaces a need for clarity in the practice of differentiating instruction. Some educators assume that there is a standard approach to instruction and that differentiated instruction is for "other" students. The more relevant perspective and approach acknowledges that there is no one-size-fits-all method for instruction and each student needs to receive tailored, or "differentiated" instruction. At Ascension Middle school, the teachers have the freedom to develop instructional practices and assessments that are tailored to BLs' specific needs. When teachers have increased agency, they can operate in their areas of expertise and deliver relevant instruction.

The teachers in the study described the tensions in their practice and explained that their focus on differentiated and quality instruction was at odds with instructional test preparation. Teachers want to prepare BLs for future academic expectations (often standardized) in public schools and higher grade levels. At present, they also want BLs to have an entry point for learning and to develop a deep understanding of the content. Instructional time is limited and time added to test preparation is taken from instructional time. For teachers, this becomes a matter of priorities. Many teachers grapple with the role of test preparation in instruction.

The findings in this study reveal that understanding the standardized assessment's norms and structures are necessary to engage with the assessment with relevance. This suggests that teaching test preparation with a specific focus on language is beneficial for BLs' test performance and overall experience engaging with the examine. Making the test norms and procedures explicit reduces confusion and may increase BLs' likelihood of producing a relevant response.

As long as the tests are mandatory, teachers will need to prepare their students to engage with them. Unfortunately, this will always take away from instructional time and in many ways, places an unfair burden on teachers and students. However, there are ways to alleviate that burden and transform it into an instructional tool. Test preparation can still serve as an instructional practice when it is used to teach across content areas, to consider the audience one writes for, and when its implicit linguistic norms are made explicit. BLs can use this knowledge and skillset around test preparation in future academic settings.

Ultimately, teachers should spend more time providing instruction for content areas than for test preparation. There is no content knowledge to assess if content area instruction does not occur. The knowledge BLs possess may not often be captured by a standardized assessment but they still have that knowledge. Standardized test scores can be misleading but they cannot take away the knowledge and experiences students already possess.

#### **Implications for Test Designers**

The implications for test designers are specific to their role in BLs' experiences engaging with the open response items. It is likely that the federal and state policies will continue to mandate standardized assessments and there will always be shortcomings in the assessment's ability to capture what BLs know. Like teachers, test designers' perspectives on assessment

influence their approach. There is a need for perspectives that acknowledge BLs' experiences and patterns of interpretation when engaging with the item text. Additionally, the linguistic structures included in the assessment's design prove problematic and there are feasible changes that can make the assessments less challenging to understand.

Regarding perspective, test designers should operate from a multilingual standpoint. They should not assume that the students taking the test are monolingual English speakers and should recognize that many of the students taking the exam speak English as a second or even third language. Test designers implicitly fold English into the assessments' structure, neglecting to make its monolingual stance explicit. This begins as an internal issue that manifests in the assessment design. Test designers can make the assessment's norms and expectations direct and explicit to minimize the confusion around the text. BLs cannot interact with the assessment to seek clarification. Therefore, test designers must take the entangled relationship between language and the learning and communication of content knowledge into account.

In this study, the findings show that BLs bear the burden of bridging the gap between the assessment's shortcomings and test performance. BLs are sorting through their personal and academic experiences and bridging the gaps the assessment fails to cover. Test designers should be responsible for making these connections and not BLs. Test designers should be accountable for this because they are responsible for designing an assessment that functions as an accurate measuring tool. Test designers must recognize that their perspectives and approach are cultured and value-laden. They are not neutral or without responsibility. Furthermore, their work has a strong and substantial impact on BLs' overall experiences.

# **Implications for Policymakers**

The implications for policymakers relate to their role and the authority that comes with it. There are state and federal policies that impact BLs language of instruction and the tests they take. At times, there are conflicts between policies that impact teachers, test designers, and BLs. Test designers and teachers are tasked with interpreting policy through design and instruction and BLs take on any inconsistencies and disconnects through their experiences. For these reasons, there is a need for a change in the overall approach to education policy regarding BLs and a change in how policymakers communicate with key education stakeholders.

Current education policies with mandates for BLs sometimes take a problematic view of BLs and their education experiences. BLs are often referred to as a subgroup in ways that move their experiences to the margins of policy. BLs represent a large and growing student demographic yet remain an afterthought or caveat in the language of education policy. This disconnect highlights a misrepresentation of "standard" approaches in education policy. It shows that the term "standard" actually represents the dominant, valued, and central culture. This is an unacceptable foundation for establishing equitable assessment practices.

Education policies are often presented through simplistic mandates. Standardized assessments are implemented as if the test scores are solutions in and of themselves. The findings in this study support the argument that assessments cannot guarantee equitable education practices around instructional quality and access. BLs may misinterpret the item text for many different reasons, leading them to provide responses that are not relevant to the test. Test designers and practitioners cannot accommodate the role of standardized assessments in education without a deeper understanding of the standardized assessment's purpose. Additionally, there needs to be a strong connection between the assessment's purpose and the actual function in BLs' experiences.

## Limitations of the Study

This qualitative case study has limitations resulting from logistical and contextual circumstances. The research occurred in one private school that is not required to administer the state assessment as opposed to a one public school that must follow this mandate. This functions as a limitation because many students in public schools are prepared to identify certain standardized test structures. This may have impacted BLs' perception of the exam. At the same time, some BLs were newcomers and would not have had this experience even if they were students in a public school. Conducting research in more than one school may have captured more of the variation in BLs' academic experiences. Additionally, the teachers at Ascension are also more linguistically diverse than what is typical of public schools in the area. This influences the perspectives of the teachers making observations of BLs because they are also multilingual.

Additionally, the number of participants is a limitation of this study. Only three teachers and six students participated. An increase in the number of students would increase the responses gathered for analysis. This could have a significant impact of the findings.

The sociopolitical context functions as a limitation because of its potential impact on the research. There are ever-increasing political tensions around immigration policies and status in the U.S. BLs and their families may perceive research that examines the very aspects of their experiences that leave them vulnerable as a risk.

#### **Recommendations for Future Research**

This case study focused on the experiences of six fifth-grade BLs engaging with STE open response questions from the state's standardized assessment. The study generated a set of

rich and meaningful data that leads to additional lines of inquiry. Teachers' and BLs' discussions of their observations and experiences emphasized the complexity of teaching and assessment from different perspectives.

There are many sound practices that teachers employ such as scaffolding, differentiating instruction, tailoring assessment. However, there are ways that they questioned these practices because they believed they were not preparing students for the realities of their academic future. I would like to examine teachers' negotiations between test preparation and instruction in further detail placing an emphasis on the impact of teachers' intentions and expectations on their practices. The research would explore how teachers can implement test preparation practices without diluting instruction or expressing agreement with standardized approaches they find problematic.

A possible area for future research might be a longitudinal study that would systematically examine BLs' test-taking experiences across several grades and academic years. A group of BLs would be shadowed and surveyed from elementary school and concluding when completing the high school exist exam. The purpose of such a study would be to define if BLs' early experiences with STE standardized assessment are carried over into their high school years. A longitudinal study of this nature would reveal the pervasiveness of the standardized tests throughout the elementary, middle and secondary school.

#### **Closing Comments**

The strongest academic experience cannot provide a quick fix for any widespread systemic issue. However, it can set into motion the acquisition of knowledge and opportunities that would not otherwise be stirred. No one should be denied those opportunities. There is something incredibly dehumanizing being consistently and systemically placed in the margins, cast as "other", and being led to believe the knowledge you possess is not within your grasp. Unfortunately, these are common experiences for BLs in U.S. schools. It is critical for teachers and researchers to advocate on BLs' behalf and begin to redefine bilingual education. As a researcher, I am discovering new ways to advocate. When I left my teaching position, I recognized that it was the right choice but there were still questions left unexamined. I knew I had unfinished business in the field of education and now recognize why. This dissertation is the beginning of what is unfinished and this research has helped me build the resolve, discipline, curiosity to pursue this work to its end.

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# APPENDIX A

# STUDENT INTERVIEW PROTOCOL

# Interview Protocol for Science Test Items

# (Make sure you are recording and tell the student that you are now recording)

Today we're going to look at some science test questions. I'm going to ask you read one or two test questions and answer them. After you answer them I'm going to ask you some questions about the questions and what you think about it. I'll ask you questions about your answer too. During our time together, you can use any language you prefer.

Remember this is part of a research project. You will **NOT** get a grade on this. I just want to know what you have to say about the test questions to learn about your thinking okay? Do you have any questions for me?

Okay let's get started. Here is the first question (hand the student the question, the blank page to respond, and the black pen). Let me know when you're finished.

Record the time when student starts reading \_\_\_\_\_: \_\_\_\_ Record time when student starts writing their answer \_\_\_\_\_: \_\_\_\_

1. Thanks for taking the time to read the question and think about your answer. Please read me your answer (have student read answer for part a and b)

- If student circles one of the prompts as if it was a multiple-choice question still allow them to read the answer they circled. Do NOT indicate that this is not a multiple-choice question
- If student did **NOT write an answer** say, *I see you didn't write an answer. Would you like to tell me your answer out loud?*
- 2. What is this test question about?
- 3. How did you know that?
- 4. How did you know what to put (or say) for your answer for a?
  What did you think about before you wrote (or said) your answer?
  What language did you use when you were thinking? Did you use any other languages?

How did you know what to put (or say) for your answer for **b**? What did you think about before you wrote (or said) your answer? What language did you use when you were thinking? Did you use any other languages?

Is it easier for you to talk about what you know or write about what you know? when we did this? What made \_\_talking/writing\_\_\_ easier

Why do you think kids in school take science tests? Who do you think makes up these kinds of science tests? Who do you think grades them?

What does a fifth-grader need to know to do a good job answering these test questions?

I noticed you wrote your answers in (Language). How did you decide what language to use?

# APPENDIX B TEACHER INTERVIEW PROTOCOL
#### Teacher Interview Protocol

Thank you for taking the time to meet with me. I'd like to hear from you and learn about your experience teaching and assessing fifth-graders and also about your experience collaborating on the project conducting student interviews.

During our conversation I'll ask you some questions about: your experience conducting the interviews your students' responses to the interview questions the ways you assess students in class the type of work, activities, projects students do during their science instruction

First I'd like to ask you about your overall impressions of the interviews. How did they go?

Here is a copy of each of the 2 items. What were your initial impressions of these particular open response test items?

How did you expect students to engage? Is that what happened?

As a fifth-grade teacher, what do you identify as the main science, technology, and/or engineering concepts represented in each of these items?

What makes this a science, technology, or engineering question? and this one?

Based on your observations, what influenced how much time it took for the first student to complete beach garden? Seesaw?

Based on your observations, what influenced how much time it took for the second student to complete beach garden? Seesaw

Do you think this response accurately portrays the first student's science knowledge? Why? Do you think this response accurately portrays the first student's science knowledge? Why

Do you think this response accurately portrays the second student's science knowledge? Why? Do you think this response accurately portrays the second student's science knowledge? Why?

Did you see a difference between what students were able to communicate in written form and verbally?

If yes, what did you notice? If no why do you think that might be the case?

Do these items reflect any other of the leaning objectives students encounter in class? If yes, which ones?

What type of science work, projects, activities do these students do in during their science instruction?

How (else) do you assess student learning in class?

How do you find out if students understood the content? How do students show their learning?

Are the students you interviewed accustomed to taking paper and pencil assessments?

Are there similarities between the way you assess students in class and the way standardized test items are used to assess students? Differences?

Do you know how your school decided to use the Iowa Science assessment?

Do you think large scales science assessments like the MCAS or the Iowa Science assessment adequately capture these students' knowledge? Why or why not?

What are the benefits and/or drawbacks from using large scale science tests to assess bilingual learners?

Thank you for answering these questions. I'd like to ask you a few questions to close.

Were there things you expected to happen in the interview that didn't occur?

Was there anything that surprised you during the interview? Anything that was unexpected?

Has your experience conducting the interviews changed or confirmed any of your thoughts or perspectives about the students you've interviewed and their knowledge?

Thank you again for your time

\*Does your school assess bilingual learners' language proficiency? How?

## APPENDIX C

# STUDENTS' WRITTEN WORK

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
- Show all your work (diagrams, tables, or computations) in your Student Answer . Booklet.
- If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

- a. Describe two properties of sandy soil that make growing vegetables difficult.
- b. Describe one thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.

ATT Can't be difficult ti trail Sound Will Movice Speeds and wit have a lot HING 'OF thou fi i a gre sund and surthing the we sure you have hut when a sure and

#### Cecilio:Seesaw

I think wood would be a good matchal to wake Geessaw belowse work creations we made of wood and bean it is stand and doesn't heat up



The students in a class want to build the type of seesaw shown below. The students can make the seesaw out of any material, but they know some materials have properties that make them a better choice to use for the seesaw than other materials.



- a. Identify one material that would be a good choice for the students to use to build the seesaw.
- b. Describe two properties of the material you identified in part (a) that make it a good choice to use to build the seesaw.
- c. Describe one design feature that the students should consider before building the seesaw. Explain your answer. DC



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Cecilio:Seesaw continued

C. They should mate the material guadty what flat.

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
- Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.
- If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

a. Describe two properties of sandy soil that make growing vegetables difficult.

Describe **one** thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.

#### Danila:Seesaw

. .

· · ·



The students in a class want to build the type of seesaw shown below. The students can make the seesaw out of any material, but they know some materials have properties that make them a better choice to use for the seesaw than other materials.



a. Identify one material that would be a good choice for the students to use to build the seesaw.

- b. Describe **two** properties of the material you identified in part (a) that make it a good choice to use to build the seesaw.
- c. Describe **one** design feature that the students should consider before building the seesaw. Explain your answer.

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
- Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.
- If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

- a. Describe two properties of sandy soil that make growing vegetables difficult.
- b. Describe **one** thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.

D Sandy think's it could be difficult because she inversionent to a beach

D Alicia could add more water and kind of ina shader Place. .....



The students in a class want to build the type of seesaw shown below. The students can make the seesaw out of any material, but they know some materials have properties that make them a better choice to use for the seesaw than other materials.



- a. Identify **one** material that would be a good choice for the students to use to build the seesaw.
- b. Describe **two** properties of the material you identified in part (a) that make it a good choice to use to build the seesaw.
- c. Describe **one** design feature that the students should consider before building the seesaw. Explain your answer.

A good choice Might be like long wood stick So it could move. You could identified in Part by is that the long wood stick could use like something that you could holdon. They should Make the some those you donget

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION. .
- Show all your work (diagrams, tables, or computations) in your Student Answer . Booklet.
- If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

- a. Describe two properties of sandy soil that make growing vegetables difficult.
- b. Describe one thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.
- A. Two properties OF Sandy soil that maske growing vegetables difficult is the sand not being moist enough and high tide blowing against the shore. B. One thing Alicia could and to the soil is Fertilizer to help the

Plants grow better.

#### Session 2

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
- Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.
- If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

- a. Describe two properties of sandy soil that make growing vegetables difficult.
- b. Describe **one** thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.

Two properties of sund soil that make growing vegetubles difficults are to grow a plant you need we tand moist soil and the seeds would probally blow away with thedry Sund one thing Alicia could add to the Soil to make it better forgrowing vegetables mis to add a lot of water

Question 21 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
- Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.
- · If you do the work in your head, explain in writing how you did

the work. Write your answer to question 21 in the space provided in

your Student Answer Booklet.

21. Alicia lives near the beach. She wants to plant a vegetable garden, but she knows vegetables will be difficult to grow in the sandy soil in her backyard.

- a. Describe two properties of sandy soil that make growing vegetables difficult.
- b. Describe **one** thing Alicia could add to the soil to make it better for growing vegetables. Explain the reasoning for your answer.

- Rocky properties - Really wet properties

B -Compost because it help the envorment and It will help

# Ida:Seesaw



The students in a class want to build the type of seesaw shown below. The students can make the seesaw out of any material, but they know some materials have properties that make them a better choice to use for the seesaw than other materials.



- a. Identify **one** material that would be a good choice for the students to use to build the seesaw.
- b. Describe **two** properties of the material you identified in part (a) that make it a good choice to use to build the seesaw.
- c. Describe **one** design feature that the students should consider before building the seesaw. Explain your answer.

polly

-Handel -Wood/thema.

I think thety Should reconize or normal SEPSAW.